HS1026

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# Tree Density, Hedging, and Topping[1]

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Most growers have recognized the importance of higher density plantings to increase production over the life of the grove. Higher density plantings produce larger yields earlier, and can make more efficient use of nutrients and irrigation water. Average tree density in orange groves has increased from around 80 trees/acre in 1970 to over 130 trees/acre in 2004 (Fig. 1). This is primarily due to a decrease in the in-row spacing. Between-row spacing has remained fairly steady around 25 feet, but in-row spacing has decreased from 20 feet in 1960 to less than 15 feet today. A 25 x 12.5 foot spacing would provide a density of almost 140 trees/acre. By facilitating more efficient fertilizer uptake from root systems and better spray interception of crop protection chemicals by tree canopies, higher density plantings provide earlier returns on investment and can help reduce energy use.

If adequate water and nutrients are supplied to plants, the interception and utilization of sunlight is the next most important concept to consider in grove design. A major constraint on productivity of any crop is the amount of photosynthetically active radiation intercepted. Good grove design and management provides a canopy structure in which a large amount of the canopy receives optimum light intensity. One aspect of higher density plantings is

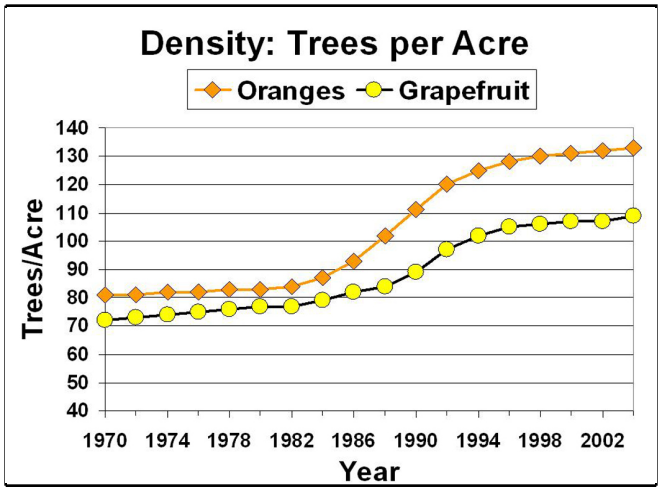


**Figure 1.** Changes in tree density of oranges and grapefruit. Credits: Courtesy Florida Ag Statistics Service.

that they require hedging and topping to maintain good light interception. In mature citrus groves that are not hedged regularly, insufficient light and increased shading promote a thin canopy and reduction in fruiting on the lower parts of the tree.

Factors that affect light interception in a mature grove include width of the drive middle, foliage wall angle (hedging angle), tree height, and row orientation. In a mature grove that is maintained as a hedgerow, solar radiation that reaches the ground between the rows is essentially lost. Harvesting and

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machinery travel require a minimum drive middle of 7 to 8 feet. When the sun is directly overhead, drive middles will be fully illuminated. At other times of the year, depending on solar elevation, trees will intercept varying amounts of radiation.

Canopy and bearing volume are two important factors in fruit production. Canopy volume is the total volume of the tree canopy. Generally, trees with larger canopy volumes produce more fruit than smaller ones. Bearing volume is the total volume of the outer 3 feet of the tree canopy. It is estimated that 90% of the solar radiation is intercepted by this outer canopy. When trees are small or in a narrow hedgerow, the total canopy volume may be considered to be productive. However, when trees are large, the inner nonproductive part (scaffold limbs and branches inside the outer 3-foot shell) can be a major component of the total canopy volume. One advantage of closely spaced and hedgerow systems is that they develop bearing volume more rapidly. An ideal grove would maximize bearing volume, but there are limits on how much bearing volume per acre can be increased. Adequate access for grove machinery and harvesting equipment (i.e. sufficiently wide drive middles) must be maintained.

## Tree Pruning

Pruning 1) adjusts tree shape and the ratio of the structural framework to the fruit producing outer canopy shell, 2) alters the ratio of shoots to roots, and 3) alters the carbohydrate (food storage) status of the tree. Most Florida groves need to be pruned to avoid problems associated with overcrowded, excessively tall trees. Pruning mature trees usually reduces yield in proportion to the amount of foliage removed.

Pruning should begin when trees grow outside their allocated space. Continued canopy growth and crowding causes poor light penetration, loss of lower leaves and bearing wood, relocation of fruiting to the upper canopy area, and reduction in yield, fruit size, and external quality. Pruning should start soon after trees reach containment size or before these undesirable factors become dominant.

## Hedging

Hedging involves cutting back the sides of the tree to reduce crowding between rows and improve equipment access to the grove. Equipment developed for this purpose has made hedging an effective and common practice in Florida. Hedging should be started before crowding becomes a problem so that only small branches are cut and minimal crop reduction results. With close spacings and more vigorous trees, hedging is required sooner and more frequently. If pruning is deferred until severe crowding occurs, removal of a large part of the tree canopy may be needed. This can cause excessive vegetative growth and a major reduction in subsequent yield. Heavy cutting is more expensive; greater crop reduction can be expected, and brush removal is more difficult and costly.

Hedging is usually done at an angle. The cutting blades are tilted toward the tree tops so the middles are wider at the top than at the bottom. This allows more light to reach the skirts of the tree. Hedging angles vary from 0 to 20 degrees from vertical, and 10 to 15 degrees is most commonly used.

Hedging helps maintain yield. It does not necessarily increase yield. Depending on the severity of the hedging, yield reduction can be expected the year after hedging, but then yield recovery should occur in subsequent years. If hedging is not periodically done, particularly on vigorous, high density plantings, yield reduction due to shading can occur. Hedging should begin before heavy cutting is needed and repeated at appropriate intervals, so the desired hedgerow shape can be maintained at low cost with minimum canopy loss. A regular hedging/pruning program eliminates the need for large cuts, avoids excessive vegetative growth, maintains good fruit production, and simplifies brush disposal. Maintenance hedging should begin when trees encroach on the 7 to 8 foot drive middle so that no more than a foot of foliage is removed from each side.

Hedging programs vary considerably with variety, rootstock, tree vigor, spacing, and grower preference. Some growers prefer hedging every middle every year. This allows rapid hedger

movement through the grove with minimal leaf and twig removal. Amount of brush produced is low and can be easily mowed, allowing incorporation into the soil. Groves on a 2-year program are hedged in alternate middles each year. Three and 4-year programs can also work for less vigorous trees or those planted on a wider spacing. In all cases, sanitation of pruning equipment between groves and large blocks is necessary to reduce potential disease spread such as citrus canker.

## Topping

Topping involves cutting off vegetation in the top of the tree and should be done before trees become excessively tall. No studies have shown an increase in yield due to topping. Hence, topping could be considered to be a necessary evil. Excessively tall trees are more difficult and expensive to harvest and spray. Topping trees will increase light penetration into the lower canopy. Yield reduction due to minor topping is usually not too great, if the trees still have producing lower skirt area. However, if trees have lost their lower canopy bearing wood, a large yield reduction can occur in the first year after topping since much of the fruit producing wood and foliage would be removed. Topping tall trees would still be beneficial in the long run, since it would help trees regain their lower skirt area and bring them to a more manageable height. Topping should not be started in cold areas until after the threat of freezes is past. In freeze prone areas, it is best not to top in the fall to avoid possible cold injury to new growth and exposed internal scaffold wood.

Tree spacing needs to match the tree vigor. Planting vigorous tree and rootstock combinations in a narrow spacing will necessitate frequent pruning and removal of fruiting wood. To meet the light requirement for the lower tree skirt using a 10 to 15 degree hedging angle, it can be conservatively estimated that tree height should not generally exceed twice the middle width. For example, with an 8 foot middle, trees would receive adequate light at the base if they were 16 feet tall (Fig. 2). On more vigorous rootstocks such as Carrizo, tree height could be allowed to go to 18 feet to reduce topping frequency (assuming labor is available to pick fruit at this height). For some mechanical harvesters, maximum

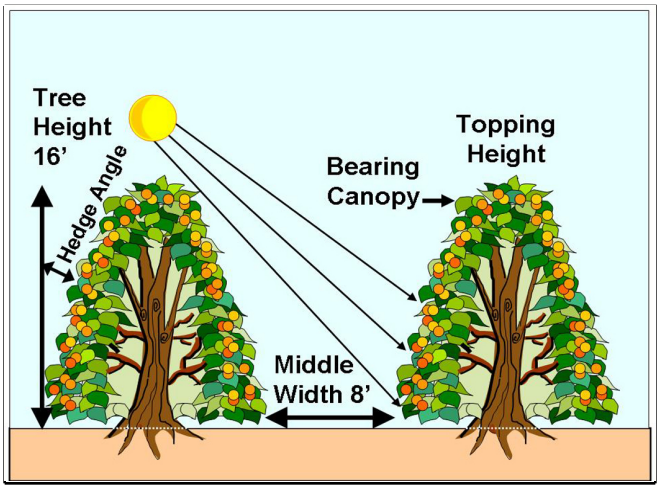


**Figure 2.** Topping height, middle width, and solar angle influence amount of sunlight that gets to the lower canopy.

recommended height for is 18 feet, tree width at the base is 13 to 16 feet, and skirt height is 30 to 40 inches.

There are numerous hedging and topping schedules that can involve 1-, 2-, 3-, or 4-year pruning programs. Growers can decide which program they prefer based on tree density and vigor.