

TREE SPACING AND CONTROL OF AVOCADO TREE GROWTH

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Spacing, training, control of tree growth and orchard thinning are subjects that have been debated by avocado growers for many years. The variability in tree response resulting from the differences between varieties and the influences of soil and climate make broad generalizations difficult. Each situation must be evaluated on its individual requirements. The primary objective of the avocado grower is to manage his trees to ensure the greatest production over the life of the orchard while maintaining efficiency in the necessary cultural operations.

Tree Spacing

Spacing is one of the most important considerations in planting an orchard. The correct spacing for the long-term productive life of the orchard will depend on the expected size of the mature tree.

Mature tree size depends upon several factors. Each variety has its natural growth habit which can be grouped into 3 general types: large spreading, medium spreading and small erect (5). The mature size of the tree is also influenced by soil type and depth. The same variety on a deep, well-drained and fertile soil will attain a greater size than on a shallow, restricted or less fertile soil. Climate and other environmental influences also affect mature tree size (12, 13). Examples of the average spread or diameter of mature trees under California conditions are shown in Table 1. A determination of mature tree size would have to be made for the conditions and cultivars involved for these and other cultivars grown under different conditions in other avocado-growing areas of the world.

In practice, few avocado orchards are initially set at spacings to accommodate the mature tree size. Planting at such spacings results in low production per ha while the orchard is young. High costs of land, development and culture have made it desirable, even necessary for growers to attain the greatest yields possible during the first few years of production. Consequently, most orchards today are double-set and some are quadruple-set.

Planting a greater number of trees per ha, however, requires a positive program of growth control and orchard thinning (6, 12). Otherwise, excessive crowding causes shading-out of lower branches with the only growth occurring in the tops of the trees. This results in loss of production, higher harvesting costs and greater difficulty in carrying out necessary cultural operations of pest and disease control.

The wisdom of extremely close initial tree spacing is sometimes questionable. Experience has shown it is only-justified for precocious cultivars. Yields attained before crowding of non-precocious cultivars occurs are often not sufficient to compensate for the additional cost involved.

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Consideration should be made for the location of the pollinizers, if needed. The correct location and spacing of pollinizers will allow the correct ratio to be maintained when orchard thinning becomes necessary (1, 7).

Training Young Trees

Young avocado trees generally require little training and a satisfactory branch structure is developed if they are not pruned. A young tree may occasionally grow sideways or form an unbalanced top, but such conditions may lie corrected by pinching out or lightly cutting back the lip of the unruly branch or trunk (11, 14). Heavy cutting in an attempt to force the tree to develop symmetrically merely delays the time it will come into production. There are some situations, however, when training of young trees is desirable.

To Change Growth Habits

The natural growth habit of some cultivars is erect with a minimum of spreading. 'Bacon' and 'Zutano' exemplify this type of growth in California. Unless controlled, the tree will soon reach a height where harvest is difficult and costly.

The terminals of upward-growing shoots on the young tree are pinched out to force lateral branching and prevent upward growth. This must be repeated after each growth flush during the first few years (11). Thereafter, a light to moderate selective pruning of upright growing shoots will be necessary to restrict the height of the tree.

Table 1. The size of mature avocado trees. ^z

Type	Large spreading	Medium spreading	Erect
Example	Fuerte	Hass MacArthur	Bacon Zutano Reed
	Diameter		
Deep soil	15 m	12 m	8 m
Shallow soil	11 m	8 m	6 m

^z Adapted from Goodall (5).

To Prevent Wind Damage

It is desirable to keep trees low and as compact as possible in areas where winds are strong and frequent. Pinching out the terminals of shoots growing upright will force lateral branching and create a more dense tree which can better withstand strong winds.

Effects on Yield and growth

There is some evidence that cutting back the upright shoots of young trees decreases trunk cross-sectional area and depresses production (1, 5). This was found to be true in one trial but the pruning of upright shoots was not started until the trees were 4 years old and the amount of shoot growth removed was far in excess of merely pinching out the terminals. More evidence, starting at an earlier tree age, is needed before definite conclusions can be drawn.

Pruning, Hedging and Topping Mature Trees

The need and desirability to prune or control the growth of mature avocado trees has been a matter of debate for many years. We have found that pruning does not increase fruit yield in California. Continual and severe pruning generally stimulates vegetative growth at the expense of fruiting, so pruning should be done only when absolutely necessary (8, 11, 14). There are, however, situations in all avocado-growing areas where tree control by pruning is necessary and desirable.

Reasons for Pruning

To reduce harvest costs. Increasing harvest costs are becoming a major factor in avocado production. Fruit produced in the tops of tall, upright trees are more difficult and more costly to harvest. It is questionable in some cases if the cost of harvest is compensated by the return. Reducing and maintaining the height of the tree at an economical level is a practice followed by many even though the total crop may be reduced (10, 11).

To prevent wind damage. Major damage and breakage may be prevented in areas of extreme winds by lowering the height of fall-growing cultivars (10, 11, 14).

To allow more effective pest control. More efficient and effective spray coverage may be achieved where there is less congestion between rows and when tree heights are not excessive, so pruning may be justified in areas which require chemical pest control (10).

To permit effective irrigation. Some pruning may be necessary in orchards that are sprinkler-irrigated to assure a uniform water-distribution pattern. Low-hanging branches may interfere with the pattern of low-head sprinklers. These branches should be selectively removed (11). Similarly, overhead sprinklers may be obstructed by tall trees and tree height control must be practiced to allow uniform coverage (10).

To permit cultivation and mowing. Low-hanging branches may interfere with cultivation or mowing where these practices are used. It is best to selectively prune the low branches rather than risk breaking them off accidentally with cultivation or mowing equipment (11).

To delay crowding. The need to thin an orchard may be delayed for a year or 2 by selective removal of branches on temporary trees which will later be removed. This provides more illumination to permanent trees and prevents loss of lower foliage and production. Such pruning does reduce the yield of the temporary trees, but reduced production for a year or 2 is preferred to no production at all on the temporary trees.

Methods of Pruning

Selective pruning. Selective pruning is accomplished by hand tools or power-assist hand tools in which the cuts made are individual and selective. This is preferred in most cases and is the only type of pruning adaptable to the terrain on which some avocado orchards are planted. Selective pruning, as the name implies, allows the individual selection of branches which are to be removed. It may be upright shoots or branches to limit or reduce the height of the tree, overhanging side branches to reduce crowding, low-hanging branches which interfere with irrigation or other cultural operations *etc.* Prune sparingly and make cuts as close to a lateral branch as possible when such pruning is necessary. The greatest growth stimulation is nearest the cut. Removal of large branches will stimulate vegetative growth over the entire tree (11).

Mechanical hedging and topping. Hedging and topping are non-selective types of pruning which are being used today by economic necessity. Relatively little topping and even less hedging has been practiced in California. However, the use of hedgers and toppers in southern Florida for avocado tree control has increased in recent years and has become an accepted cultural practice (10).

Hedging and topping are done by large machines which are non-selective in their cutting but which remove growth at a lower cost. The lower cost of this type of pruning may well compensate the temporary loss of production that results and the repeated tree control necessary with the following regrowth.

It should be noted that the vigor and productivity of avocado trees vary depending on the cultivar and climate in which they are grown. We are not sure that frequent non-selective cutting to control growth would be a sound or economical practice in climates and with cultivars such as we have in California. More information is needed concerning these practices in other areas.

Chemical growth inhibitors to retard the regrowth of pruned trees or to initially train them to a more compact size has been investigated (2, 3, 9). There are currently no satisfactory materials for use, even though some have shown promise.

Time of Pruning

Light selective pruning may be done at any time of year. Heavy pruning is best done after the crop is harvested but before late summer or early fall. Late pruning may stimulate growth and make the trees more susceptible to frost damage in areas where cold injury may be a problem (10, 11, 14).

Orchard Thinning

One alternative to pruning for tree control is crowded orchards. However, orchard thinning instead of pruning is being used more and more in California. This is a planned program of tree removal to prevent excessive crowding that results from spacing the trees too closely at planting time (1, 12).

Orchard thinning has been shown to be beneficial in terms of production (Fig. 1). Production ultimately increases and surpasses that of the crowded orchard,

although there is a decrease in yield immediately following thinning (4, 12).

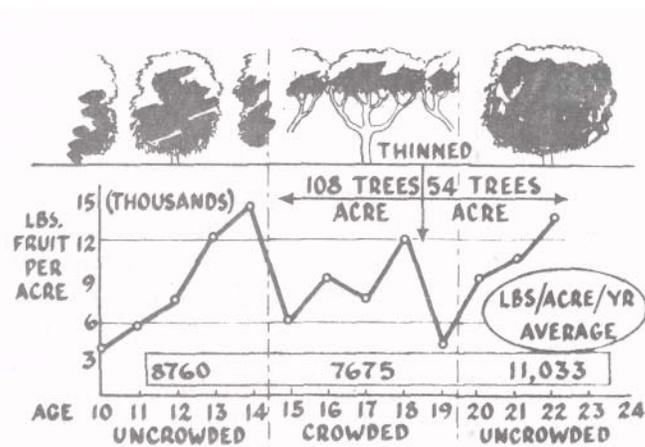


Fig. 1. Production record of 'Fuerte' orchard before and after thinning. (Note: lb/A x 1.12 = kg/ha; trees/A x 2.47 = trees/ha.)

The desirability of closer initial tree spacing to achieve greater early yields has been discussed. However, lower branches are shaded out and production decreases as the trees grow and start to crowd. Harvest costs are increased by crowding since fruit is produced only in the hard-to-reach canopy of foliage high above the ground.

Orchard thinning, the removal of trees to provide space for the remaining trees, is one method a grower can use in a positive program of orchard management.

Time of Thinning

There is no set rule for timing orchard thinning. The original spacing and the rate and type of tree growth determine when the orchard should be thinned. Orchards should be thinned before crowding and before the loss of illumination causes shading out of the skirts or lower fruiting areas.

Thinning Systems

Progressive thinning to relieve orchard crowding is the most widely used system in California. The orchard is platted to note any weak trees which, as far as possible, are included in the first thinning. A temporary tree can be led and trained to fill the space where a tree is missing at a permanent location. Different parts of an orchard are considered as separate blocks and a removal pattern for each block is established to remove the greatest number of weak or diseased trees.

The first tree thinning consists of removing every other diagonal row through the block. A second thinning is accomplished by removing every other row when trees again start to crowd. A third thinning, if necessary, removes every other diagonal row of the remaining trees in the block. By this method, trees set at an initial spacing of approximately 6 m would be spaced at about 8 m following the first thinning, 12 m following the second and 15 m following the third thinning.

Stumping trees by blocks is a method used primarily to allow the recovery of an

extremely crowded orchard prior to thinning. Regrowth on permanent trees left after thinning may take several years. Trees are cut back to 1-1.5 m leaving stubs of large scaffold limbs. The stumps rapidly put out new growth and production normally starts again in the second or third year. Stumping is usually best done by blocks or by sections so that production of the whole orchard is not lost at one time. Progressive thinning should be started when the stumped trees grow to the point of crowding.

Stumping and topworking is a method sometimes used to change a crowded orchard to a more productive or desirable cultivar. One variation is to stump the trees and topwork the stumps to a different cultivar rather than letting the original cultivar regrow. Progressive thinning is begun when topworked trees start to crowd.

A second variation is to stump alternate diagonal rows and topwork the trees to another cultivar. The other rows are stumped and topworked when these topworked trees start to crowd the remaining trees.

Thinning to hedgerows is a method by which alternate rows of trees are removed which eliminates crowding in one direction but not in the other. Observations indicate that while initial yield response following thinning to hedgerows may be better than progressive thinning, the long term response is in favor of progressive thinning.

Summary

Correct tree spacing is a most important factor in planting an orchard and should be based on anticipated mature tree size. Mature tree size varies depending on cultivar, soil and climate and must be determined for each area.

Most orchards are initially double-set and some quadruple-set to provide greater yields per ha when trees are young. Greater tree population requires a positive program of growth control and/or orchard thinning to prevent excessive crowding resulting in loss of production and higher costs of culture and harvesting.

Training young avocado trees is seldom necessary and can delay production under normal conditions but is of benefit for special situations.

Growth habits of tall-growing cultivars may be altered and wind damage lessened by pinching out terminals of upright-growing shoots. Heavy cuts should be avoided.

Continual and severe pruning of mature trees stimulates vegetative growth at the expense of fruiting. Some pruning may be necessary to reduce harvest costs and prevent wind damage by lowering tree height, to allow for more effective pest control by reducing congestion and height, to permit effective coverage of sprinkler irrigation by removal of obstructing branches, to permit cultivation and mowing by removal of low branches and to delay tree crowding by reducing the size of temporary trees.

Pruning may be selective by making individual cuts with hand tools to remove

branches or non-selective using large machines which top or hedge the tree. The method used is dictated by economics and the type and rate of tree growth following pruning. Light, selective pruning may be done at most times of the year while heavy pruning should be done after harvest but before late summer or early fall to avoid possible frost damage.

Chemical growth inhibitors to retard regrowth or to train trees have been investigated but none are currently satisfactory for use.

Orchard thinning is an alternative to pruning for correcting or preventing crowded orchards. The time of thinning varies with cultivar, original spacing and rate of tree growth but should be done before trees crowd.

In progressive thinning, trees in alternate diagonal rows are first removed. A second thinning, if crowding again occurs, is the removal of trees in every other row. If a third thinning is required, alternate diagonal rows of the remaining trees are removed. This method has been practiced successfully in California but rarely to the third step.

Stumping by blocks is used to relieve severe crowding. Trees are cut back leaving 1-1.5 m stubs of large scaffold branches. Regrowth is rapid and production resumes in 2 or 3 years. Progressive thinning is started when trees again start to crowd.

Stumping and topworking is used when a change of cultivar in a crowded orchard is desired. The entire orchard may be topworked or done by alternate diagonal rows. Progressive thinning is practiced when topworked trees again begin to crowd.

Thinning to hedgerows is the removal of alternate rows of trees to relieve crowding in one direction but not the other. Initial yield losses are not as great but long-term production favors progressive thinning.

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