Prune your way to greater yields

Pruning aims to increase productivity and better tree development through selectively eliminating branches from trees. If we are not increasing the productivity of the orchard, we are *cutting* and not pruning. In an orchard, the main principle of pruning is for every tree and every branch to have its own space and its own light.

Andries Bester
SUBTROP

COSMOCEL HOSTED JOSÉ Cortes Gonzaléz, president of the Association of Producers and Exporters of Avocado from Jalisco (Mexico), on a visit to Letaba so he could share his tree management strategies with our avocado growers. However, Mr Gonzaléz assured us that the practices he proposes are equally suited to other subtropical crops such as mangoes and citrus. In Mexico, a single labourer can prune 100 to 200 avocado trees per day according to this method.

Essential plant nutrients include water (H_2O), oxygen (O_2), carbon dioxide (CO_2), nutrients (N, P, K, Ca, etc.) and carbohydrates. According to Justus von Liebig (1840), plant growth is limited by the scarcest resource. In the absence of light, the synthesis of carbohydrates is not possible and biomass production is impeded. Therefore, with inadequate lighting the productivity of an orchard is also limited.

Just like water and fertilisers, light should also be measured to determine sufficient availability. When using a lux meter, we always need to have a reading greater than 60 µmol/m²/sec in the centre of the tree canopy. Readings below 30 µmol/m²/sec are common in unmanaged or incorrectly pruned trees, by the third year already. This indicates that pruning should have started earlier. It is notably easier to prune 500 young trees than 500 old trees. Furthermore, it is the easiest to prune 500 trees at the nursery stage before field establishment.

WHAT DO WE AIM TO ACHIEVE BY PRUNING?

- Reduce tree height to easier manageable sizes, as tall trees generally pose challenges during harvesting.
- Increase the efficacy of agrochemicals and phytosanitary control measures.
- Prevent the formation of microclimates that are favourable for pests and diseases. Many fungal species are favoured by warm humid conditions while several bacteria are favoured in cold humid climates. Correct pruning can significantly reduce the relative humidity inside the tree canopy.
- Create open working rows for tractors and equipment and to further increase air circulation in the inter-row spaces.
- Increase and maintain the amount of light in the canopy to prevent the formation of bare, unproductive branches resulting from insufficient sunlight.
- To rejuvenate unproductive bare branches and reinvest new younger and productive shoots in their place.
- Suppress alternate bearing.
- Reduce yield losses. Fruit size are reduced the further the fruit is located from the trunk and the more branching there is between the fruit and the trunk.
- To increase and maintain the productivity of each tree. In a study conducted by Mr Gonzaléz, it was shown that tree productivity increased from 77 kg/tree to 96 kg/tree simply by changes in the pruning programme.

WHEN DO WE PRUNE?

The most drastic pruning activity for main tree structuring should commence directly after harvest. This is generally at a time when trees are dormant and don't respond to pruning activities with excessive vegetative growth. Less drastic pruning activities can be done from flower initiation up to fruit-set. During flower initiation and flowering,

Figure 1.1 (Before). It is easy to start shaping trees while they are still in the nursery. Here we have an example of a tree with a strong central leader but also multiple lateral branches.

Photo credits: José S. Cortéz Conzaléz

Figure 1.2 (During). Three ideally-spaced structural branches were identified (arrows), with the lowest branch commencing no lower than 30 cm from the surface. The central leader was cut flush with the highest of the three structural branches. All extra structural branches were removed.

Figure 1.3 (1 month after). Once the central leader has been taken out, the newly selected structural branches will strengthen and develop over the following month.

the tree is in a reproductive stage and the tree's response to pruning is reproductive – by producing more flowers and setting more fruit. Nearly all subtropical trees produce an excess of flowers.

Flowering can be thinned out through pruning by up to 50% with no detrimental effect on the yield. After fruit set, the tree is in a growth or vegetative stage and the response to pruning is vegetative by producing more shoots and leaves. This is detrimental to productivity. The only type of tree management that should be done after fruit set is to remove new water shoots which may compete with the fruits for nutrients.

Remember: Eliminating flowers does not lower one's yield.

HOW DO WE PRUNE?

Designating a name for each type of branch makes it is possible to follow a step by step methodology knowing what to prune in almost any tree at any stage. Furthermore, it facilitates communication and knowledge transfer when training and instructing the workers on how to select and prune the correct branches.

Six types of branches:

1. Central leader (Sentrale leier)
Grows from the centre of the tree and covers the centre of the tree. It uses up a lot of resources and is not highly productive as it prevent sunlight penetrating into the tree. Trees generally have one central leader. They can develop into tall trees quickly which is generally not preferred. The central leader suppresses the growth of the structural branches, and is therefore eliminated as soon as possible, preferably in the nursery already.

2. Lateral leader (Laterale leier)
Grows from the side of the tree out of a structural branch towards the centre of the tree where it covers the centre in the absence of a central leader. Lateral leaders are less vigorous than central leaders. Several lateral leaders can be found (1-5) per tree, depending on the amount of structural branches present and should also always be removed as they compete for sunlight with the structural branches.

3. Structural branch (Raamtak)
To the grower, structural branches are the most important type of branches of the three primary kinds. Structural branches are the most productive and determine the final tree shape. Three structural branches per tree are optimal at densities between 300 to 500 trees/ha. Lower densities will require more structural branches while higher densities will require less.

It is incorrect to assume that more branches will improve productivity. The yield potential is determined by the trunk circumference. For avocado trees, every cm of trunk circumference gives at least 1 kg fruit.

Three structural branches per tree are optimal. Here is the proof:
Desired yield 25 t/ha
Planting density 7x4,5 m = 317 trees
951 branches / 25 000 kg = 26,3 kg per branch ⇨ realistic
26,3 kg per branch / 0,32 kg per fruit = 82 fruit per structural branch ⇨ still realistic

4. Layers (Skouers)
Branches that grow between other trees in the row, and between structural branches in the tree are called layers (skouers). Layer branches are initially very productive because they grow laterally, but often become too complex. A clearing of at least 50 cm between trees – wide enough for a man to pass between trees - and 2 m between rows, are critical for good air movement and to facilitate effective spraying. Every tree and every branch needs its own space and light. By leaving a space of 50 cm between trees and 2 m between rows, air circulation in the orchard can be increased by up to 200% compared to conventional orchards.

5. Skirt (Soom)
All branches within the first 50 cm from the ground are called the tree's skirt. Skirts are generally very productive; however, low hanging fruit are often of poor quality when they come into contact with the soil and are only accepted for certain markets. Skirts are generally more shaded than the top parts of trees and have to "borrow" photosynthates from the top branches. Removing the skirt allows the energy to be utilised in the structural branches and layers. It is however not required to remove skirt branches in regions with low annual precipitation (<1 000 mm) or markets that pay fair prices for lesser quality fruit, as the skirts could help maintain soil moisture and reduce soil temperatures. It is advised to remove the skirts of trees in high-rainfall areas, such as those encountered in Mexico (1 300 – 1 600 mm/year), as it will reduce the volume of low-quality fruits harvested, which earn only a fraction of the price of Class 1 fruit on the American market. In South-Africa, it is potentially better to leave the skirts, as we have a fairly good market that accepts damaged fruit. It is however important to clear the skirts near the micro-sprayers for good irrigation coverage and allowing granular fertilisers that may have been applied to dissolve properly.

» TO PAGE 26

Figure 2. Young tree after the skirt, central leader and excess structural branches were removed.

Prune your way to greater yields

Figure 3.1 (Before). Yield-bearing avocado tree with poor light penetration towards the centre of the tree due to multiple lateral leaders and skirting branches reaching to the ground.

Figure 3.2 (After). The same tree after the layers and skirt were cleared, lateral leaders taken out and three structural branches were identified. Each structural branch now has sufficient access to light and air circulation. This will ensure that branches remain productive and pests and diseases easily manageable.

Figure 4. Once enough space and light are available, nearly the entire tree will be utilised to grow your crop.

›› FROM PAGE 25

6. Replacement branches (Vervangers)

All previously mentioned branches have the last type: replacement branches. They are so-called because they will eventually replace existing layers and structural branches. Replacement branches are highly productive young growth. When pruning, replacement branches should only be cut back immediately above the next replacement branch to determine growing direction and prevent die-back. This is also one of the greatest challenges with mechanical pruning practices.

Table 1 is a summary of above actions tailored for various scenarios based on tree-age and orchard condition.

The following basic principles apply in any scenario:

- Trees should be trained from year one.
- The most important outcome is that trees are separated without growing into one another.
  - Light is also a nutrient.
  - Every tree and every branch needs its own light and its own space.
  - Focus on removing shorter layers close to structural branches that sag and intercept light when bearing fruit.
- The end goal is to only have three structural branches.
  - Right after pruning it might not be attractive, but don't be deterred. If we take the central leader out, it will make it favourable to select structural branches.
  - Only one vigorous lateral leader should be eliminated per season. If there are non-vigorous branches, those additional to three designated structural branches can be eliminated in one season.
  - If a central leader is present, it should only be removed by tipping the top 33%. Any more aggressive pruning results in sun damage.
- Tree height is determined by the inter-row width. It should be limited to 70% of the row width but could even be less as the maximum manageable tree height in any scenario is 4,2 m.
- Planting densities are determined by tree vigour, climate and soil quality.
  - Drier regions and marginal quality soil can sustain greater tree densities than warm, humid regions with high-potential soils.
  - 1 000 to 2 660 trees/ha are possible.

The author wishes to thank Herman Els (Cosmocel S.A.) for the sharing of valuable information and facilitating the visit of Mr Gonzaléz, and Nico Claassens (Laeveld Agrochem) for his help in authoring this article.

Photo credits: José S. Cortéz Conzaléz

Table 1: Prune your way to greater yields - Summary of recommended actions based on tree-age and condition.

		Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
Shaping trees in the nursery (Figure 1)		Observe	It is far easier to prune young trees to the desired shape before establishment.	Identify three structural branches and remove the rest - they will develop into strong branches in a month from pruning.	Remove central leader at highest point of selected structural branch.	Remove lateral branches if present.	Nursery trees are ready for pruning once lower structural branches have reached 20 cm length and are 30 cm above the ground.	
Shaping young trees in the orchard (Figure 2)		Observe	Prune back central leader.	Identify three structural branches spaced well apart and remove the rest.	Remove all lateral leaders.			
Structural pruning of productive orchards (Figures 3, 4)		Observe	Prune all shoulders back to replacement branches: • 50 cm clearing between trees • 2 m clearing in the row.	Cut 33% of central leader back each year.	Remove all lateral leaders in one year. Lateral leaders that are strong and vigorous, and already have a big canopy should be removed over 3 years by taking off 33% per year.	Identify three structural branches equally distributed around the main trunk to keep, and remove additional structural branches over 3 years by taking off 33% per year.	Reduce the size of selected structural branches if necessary - over multiple seasons if very tall.	Young trees can be reduced by 60 cm height at most per season and large trees 1,2 m. Pruning should be limited to removal of 30% of tree volume at most in one season to avoid strong vegetative regrowth with reduced yields.
Restructuring established trees	**Year 1**	Observe	Prune all shoulders back to replacement branches: • 50 cm clearing between trees • 2 m clearing in the row.	Remove the skirt branches (50 cm clearing from surface)	Prune back leaders: a) 33% of central leaders b) 100% of lateral leaders.	Decrease tallest structural branches by 1,2 m.		
	Year 2	Observe	Prune all shoulders back to replacement branches: • 50 cm clearing between trees • 2 m clearing in the row.	Remove the skirt branches (50 cm clearing from surface)	Prune back leaders: a) 50% of central leaders b) 100% of lateral leaders.	Decrease tallest structural branches by 1,2 m.		
	Year 3	Observe	Prune all shoulders back to replacement branches: • 50 cm clearing between trees • 2 m clearing in the row.	Remove the skirt branches (50 cm clearing from surface)	Remove leaders: a) 100% of central leaders b) 100% of lateral leaders.	Decrease tallest structural branches by 1,2 m.	Identify and mark three structural branches per tree.	
	Year 4	Observe	Prune all shoulders back to replacement branches: • 50 cm clearing between trees • 2 m clearing in the row.	Remove the skirt branches (50 cm clearing from surface)	Remove leaders: a) 100% of lateral leaders b) No central leaders should be present by now.	Prune back 33% of unmarked structural branches.		
	Year 5	Observe	Prune all shoulders back to replacement branches: • 50 cm clearing between trees • 2 m clearing in the row.	Remove the skirt branches (50 cm clearing from surface)	Remove leaders: a) 100% of lateral leaders.	Prune back 50% of unmarked structural branches.	Reduce length of three identified structural branches.	
	Year 6	Observe	Prune all shoulders back to replacement branches: • 50 cm clearing between trees • 2 m clearing in the row.	Remove the skirt branches (50 cm clearing from surface)	Remove leaders: a) 100% of lateral leaders.	Remove 100% of unmarked structural branches.	Reduce length of three identified structural branches.	Enjoy the benefits of a rejuvenated orchard.