# AVOCADO TREE SPACING TRENDS AND SIZE CONTROL IN SOUTH AFRICA

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## INTRODUCTION

Correct spacing is one of the most important considerations for economic success in growing avocados. The correct spacing for the long-term productive life of an avocado orchard depends on the expected size of the mature tree which depends on several factors, such as climate, soil type and soil depth, rootstock vigour and the cultivar's natural growth habit (Gaillard, 1987). Therefore, a general recommendation for the best spacing cannot be given. The aim of this paper is to point out the trend to higher planting densities and recently adopted pruning and growth control practices in South Africa.

Traditional planting distances for avocado in various countries are listed in Table 1, These planting distances suited the spreading growth habit of the cultivar Fuerte which was the most popular cultivar world-wide about 30 years ago. In the meantime, "Mass" has become the major avocado cultivar in the international fruit trade. Due to its more upright growth habit, most avocado-producing countries have adopted closer planting distances compared to the old "Fuerte" orchards. Precocious cultivars with an upright growth habit, "Gwen" and "Pinkerton", are being planted even closer than "Mass" (Whileyetal., 1990).

**TABLE 1:** Traditional planting distances for avocado in various countries (Gaillard, 1987).

| Country | Planting Distance | Trees per ha |
|---|---|---|
| Florida | 9 x 9 | 123 |
| Mexico | 8 x 8 | 156 |
| Chile | | |
| Spain | | |
| South Africa | | |
| Australia | 5 x 10 | 200 |
| Israel | 6 x 8 | 208 |
| California | 7 x 7 | 204 |

High costs of land, development and cultural operations force growers to attain the greatest yields possible during the first few years of production from closely-planted trees. However, close tree spacing in young orchards traditionally required timely tree thinning when trees start shading one another. Orchard practice was to repeat tree thinning a few times through an orchard's life in order not to lose production potential. Consequently, most older orchards in South Africa were initially planted with four times the number of trees compared with 50 to 100 mature trees after final thinning. Large areas of old "Fuerte " orchards exist in South Africa, and their low tree number per hectare and huge tree size makes them difficult to manage. Some farmers have therefore pulled out old "Fuerte" orchards and replanted "Hass" according to modern orchard systems.

## THE MODERN AVOCADO ORCHARD

With the planting of every new orchard avocado farmers are concerned about:

- Speedily achieving the breakeven point
- Speedily achieving optimal production
- Annually maintaining optimal production
- Achieving a long economical lifespan of the orchard.

### *Spacing and row orientation*

To achieve the goals of early breakeven and optimal production, intensive plantings are necessary. Plantings of approximately 400 trees per hectare are recommended. The problem with such plantings of avocado trees is that within a few years overcrowding and encroachment problems will occur. The main disadvantage is that light penetration is then restricted to the tops of the trees and very little light can penetrate into the tree or to the base of the tree.

To establish more intensive plantings without accelerating encroachment the following measures need to be applied:

- plant trees in a rectangular system. In this way there will be an opening between the tree rows to allow light to penetrate and reach the base of the tree,
- plant the tree rows as close as possible in a geographical North/South direction. This will have the effect that the two sides of the hedgerow will receive equal amounts of sunlight,
- prevent the top of the tree from becoming broader than the base and forming a light impenetrable canopy.

Guideline for spacings are shown in Table 2.

**Table 2.** Guideline for spacings (m) of new plantings and possible tree thinning options. Tree number per hectare in brackets.

| Years | Pinkerton Ryan | n low vigour areas | Hass in high Vigour areas |
|---|---|---|---|
| 1 to 7-10 | 5.5x3 (606) | 6x3.5 (476) | 7x3.5 (408) |
| 8-10 to 14 | 5.5x6 (303) | 6x7 (238) | 7x7 (204) |
| 8-1 4 to 20 | 11 x6 (151) | 12x7 (119) | 14x7 (102) |

If the trees are shaped and pruned, as will be discussed later, the above mentioned thinning options will be drastically curtailed or possibly even completely eliminated. Various research activities are presently directed at these aspects and are providing valuable information. The initial advantages of intensive plantings can therefore be realised and bearer shoots kept productive through effective light management and the thinning option retained for use as an emergency measure only.

**Work row, cover crops and mulching**

As already discussed, new orchards should be planted in a rectangular system. There will therefore be a tree row in which the trees will be closer to each other and a work row that will separate the tree rows from each other.

The necessity of the work row is in the first place to optimize the utilization of sunlight by the leaf canopy. The distance between the tree rows (stem to stem) must be such that the tree height must not be more than 70% of this distance. If the distance between rows is therefore 5 m then the tree height should be limited to 3.5 m.

Secondly, the work row must be wide enough for implements such as sprayers, picking trailers and mechanical pruning equipment to be used. Previously, work rows were avoided in avocado orchards in South Africa. In future, movement of tractors in the orchard will be allowed if certain requirements are met:

- only light orchard tractors and implements should be used (+- 1.8 m width) and work row orientation must remain constant within an orchard's life.
- traffic movement to be allowed only in the centre of the work row. No riding within the drip area of the trees.
- the area ridden on must be planted with a cover crop.

If a vehicle track width of 2 m is allowed between the drip areas of the trees then the tree height must not exceed 1.75 times the width i.e. for 2 m width it must not be higher than 3.5 m.

It is recommended that the track portion of the work row be planted with a suitable permanent ground cover. It would be useful if the cover crop was such that cuttings can be used as mulch. The tree drip area must not have any growing crop but should be covered with a suitable mulch. The tree drip area includes all the area under the branches. In the case of a 5 x 3 m planting it will be 1.5m on either side of the stem. This is also the area that needs to be irrigated.

## Tree shape and manipulation

We are striving for effective tree shapes for an optimum canopy area per hectare. An effective tree has to meet certain requirements:

- trees must have a pyramidal form, i.e. the top portion must be narrower than the base section. If this is not the case then the top canopy will completely shade the lower parts. If all the tree tops are wide then they eventually touch each other and the lower parts of the trees will die off.

- trees must not be too wide. If branches are allowed to become too large and long, the inner parts of the tree will die back and only the outer potions will remain effective.

- trees must not be too dense. If one branch is allowed to develop directly above another the top branch will shade the lower branch.

For the achievement of the set goals, the management of light utilization and penetration is crucial. Light must be intercepted by optimally exposing the largest possible leaf canopy to sunlight. In addition the tree must be developed in such a way as to make effective light penetration possible.

The aim with intensive orchards is to speedily reach the optimum leaf surface area per unit of soil surface area. Orchard design enables the leaf surface area to optimize light interception. Correct tree form and structure make effective light penetration to the inner portions of the tree possible. Tree manipulation helps to establish and maintain this situation.

Plant parts differ in their sunlight requirement but need between 30 to 50% of the available sunlight to function normally. When the minimum requirement is not met, inefficiency, retardation and, ultimately, die back will occur.

The above mentioned can be achieved by shaping trees early. A central leader or two or three leaders can be utilized. The leaders must develop vertically. Branches developing on these leaders must not be too strong (not more than a third to half the thickness of the leader). Branches or shoots at the top of the tree must be weaker than those at the base. Very strong branches and those in the wrong position must be cut away at the point of attachment. Throughout the year, upright, strong water shoots must be removed.

There is a wide choice of pruning tools to be used for tree shape management and the farmer has to make a decision based on economics. For example, where labour is cheap or the terrain is unsuitable for tractor-mounted pruning equipment, hand-operated tools will be used. These have the advantage of allowing pruning cuts based on more intelligent criteria than a set of saw blades chopping along a straight line. However, large farms and the often very limited time span available for best pruning results often necessitate the use of mechanical pruning equipment.

Mechanical pruning is usually done immediately after harvest, in order not to cut off fruit and to still get the advantage of good light penetration for the next season. However, in late cultivars (e.g. 'Hass,) the latter is often not to be achieved after harvest, while early picked 'Fuerte' trees pruned directly after harvest would have sufficient time to recover before the next spring - provided the pruning was not too drastic.

Summer pruning can best ensure that sufficient light gets into the canopy to initiate flowers not only on the peripheral parts of the tree. Summer pruning may be carried out by hand or machine.

In the case of an extremely dense orchard, drastic pruning after harvest might be needed. This is sometimes carried out on one side of the tree row in one year and on the other side in the next year, in order to maintain reasonable cropping while getting light back into the inner part of the canopy. If summer pruning is carried out annually, the canopy should be receiving sufficient light to avoid such drastic pruning.

In spring, the regrowth resulting from pruning is often treated with a triazole growth retardant (e.g. uniconazole or paclobutrazol). Under very vigorous growing conditions, growth retardants play an important role in pruned orchards, as they stimulate reproductive development while slowing down shoot growth during the time of fruit early set (Köhne, 1989; Adato, personal comunication).

**Cultivar**

The choice of the cultivar plays a major role in the success of the annually pruned avocado orchard. Unfortunately, the most important cultivar, Mass, is more difficult to manage regarding tree size control than Ryan and Pinkerton.

**CONCLUSION**

Presently, Hass trees in annually pruned orchard systems are financially viable only when a growth retardant is used to control excessive juvenile growth.

However, in future similar success may be achieved using more productive rootstocks an/or cultivars. Research in that direction is under way but it will take some years until sufficient yield data are available to warrant commercial implementation. In the meantime, Hass on Duke 7 planted at a spacing of e.g. 7 x 3.5 m or 7 x 5 m might become the new norm in South Africa. Square planting distances and regular tree removal (thinning) will be abandoned by progressive avocado growers.

## REFERENCES

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