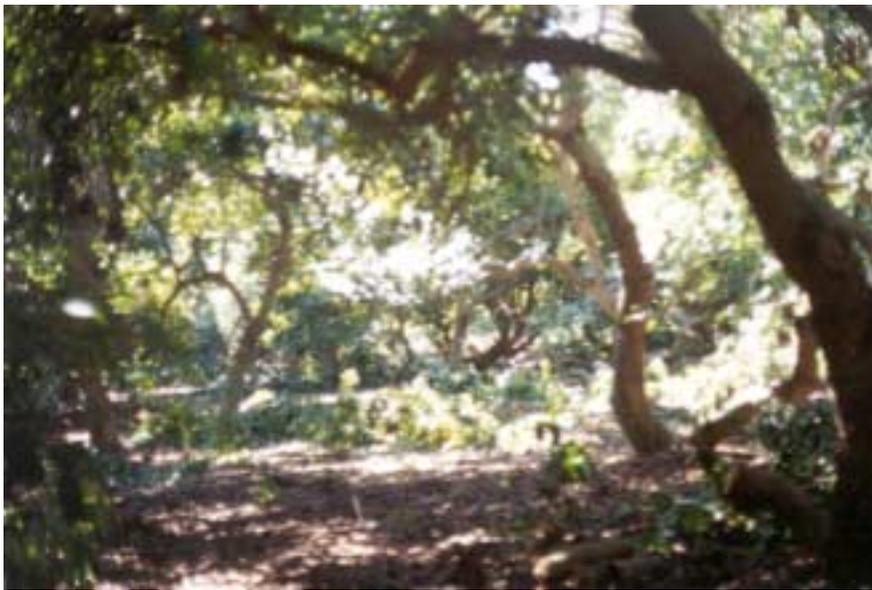


Intergrated Avocado Canopy Management.

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Photosynthesis is the most basic process in crop production. Without effective light in an avocado orchard, the production potential will be seriously limited. Overcrowding reduces light to the trees and restricts all processes adversely

The effect of shading is as severe as the effect of Phytophthora and both decrease the yield potential dramatically. The tree will first lose shaded leaves and then the small twigs will die. Branch die back will follow and eventually bigger side branches will die until only the main vertical limbs are denuded for a few meters at the base. The only green growth will be limited to the treetops. The rainforest origin growth pattern of the avocado becomes very clear at this stage. The problem situation is that the tree can only develop vertically with limbs and trees competing for light.



Without an effective canopy management system the average avocado tree increases by 1 meter in diameter per year. This growth leads eventually to overcrowding. The growth rate influence the planting distance and it is easy to calculate the time between planting and the onset of eventual crowding between the trees.

Canopy management systems developed over many decades and the process was very slow, frustrating and expensive. Many Horticulturists

and growers developed different models to suit specific concepts or needs under specific conditions over the years. Pruning is regarded as the most difficult cultural practice in the production and regarded by many as a destructive process. Many orchards are left to crowd to the extent that corrective action is needed.

Three different stages can be identified in the development of canopy management.

1. Individual Limb management.

Initially individual limb removal or manipulation was used to manage the size of the avocado tree. With these systems, the trees are normally planted at a wide spacing.

- Individual limbs are ringbarked or cinctured to increase yield in the season just before it is removed.
- Removal of the highest or widest growing limbs represents a protocol that is practised.
- Concepts like cutting windows and rejuvenation forms part of this culture.
- Water shoots are cut back or removed to prevent excess growth.
- Some growers that use the limb manipulation systems are very successfully and produce good yields. Unfortunately these systems are also regarded as labour intensive.
- Cultivars like Ettinger, Edranol and Reed are treated very successfully.

2. Individual tree management.

The alternative to limb manipulation was the manipulation or removal of total trees. Bob Plath was the first to show that production can be maintained if alternate trees were removed on the diagonal. This created space and light for the remaining trees. I confirmed this system in South Africa and it developed to a major commercial system. Good yields of 25 and even 35 Tons/Ha were produced for many years and trees developed to enormous sizes in South Africa. A number of variations on individual tree management developed over the years. Individual tree record keeping gave more substance to tree selection other than position in the orchard. Consistent and poor producers were eliminated and the outstanding “super” trees were retained in the upgrading process.

It is worthwhile to consider a few options of individual tree manipulation:

1 Cut the trees down and start again.



2 Staghorn the trees.



Individual trees or rows or parts of orchards can be cut down and expected to be back in production within two to three years

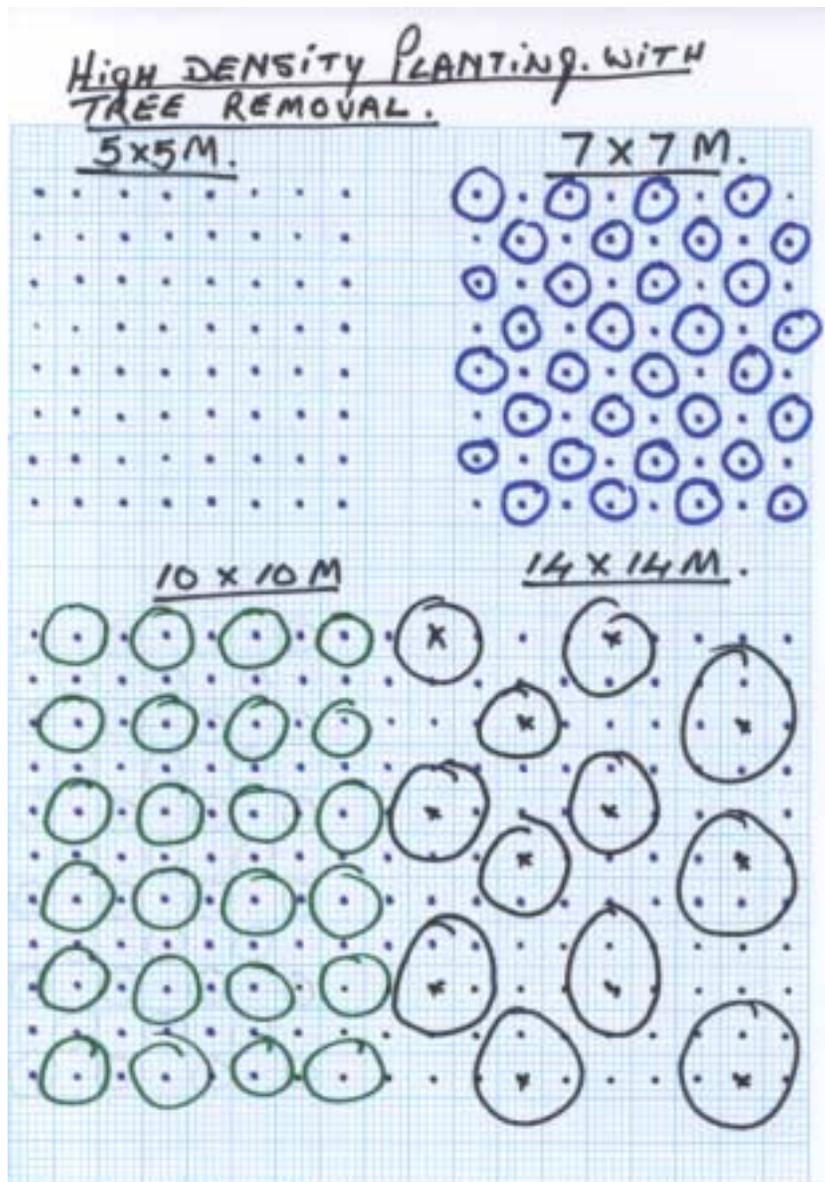
3 Limb pruning.



This system originated in Chile and many variations can be found. The trees can also be back in production within two to three years. This system is used for older trees that are severely crowded.

4 Tree removal.

The principal is to do an initial high density planting at a close spacing of 5 Meter by 5 Meter with 400 trees per hectare. At 5 to 6 years the alternate trees are removed on the diagonal row direction. This leaves the orchard at 7 M by 7 M with 200 trees per hectare. At year 8 or 9 the process is repeated and the spacing become 10 M by 10 M with 100 trees per hectare. The final stage is a 14-M by 14-M block of 40 to 50 trees. This system worked well for Fuerte in areas with available and affordable labour costs.



3. The hedge row of young trees.

The management of the avocado as a hedge is certainly a big step forward. This is probably the system that the more successful producers will follow and develop in the future. The exact dimensions and angles and timing and concentrations will certainly become more fine-tuned in the future. The basic model will remain as the guideline for the benefit of avocado producers.

Research over many years used sophisticated technology to develop a high density planting system of many small trees with a high yield potential of high quality fruit.

- Researchers like Dr Stefan Kohne tried high density planting systems like the palmet and datura with up to 800 trees per hectare. Very intensive manipulation of the branches to improve fertility and reduced the vegetative growth rate. Some success was the production of 20 tons per hectare within 3 years. One can probably re evaluate these systems with the help of summer pruning technology.
- The ideal was to change the competition between shoot and fruit development. PGR's were used to increase fruit set and to reduce the growth rate. Fruit set was improved but the reduction of vegetative growth rate was without the desired advantage.
- Dwarfing rootstocks were collected to be able to plant high-density avocado orchards on a permanent basis. This work is expensive and slow. The research is continuing in South Africa and the development in Mexico by workers from the Citamex Foundation is pioneering research and sponsored by Dr. Sanchez Colin.
- The concept of central leader trees was the basis of work by Dr Piet Stassen and Braam Snijders. High-density orchards are established and manipulated to single leaders and they expect good yields.

Principles are:

- * Cut side branches out that are more than a third of the diameter of the central leader.
- * Remove all growth with an acute angle.
- * Tip all shoots after 20-cm growth
- * Space horizontal shoots evenly in a spiral on the central leader to avoid overshadowing by growing directly above one another.

Many growers in Australia also prefer a multi leader growth form for young trees.

All these systems are suited for eventual hedging and depend on the management skill of the management.

4. Hedging of mature orchards.

Hedging forms an integral part of integrated management where all management factors play a role. The success or failure of hedging

depends on the individual and sum of the total management of limiting factors.

The important factors are:

- Phytophthora Control.
- Irrigation Management.
- Nutrition Management.
- Reserve Management.
- Fruitset Management.
- Hedging Management.

4.1 Phytophthora Management,

All factors and control measures should be used to minimise the effect of phytophthora. Drainage, good irrigation, organic material and chemical treatments are the most important.

4.2 Irrigation Management.

It is important to manage the root system well supplied with water and oxygen. This means that the root system is managed fairly shallow with a system of relatively frequent smaller irrigations. Measurement of the available soil moisture is essential. The objective is to eliminate or reduce any stress and this can be measured with a dendrometer.

4.3 Nutrition Management.

Management of nutrition is very important in the avocado and the main objectives are:

- Balance the supply of nutrition.
- Eliminate deficiencies and excess situations.
- Fertilise for production of fruit without stimulating vegetative growth too much.
- Fertilise according to the phenological needs of the trees.

4.4 Reserve Management.

The avocado is regarded as an alternate bearer as result of the depletion of reserves. Harvesting should be planned to maintain a level of reserves

that will make a next crop possible. Late harvesting of big crops will reduce the next crop potential.

4.5 Fruitset Management.

The process of fruitset is the most important for avocados. All factors contributing to fruitset should be considered. Light, Pollinators and pollinisers are vital elements. With the new technology in Plant Growth Regulators, good fruitset became much more realistic and contribute to good yields of good quality fruit.

5. Hedgerow Management.

The pyramidal hedgerow for avocados was developed in Israel by many. Dr Isaac Adato played a critical role to understand and refine the processes in more depth. The more successful growers in Israel, South Africa and certainly in Australia implement the present technology. Other countries like Chile are in the early stages of implementation of the hedgerow system.

The pyramid shape with a north/south row orientation is the most efficient for light utilisation in any. The limitation of the tree height is roughly 75% of the inter-row distance and will be influenced by latitude and row orientation.

The basic shaping of trees into hedges can take a number of years to get to an ideal shape and dimensions. This is a process and not an event.

There are three basic steps:

5.1 SHAPING OF THE HEDGE

It is essential to shape the hedge as a first step to create surfaces to work with. Shape the tree by cutting one or both sides to get to the desired shape.

The dimensions and severity of the shaping cut depends on the tree size, spacing, severity of crowding and row orientation.

This is done post harvest and is a destructive process because you remove fruiting summer growth.

In cases where the cuts are very deep, it is better to shape the eastern side in the first year and shape the western side in the second year.

It is essential to cut at an angle into the tree to get light penetrating to the full canopy side of the tree.

To compensate for the loss of fruiting material, it is essential to compensate by using a PGR for fruitset. This will enable you to shape your orchard without losing crop or even increase your yield. In fully shaped orchards, cutting branches will create windows for additional light penetration.

5.2 Control of wild reaction growth

Control all water-shoots in the early summer by removing cutting them back selectively.

5.3 Maintenance Summer Pruning

In my mind the principles of summer pruning to maintain orchard shape is probably the greatest contribution to avocado production in the past 20 years This is Dr Adato from Israel's biggest contribution to the avocado world.

Summer pruning is designed to:

- 1 Manage the tree size and shape without damaging the production potential.





- 2 The basic principal is to understand that the role of the spring flush is purely vegetative extension growth.
- 3 The summer growth is the critical growth that develops flowers on mature growth for the next crop.





- 4 This makes timing very important and you must remove the mature spring flush just outside the fruiting line.
- 5 At each cut, the regrowth will become more complex. Regrowth



from summer pruning will initially be juvenile and PGR's are used in Israel and South Africa to mature the reaction summer growth.

- 6 At each cut several matured shoots will develop into flowering shoots.
- 7 The timing is also critical to enable flower induction to take place normally for the creation of flowers in the spring for the next crop.

6. Steps to implement integrated hedging.

- 1 **Manage your Phytophthora control, irrigation, nutrition and reserves.**
- 2 **Shape the trees into a hedge after harvesting in winter.**
- 3 **Increase fruitset with a PGR during springtime.**
- 4 **Remove wild growing water shoots in November.**
- 5 **Cut the spring flush back to just outside the fruiting line.**
- 6 **Mature the summer flush reaction growth in time for flower induction in the autumn.**

7. Advantages of an intergrated hedging system.

- The yields increase.
- Fruit quality will increase.
- Fruit size will increase.
- The trees crop much more regularly.
- The total bearing surface is exposed to sunlight, which is free of GST.
- The production process can be almost fully mechanised.
- Cultivation is much easier and cheaper.
- Spraying is much more efficient.



