

## Manipulation of Hass Avocado Trees — Pruning

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### ABSTRACT

Various preliminary experiments dealing with pruning of young and older trees have been carried out over the past two seasons. Techniques were and are being developed to successfully train young trees to a central leader for higher density plantings. Success has also been achieved with the rejuvenation and shaping of trees in older dense orchards. Control of growth remains the overriding requirement and must receive a lot of attention in future research in order to develop an effective tree management programme.

### INTRODUCTION

During the past two seasons various manipulation trials have been initiated in order to investigate their feasibility, applicability and suitability to the avocado industry. These investigations and future work will examine mainly two aspects:

- What should the layout for a new orchard be, and how should the trees be shaped and maintained in order to:
  - achieve a commercial yield 24 months after planting and maintain optimum production;
  - let the tree function efficiently and effectively with bearer shoots spread laterally around and within the tree; and
  - maintain tree height and width within a certain allocated space for as long as possible.
- How should older established orchards be handled in order to:
  - develop bearer shoots on bare unproductive areas within and at the base of the trees without stimulating unnecessary vegetative growth; and
  - maintain the yield at a commercially acceptable level and keep the fruit within reasonable reach of pickers.

Pruning of avocado trees is already an established process in Israel with both mechanical and manual methods being employed (Homsy, 1995). In South Africa, with high-potential soils and with favourable climatic conditions, pruning of trees can stimulate vigorous watershoot production. The time of pruning, type of cut, water shoot management, induction and control of growth, judicious nitrogen application, elimination of fruit drop and growth control measurements are aspects of major importance to be

considered when pruning is contemplated.

When the existing situation in the avocado industry is taken into account, it is apparent that comprehensive tree management, which includes pruning and other manipulations, can no longer be regarded as impractical. Producers want to plant trees closer to gain by the earlier larger yields and to delay the excavation of trees for as long as possible. In older orchards tree sizes not only becomes a labour problem, but trees bear only on exposed areas and have low yields as a consequence. When this situation is remedied by tree thinning, the remaining trees will overgrow the space created within two years. Even in cases where trees are cut back to frame branches, bushy shoot development occurs, which is unproductive for a few years and thereafter forms a dense bush. A tree management programme will, to a greater or lesser extent, have to be implemented. The main challenge is to develop a workable tree management programme for the avocado industry.

Stassen, Davie & Snijder (1995) recommended that new orchards be planted in such a way that optimum light utilization of the total leaf canopy occurs. To achieve this rectangular planting system with a North-South orientation is recommended. For light interception and penetration to take place the tree shape must be such that the tree top is always narrower than the base. Stassen, Davie & Snijder (1995), in a paper delivered at the third World Avocado Congress in Israel, described guidelines by which an avocado tree can be trained to a central leader shape to meet the above requirements.

Snijder & Stassen (1995) described strategies for regenerating problem orchards where encroachment has occurred. Francis (1994) describes a method where two branches per year are pruned until the tree is corrected by the third year. Martin & Whitney (1995) recommended the process of stumping by cutting off the tree at 300-600 mm instead of removing the tree. A single shoot is then selected and trained to form the new central leader. A tree management programme similar to a spray and fertilizer programme will in future be seen as part of the normal orchard programme of avocado producers. This programme will undoubtedly take time to develop and will require a cooperative effort.

In this and the following paper we will list briefly the current actions being taken. This paper will deal with pruning, and the following paper will deal with fruit manipulations.

## **MATERIAL AND METHODS**

### **Experiment 1**

*Aim:* To shape young established trees to a central leader form and to induce fruiting in the second year. To compile potential fruit load graphs on which future fruit pruning and thinning programmes can be based.

The trial comprises a standard 5 m x 5 m Hass on Duke 7 planted in November 1993 which was interplanted to 5 m x 2,5 m in September 1994. The trees were subsequently regularly shaped by light pruning and maintained as described by Stassen, Davie & Snijder (1995).

The trial consisted of the following treatments. Every alternate row was cinctured on 5 May 1995 to test the effect on fruit set. After flowering and fruit set, fruit counts were

made on 22 November and fruit thinning was applied as follows:

- Thinned to 100 fruits per tree
- Thinned to 80 fruits per tree
- Thinned to 60 fruits per tree
- Thinned to 45 fruits per tree
- Control — no thinning

Where trees were thinned to 45 fruits per tree the treatment was applied only to cinctured trees. Five single tree plots per treatment were used.

## Experiment 2

*Aim:* To determine how trees that are already established for two years and where the leaders have been topped will react to severe and less severe pruning. To compile a fruit load graph.

The trial consists of a 6 m x 6 m standard Hass on clonal Duke 7 planted in November 1992. Ten trees were rather severely pruned and shaped during 1994 while a further twenty were left as controls. The control trees were lightly pruned in the winter of 1995 to prevent the tops becoming wider than the base. This pruning action was followed up in December by a second pruning.

The following treatments were randomly applied on 22 November 1995 to 5 single tree plots per treatment.

<i>Severely pruned trees</i>	<i>Lightly pruned trees</i>
Thinned to 150 fruits/tree	Thinned to 150 fruits/tree
	Thinned to 120 fruits/tree
	Thinned to 90 fruits/tree
Control — no thinning	Control — no thinning

Standard fertilization, irrigation and other orchard practices were applied.

## Experiment 3

*Aim:* To determine the effect of moderate pruning followed by regular summer pruning as well as the tree potential with regard to fruit load over a number of years.

The trial consists of Hass on Duke 7 seedlings planted in the Levubu area in March 1993 at a 5 m x 5 m spacing. Trees were pruned during July 1995 followed by a summer pruning in October, November, December and January 1996. The following thinning treatments were applied to 5 single tree plots randomly chosen in the orchard:

- Thinning to 60 fruits/tree
- Thinning to 80 fruits/tree
- Thinning to 100 fruits/tree
- Thinning to 120 fruits/tree
- Control — no thinning.

#### **Experiment 4**

*Aim:* To compare avocado trees planted at 800/ha (5 m x 2,5 m) and trained from inception to a central leader and a standard planting of 400 trees/ha (5 m x 5 m) that has not been pruned. To determine the optimal time of cincturing for improved fruit set.

Cincturing will be applied at the following times:

- End February
- Middle March
- End March
- Middle April
- End April
- Middle May
- Controls — not cinctured

The trial is being conducted on two blocks of Hass on clonal Duke 7 that were planted in 1994. The blocks receive the same orchard treatments except that the high density trees are regularly pruned in the form of balancing cuts.

Cincturing will be done on 20 single tree plots randomly selected.

#### **Experiment 5**

*Aim:* To compare a relatively standard planting (667 trees/ha) of the five more important commercial cultivars with a high density planting (1667 trees/ha) of the same cultivars by applying all the manipulation techniques derived from previous manipulation trials. This orchard was established in November 1995 and treatments will be applied later in 1996.

#### **Experiment 6**

*Aim:* To investigate all the chemical and physical means available to inhibit excessive growth, improve fruit set and reduce fruit fall. These trials will commence during 1996.

## **Experiment 7**

*Aim:* To regenerate commercially unproductive orchards where encroachment has occurred and to maintain the productivity of such orchards.

Hass on Duke 7 rootstocks planted in 1982 and the trees already thinned out in 1992 with recurring severe encroachment and producing about 3 t/ha of fruit in the tops, were used for pruning.

## **RESULTS AND DISCUSSION**

As yield data will only be available later in the season, reference will only be made to fruit load.

### **Pruning**

#### **Training and shaping young trees**

From the results obtained over the past two seasons the following is apparent:

- Hass avocados' growth pattern lends itself to a central or multiple leader form where the leaders are allowed to develop in an upright and dominant way.
- The time and severity of the pruning as well as the type of cut will determine the reaction.
- Pruning is not a one-off treatment and pruning in the winter must be followed by pruning in spring and summer.
- Less severe cuts can be made if the shaping phase is gradually applied after planting (and even before).
- Precocity (early fruiting) is an important requirement for inhibiting growth.
- Good initial growth (spring and summer) cause good development of side shoots (later side branches) with a natural balance to the leader(s) and tipping of the side shoots to about 200 mm to stimulate the development of laterals (future bearers).
- Side branches that are more than a third of the thickness of the leader must be bent or cut back 50 % to a bud or preferably to a horizontal side branch. Branches more than half the thickness of the leader must be totally removed flush with the leader.
- Remove strong vertical branches in unwanted positions as soon as possible, especially those with a very sharp attachment angle to the vertical. Keep side shoots as horizontal as possible by cutting back to flatter side branches in late summer.
- Remove shoots and branches to achieve a spiral orientation of branches around the leader which should allow sufficient light penetration.

#### **Maintenance pruning from the third year**

- Weaken side branches that threaten the leader(s).

- Water shoot management in the spring and summer is of utmost importance. This will involve the removal or severe cut back of strong upright shoots.
- Renewal cuts to restrict side branches and shoots and to stimulate new bearers.
- The removal of unwanted side branches where one overlaps and overshadows the other. This will seldom occur if initial shaping is carried out correctly.
- Do not open trees up too much as sunburn can occur, especially on the sunny side.
- Restrict the height by cutting back the leaders to a lower weaker relatively upright side shoot.
- Strengthen lower branches that hang on the ground or interfere with irrigation.
- Apply nitrogen fertilization at the correct time and in the right quantity. Incorrect nitrogen management causes extremely vigorous growth of water shoots that not only utilize all the nutritional elements and assimilates but suppress reproductive development and accelerate encroachment.
- Utilize available means to suppress vigorous growth round about September/October and February/March and to inhibit growth at cut wounds without preventing the development of the horizontal laterals.

**Table 1**  
Mean fruit load per tree for the various fruit thinning experiments after the first and second fruit drop periods

<i>Experiment and treatments</i>	<i>Fruit load</i>	
	<i>November</i>	<i>February</i>
<i>1. 24-month-old cinctured and pruned trees</i>		
Thinned to 80 fruits	80	56
Thinned to 60 fruits	60	50
Thinned to 45 fruits	45	40
Control (unthinned)	150	89
<i>2 (a) 36-month-old standard pruned trees</i>		
Thinned to 150 fruits	150	59
Thinned to 120 fruits	120	63
Thinned to 90 fruits	90	44
Control	187	34
<i>2 (b) 36-month-old severely pruned trees</i>		
Thinned to 150 fruits	150	69
Control	310	125
<i>3. 32-month-old moderate pruned trees with intensive summer pruning</i>		
Thinned to 60 fruits	60	44
Thinned to 80 fruits	80	49
Thinned to 100 fruits	100	43
Thinned to 120 fruits	120	44
Control	252	57

From table 1 it would appear that in the case of the 24-month-old trees a good fruit load was maintained after the January fruitdrop. The 36-month-old trees lost a lot of fruit in the January fruit-drop period. Vigorous watershoot development must be seen as the main cause. The 32-month-old trees also lost many fruit through fruit-drop but this can be ascribed to a large extent to hail damage.

### **Trees eight years and older**

The following strategies have been applied to rectify trees over a two to three-year period:

- Opened the tops of the trees to allow light to penetrate —July 1994.
  - About four vertically developing leaders were selected.
  - All branches competing with the leaders and inhibiting light penetration were removed.
  - Leaders that were developing at 45 ° or steeper were cut to weaker horizontal branches.
- Regrowth management during the summer growth seasons for 1994 and 1995.
  - All horizontal shoots that developed inside and in the lower half of the tree were left.
  - Strong upright water shoots were cut back to 150 mm for new side shoot development.
  - All strong developing water shoots that were growing in unwanted positions were removed.
- Control the regrowth during the following growth season (1996) and allow the trees to develop a heavy set to suppress vegetative growth.
- After harvests reduce the tree height and width (winter 1996).
- Maintain the tree by pruning three times a year and applying other techniques as they are developed.

Harvest data are not yet available but fruit load counts as given in table 1 show that pruning of young trees does not adversely affect their fruit set.

During the trials regular light penetration measurements were taken to determine the effect of the pruning treatments as well as the effect of the regrowth on light penetration into the tree (table 2).

**Table 2**  
Influence of post-harvest pruning and water shoot management on light penetration into sixteen-year-old trees (average of five trees at 1,5 m height and one meter from the edge of the leaf canopy of the tree)

<i>Treatment</i>	<i>Light penetration (%)</i>	
	<i>1995</i>	<i>1996</i>
No pruning	7	7
After pruning (July)	58	38
No summer pruning	11	9
With summer pruning	40	32

From the above table it is clear that regrowth after the first pruning has a detrimental effect on light penetration into the tree. This confirms the value of summer pruning to remove the unwanted water shoots and in this way ensure that new shoots develop in the lower and inner part of the tree and get sufficient sunlight for growth and fruitfulness.

## CONCLUSIONS

Preliminary experiments have shown that young avocado trees can be successfully trained to a central leader. It is, however, a continuous process that must be applied timeously and with dedication. With the provisional work most of the objectives with regard to tree form and yield have been achieved.

Old trees in dense orchards have been successfully rejuvenated and shaped over a two-year period. The trees have been transformed from a situation of poor yield with fruit only in the tops of the trees to where the whole tree now bears fruit. Production figures will be available after harvest.

It is clear that pruning of avocados has potential for South Africa. There are positive prospects that must be used and developed. Much work still needs to be done and mistakes will still be made. A practical tree management programme similar to a fertilization and irrigation programme must be the objective, and all available tools must be utilized to this end.

## SUMMARY

Some or other form of pruning is necessary. The situation in South Africa is complicated by high potential soils and growth-stimulating climatic conditions.

Various pilot studies have been conducted over the past two seasons with regard to:

- pruning and training of young trees; and
- Rejuvenation of older trees.

This work is still in the initial stages but encouraging results are being achieved.

Management of excessively vigorous growth must be approached with dedication and



the use of all tools at our disposal.

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