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Results with pruning of existing avocado orchards

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ABSTRACT

The 1999 avocado harvesting season was regarded by the industry as an off year. Low yields, with good fruit size but not very good internal quality were the norm rather than the exception. However, a fair number of producers did have good yields associated with good quality fruit and acceptable size. Most of these producers had been pruning their trees to a greater or lesser extent during the previous seasons. The pruning resulted in smaller and more manageable trees with enough young growth to lessen the impact of the off season on these trees.

These positive results have encouraged more and more producers to prune avocado trees. The principles and basic practices are fairly well understood. There are, however, still many queries relating to aspects such as timing of the operations, severity of pruning and its influence on yield, as well as the method and system of pruning to be used.

The research effort of the ARC-ITSC is currently aimed at answering these questions. In this paper the authors give the results obtained in the trials that dealt with some of these issues and also give some guidelines for actions to be taken during the next season. These guidelines are based on research done thus far. Further research is underway.

INTRODUCTION

Pruning of avocado trees is rapidly becoming standard practice in a large number of avocado growing areas. Of the 13,000 ha under avocados in 1998 (Anon, 1998), the trees on approximately 9,000 ha were older than 10 years. Of this area approximately 3 500 ha of trees have been pruned, and 1 500 ha of trees younger than 10 years are being pruned (N J F Claassens, Personal Communication). The results obtained with these pruning actions are encouraging in respect of yield, fruit quality, and relieving the encroachment situation (Stassen, Snijder & Bard, 1999).

Increased light penetration into the orchards encouraged new growth to develop on the inside of the trees. This in turn led to good quality fruit being set lower down on the tree and therefore easier to reach when harvesting. Spraying time was reduced and mechanization was possible. It was also noted that yield seemed to stabilize over a four year period, compared to unpruned trees over the same period (Stassen, Snijder & Bard, 1999).

However, these good results have not yet answered all the questions being asked about

the pruning process. The timing and severity of pruning and its effect on yield is still being investigated. The issue around different pruning systems (selective or mechanical) and the integration of different systems is not yet resolved. Overall management of pruned orchards is still unclear for many producers as is the integration of bio regulators in the orchard management programs.

Planting of new orchards also creates much discussion in regard to tree spacing and training programs. A rectangular planting system is being adopted, but densities of more than 400 trees/ha is still under close observation. However with the results obtained thus far, a long term decision can be made for new plantings.

In this paper attention is focussed on the results thus far obtained. Pruning systems and severity will be addressed, as well as results obtained in young orchards trained from planting.

MATERIAL AND METHODS

A. EXISTING OLDER ORCHARDS

The layout and treatments for this trial were described by Snijder & Stassen (1999) and Stassen *et al*. (1999). Two different trial sites were used for this investigation, one in the Kiepersol area (mid-season) and one in the Mooketsi area (early season). The Kiepersol trial consists of four treatments and a control, and is being carried out in a 12 year old Hass on 'Duke 7' orchard with a spacing of 7m x 7m. The orchard was semi-encroached at the start of the experiment, without being severely denuded. The treatments consist of the following combinations :

1. Light selective pruning — opening the work-row by thinning of the tree tops (selective — working row).
2. Drastic selective pruning — drastic pruning whereby the whole tree is shaped into a pyramid (selective — whole tree).
3. Light mechanical pruning — only one side of the tree is pruned at an angle of 10° in the first year, followed by the other side and pruning the tree height in the second year (mechanical one side only).
4. Drastic mechanical pruning —the whole tree was pruned in the first year to a pyramidal shape (mechanical — whole tree).
5. Control — the working row was opened up vertically.

Treatments commenced after the 1998 harvest were taken off the trees. Follow up summer pruning was done in January 1999 to remove watershoots and to induce further complexity. No chemical treatments were done as these trees are not vigorous growers. Low levels of nitrogen were found in this orchard (N = 1.8%). Twenty trees per treatment are used for record taking.

In the Mooketsi trial (hot, dry climatic conditions) two different systems of mechanical pruning are being evaluated. The orchards are spaced at 7m x7m after thinning in 1997. These trees were not seriously encroached at the start of the experiment, and no severe denuding had taken place at the bottom of the trees.

The treatments were comprised of the following pruning methods:

1. Mechanical pruning (pyramidal) — the whole tree was pruned to a pyramidal shape directly after harvest.

2. Mechanical pruning (upright) — these trees were pruned vertically on the eastern side, without pruning the other side. In the second year the western side was pruned vertically, and the eastern side at an angle of 10°. In the third year the western side was pruned at an angle of 10° and the height was then finally adjusted to 4m.

These semi-commercial trials were done on 12-16 year old Fuerte and Hass trees on seedling rootstocks. Treatments were done in April for Fuerte and June for Hass, at harvesting. Summer pruning was also done mechanically in December 1998 and Sunny was used on the spring and summer flushes at 1% and 0,5% respectively. Three commercial blocks for each treatment (1,2 ha each) were used for taking yield data.

B. YOUNG BEARING ORCHARDS

The layout and treatment of younger orchards has been described by Snijder & Stassen (1997 a&b, 1999) and Stassen & Snijder (1999). The orchard planted at the Burgershall research station consisted of the five commercial cultivars on Duke 7 at two different spacings (5,5m x 3m and 4m x 1,5m) and yielded its second commercial crop in 1999. The trees were selectively pruned in winter as well as in summer. A central leader system was used and the soil was of medium to high potential (32% clay). No chemical growth control has been applied to these trees, except for the Fuerte trees at the higher density which were treated with Cultar^{R} (0,8 ml. 250ml^{-1}.m^{-2} drip area). Twenty randomly selected trees per cultivar per density were used for recording results.

The trial in the Kiepersol area was harvested for the third time, and consisted of HHass on Duke 7 at two spacings (5 x 5m and 5 x 2,5m) with the higher density being pruned to a central leader system. No pruning was done in the standard density (5m x 5m) orchard. The trees were selectively pruned into a central leader system as described by Stassen *et al.* (1995). Mechanical winter and summer pruning has been applied since August 1997 and the trees were planted on a high potential soil (53% clay). No chemical growth control has been applied to these trees. Twenty randomly selected trees for each density were used for recording results.

RESULTS AND DISCUSSION

A. EXISTING, OLDER ORCHARDS

Many farmers are currently pruning older encroached orchards. The results of these pruning actions are becoming convincingly positive and good yields are being maintained. Stassen, Snijder & Bard (1999) showed the previous results of these semi-commercial trials, which are being conducted by the producer, but which are closely monitored by the ARC-ITSC.

The first yields from the trial in Kiepersol were obtained in 1999, the year after the trees were pruned. In Table 1 the yield results for the Kiepersol trial are shown.

Table 1 ***Yield results (t.ha^{-1}) for 12-year-old Hass avocado trees under different systems of pruning.***

Yield (t.ha^{-1}) before pruning		Yield (t.ha^{-1}) after pruning	
1997	1998	Treatment	1999•
23.7	14.9	Control	11.5 b
		Selective (whole trees)	19.9 a
		Selective (working rows only)	25.4 a
		Mechanical (one side only)	20.2 a
		Mechanical (whole tree)	10.7 b

• Values with the same letter are equal according to the t-test at a P_0.05.

From Table 1 it is evident that trees in a moderate stage of encroachment and lower growth vigour react positively to pruning. It is also evident that selective pruning of the whole tree as well as selective pruning by making the tree tops narrower than the bottom for better light penetration gives significantly better yields than the control and mechanically pruned trees where both sides were pruned to achieve a pyramidal shape. Trees, which were mechanically pruned at an angle on one side only, gave similar yields to the selectively pruned trees. Better control can be achieved during selective pruning action to ensure that the correct branches are being pruned, without removing too many flower buds. Branches that are pruned at the point of attachment do not grow back vigorously, and less drastic follow-up treatments are needed. The trees in the severe mechanical pruning system were left rather bare on the sides, and the yield was mainly obtained from the few remaining inner branches and the top sides of the trees that were not pruned.

In Table 2 the yield results with mechanically pruned Fuerte and Hass trees in the Mooketsi area are shown. This area has a hot dry climate and does not normally show signs of overvigorous growth on the trees.

Table 2 Yield results (t.ha^{-1}) for two different mechanical pruning systems with Fuerte and Hass avocados

Treatment	Yield (t.ha^{-1}) before pruning 1998	Yield (t.ha^{-1}) after pruning 1999
'Fuerte'		
One side only (upright)	18.21	15.36
Whole tree (pyramidal)	16.79	18.38
'Hass'		
One side only (upright)	14.53	24.07
Whole tree (pyramidal)	14.08	23.36

From Table 2 it is evident that there is no significant difference between the type of pruning system used for Fuerte and Hass under medium encroachment situations. Even severe pruning to a pyramidal tree shape still gives good yields the first year after pruning. These yield results are promising, but a few more years data are needed, before recommendations can be made.

YOUNGER, BEARING ORCHARDS

The results obtained with orchards planted in a rectangular system and pruned to a central leader from the day they were planted, have shown good results over the past four years. In Table 3, the results with the five commercial avocado cultivars on Duke 7 planted at two different spacings are shown. The orchard is situated on the Burgershall research station and was planted in October 1995.

Table 3 *Yield results (t/ha) for five commercial avocado cultivars at two different spacings*

Cultivar	Spacing	1996 (7 months)	1997 (19 months)	1998• (31 months)	1999• (43 months)
Fuerte	5,5m x 3m	0	0	3.11 a	6.25 a
	4m x 1,5m	0	0	3.39 a	5.33 b
Hass	5,5m x 3m	0	0.50	4.87 a	9.34 a
	4m x 1,5m	0	1.20	8.77 b	13.60 b
Pinkerton	5,5m x 3m	0	0.67	7.03 a	8.07 a
	4m x 1,5m	0	1.35	12.37 b	9.26 b
Edranol	5,5m x 3m	0	0	6.08 a	17.20 a
	4m x 1,5m	0	0	7.54 b	22.40 b
Ryan	5,5m x 3m	0	0	4.96 a	11.90 a
	4m x 1,5m	0	0	5.80 b	13.80 b

• Values with the same letter within columns and cultivar are equal according to the t-test at a p_0.05

From Table 3 the following can be noted:

• For trees less than 4 years old exceptionally good yields were obtained at both densities.

• Except for Fuerte the higher density gave better results than the lower density. The vigour of Fuerte discourages good yields at a higher density as more than normal pruning needs to be done to maintain tree size. A bio-regulator is needed to control vigour and help fruitset and retention.

• A yield increase of more than 100% was obtained between 1998 and 1999, except for Pinkerton. This is due to over thinning during the 1998/99 season as well as lower nitrogen levels. Pinkerton was treated similarly to Hass with respect to nitrogen fertilizer.

• Edranol and Pinkerton have not yet filled their allocated space at the lower density, and are therefore more suited for high density (> 607 trees/ha) planting.

• Regular good yields with Ryan can be ascribed to the stronger, healthier leaves present during flowering and which had been produced during the late summer (after summer pruning).

This orchard is planted on a medium potential soil, and growth vigour is not extreme. According to Whiley and Wolstenholme (1990) the avocado tree is inclined to allocate its energy resources towards growth rather than fruit. This is clearly revealed in the trees grown on a high potential soil as shown in Table 4.

Table 4 *Yield results (t.ha^{-1}) with Hass avocado at two different spacings, with and without pruning, grown on high potential soil (clay > 35%)*

Treatment	Planting date and spacing	Yield (t.ha^{-1}) (Months after planting in brackets)		
	November 1994	1997 (30 months)	1998 (42 months)	1999 (54 months)
Pruned	5m x 2,5m	2.45 a	8.9 a	7.1 a
Unpruned	5m x 5m	2.03 a	10.7 b	7.1 a

From Table 4 it is evident that on high potential soils without chemical growth inhibition, high densities do not result in higher yields and therefore do not warrant the additional inputs. Although 1999 was an off-year in the South African avocado industry, the decline in yield in the unpruned 5m x 5m planting was due to encroachment, and this orchard was subsequently thinned to 7m x 7m after the 1999 crop was removed. The lower yield in 1998 (42 months after planting) and the decline in 1999 in the pruned orchard are mainly due to growth vigour. These trees grow very rapidly throughout the season, and more than two prunings are needed to keep the trees to the required height and size and to ensure optimal light interception in the orchard.

CONCLUSION

Pruning of avocado orchards is now rapidly becoming standard practice in the South African industry. The 5,000 ha being pruned out of a total of 13,000 is a good example of the acceptance of pruning as a practice. However, many questions are still being debated in the industry. With the current research results obtained, certain questions have already being addressed:

1. Drastic pruning of medium encroached orchards in marginal soil and/or climatic conditions do not show a yield decline.

2. In high potential soils and favourable climatic conditions, selective pruning gives the best results.

3. Drastic pruning under high potential soil and/or climatic conditions will result in a yield decline for one season.

4. A growth control program should be in place to achieve good results under optimal growing conditions.

5. Summer flush control to reduce vigour and establish complexity must be practiced to optimize production.

With regard to new plantings, the results with the four-year-old orchard planted in a rectangular configuration on medium potential soils are also promising and some good recommendations can be made. Higher density plantings (more than 400 trees/ha) for Hass, Edranol, Pinkerton and Ryan can be made. Fuerte should be planted at 400

trees/ha. In the case of high potential soils, plant densities must be adapted accordingly and a growth control program should be implemented from the start. If possible, before planting on high potential soils, a cover crop should be planted to drain away some of the excessive nitrogen. This will ensure less vigor and earlier yields especially with Hass avocado.

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