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Avocado tree management – a holistic approach: Chemical manipulation

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ABSTRACT

Following intensive research into the benefits of tree manipulation, the SA avocado industry has reached the stage where many of the major commercial growers utilise some form of pruning program. The resulting orchards are now much easier to maintain and harvest, with concomitant improvements in productivity, yield and fruit quality. The question now is whether these benefits are sustainable and whether the manipulation program can be made more cost effective. Over the last few seasons it has been shown that growth inhibitors can enhance the manipulation program, giving not only efficient growth control, but also improved yields, larger fruit and better shaped fruit. The one drawback to these products is their expense. The focus of this seasons work has been on the optimisation of application rates and timing, as well as the use of adjuvants, in order to minimise the cost of using these products. This presentation will discuss the findings of the current season, and will also examine the cumulative effects which are starting to manifest after two consecutive seasons of growth inhibitor use.

INTRODUCTION

Over the past two seasons, it has become apparent that growth inhibitors can play an important role in the management of avocado orchards. They have been shown to restrict growth, improve yields and have beneficial effects on fruit size (Penter & Stassen, 1998; Penter & Stassen, 1999; Penter *et al*., 2000). The benefits are particularly noticeable when these compounds are used to supplement a regular orchard maintenance program as described by Stassen & Davie (1996a), Stassen & Davie (1996b), Stassen *et al.* (1997) and Snijder *et al*. (2000a,b,c).

The role of growth regulators has been discussed in detail in previous publications (Penter & Stassen, 1998; Penter & Stassen, 1999; Penter *et al*., 2000). In short, the avocado is characterised by extremely vigorous vegetative flushes. This is a result of several factors, including excessive soil nitrogen levels in most growing areas, limited tree management in many orchards and a genetic disposition towards strong growth which arises from its evolution in tropical rain forests (Whiley & Schaffer, 1994). Due to this vigour, there is considerable competition between vegetative and reproductive growth and yields of avocado trees are generally low, with small fruit also being a problem. Growth inhibitors act by reducing gibberellin synthesis in the plant, leading to a reduction of vegetative growth, with shoot extension being reduced by as much as 50% (Forshey, 1991). By reducing vegetative growth, there are more nutrients available for fruit development, leads to improved yields. This is the primary hypothesis which lead to the initiation of this trial. In the current report, the results of two seasons' growth inhibitor applications to the same trees will be examined.

MATERIALS AND METHODS

This trial was conducted in Levubu (Schoonuitzicht farm) on a 9 x 6 m Hass planting. Treatments included:

1. Pruning + Sunny 1%
2. No pruning + Sunny 1%
3. Pruning + Cycocel (CCC) 2000 mg.L^{-1}, 3000 mg.L^{-1}, 4000 mg.L^{-1}
4. Pruning + Cultar 0.4%
5. Pruned control
6. Unpruned control

Each product was applied as a full cover spray at flowering with Foliwett 9000 as a wetter. Treatments comprised 10 replicates of 5 trees apiece in 1999 and 5 replicates of 5 trees apiece in 2000.

Data collected included the following:

1. Number of fruit harvested per tree
2. Total weight of fruit harvested per tree
3. Fruit size distribution based on 1 tree per replicate where all fruits harvested were individually weighed.

This same protocol was used in both the 1998/1999 and 1999/2000 seasons, with one exception. During the 1999/2000 season the trial was extended to examine the effect of mineral oils on growth inhibitor efficacy. In this season five of the replicates received only the relevant growth inhibitor, while the other five were sprayed with a mixture containing the regulator with 0.05% Ampron oil.

All statistical analyses were performed using a Duncans' multiple range analysis with $P \leq 0.05$

RESULTS AND DISCUSSION

As is shown in Figure 1, mineral oil had very little effect on growth inhibitor efficacy. Where differences existed between trees receiving oil or no oil, these differences were not statistically significant. The

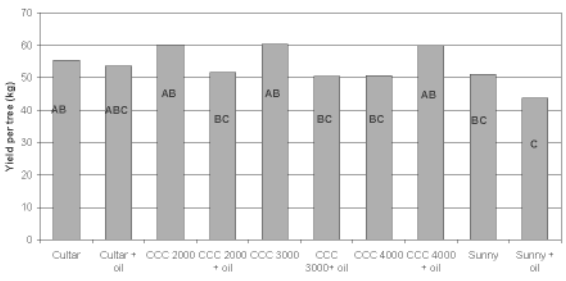

Figure 1 The effect of mineral oil on growth regulator efficacy in Hass avacado trees

effect was also variable, with oil increasing efficacy of some growth inhibitors but not others. It thus seems that oils cannot be used to improve the performance of the growth inhibitors. This means that the growth inhibitors will have to be used at current recommended rates until some other adjuvant can be found to increase their uptake and performance.

Figures 2 – 4 examine the effects of growth inhibitors on avocado yields over the two years of application. Figures 2 and 3 show the average tree yield for 1999 and 2000 respectively, while Figure 4 allows a direct comparison of the yields. It can be seen that in 1999, pruning had a negative effect on yield. This was expected to occur, as the trees were pruned for the first time in that year, and some larger branches were removed to shape the trees. Looking at the pruned and unpruned controls, it can be seen that this difference had disappeared by 2000, where the yield reduction due to ongoing pruning alone was not significant.

It can also be seen that the differences between sprayed and unsprayed trees were much smaller in 2000 compared to 1999. This could well be due to an increase in flowering in 2000 and the fact that this was an on-year. While the differences between treatments were small in 2000, Figure 4 shows that from 1999 to 2000 the yield in unpruned trees yield doubled while in the pruned trees it tripled. According to the statistical analysis, these differences in yield are not significant. However, observations indicate that the pruned trees may overtake production in the unpruned trees during the coming season. This is due to uncontrolled growth in the unpruned trees leading to a lack of light in the centre of these trees, causing a dieback of bearing branches. This will be examined in the coming harvest.

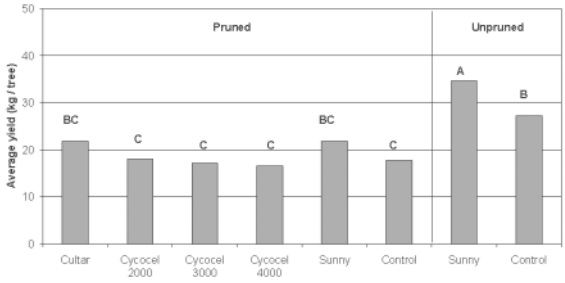

Figure 2 Effect of pruning and growth inhibitors on yield in Hass 1999

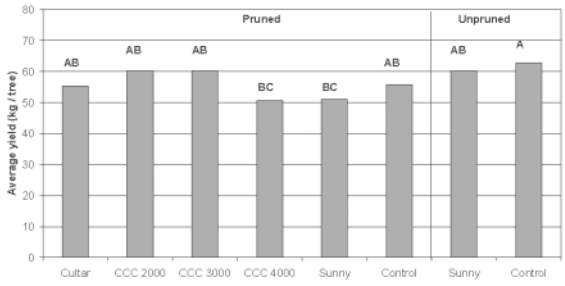

Figure 3 The effect of growth inhibitors on yield in Hass avacado trees 2000

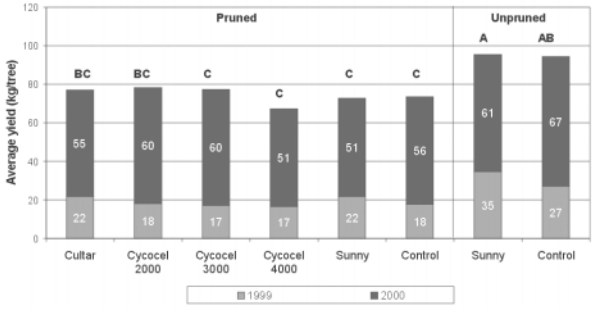

Figure 4 Hass yields over two seasons for trees treated with growth inhibitors

Figures 2 – 4 also show that in 1999 the product Cycocel (CCC) did not compare favourably with the other growth inhibitors (Sunny and Cultar). In the current season CCC produced the best results, although the difference was again not statistically significant. This improvement may indicate one of two things:

1. Sunny and Cultar gave a bigger yield in 1999. This may have depleted the reserves of these trees, leading to a smaller crop in 2000 relative to the CCC treated trees.
2. CCC may have a residual effect, with product sprayed in the 1999 season having an effect on the 2000 crop. This effect has already been documented in CCC trials with pear trees. It remains to be proven that a similar effect is occurring in avocado orchards. Results from the 2001 season may corroborate this.

In Figures 5 – 7 the effect of the growth inhibitors on average fruit size is examined. Figures 5 and 6 show the data for 1999 and 2000 respectively, while Figure 7 is a comparison of the two years. A comparison of the pruned and unpruned controls, shows that in both years fruit size was dramatically improved by pruning alone. This increase in fruit size was statistically significant in both years. It can also be seen that the use of growth inhibitors both alone and in conjunction with pruning increases fruit size. Again, these increases are significant.

Another noticeable result is the overall decline in fruit size from 1999 to 2000, regardless of treatment. This can be attributed to the increase in crop load on these trees. This reduction reduced the average fruit size in untreated trees to a count 22, of which 40% of the fruit was undersized (count 24 or smaller). In contrast, the best treatment provided an average fruit size of 16 with only 15% of the fruit undersized (Figure 8). It can thus be seen that growth

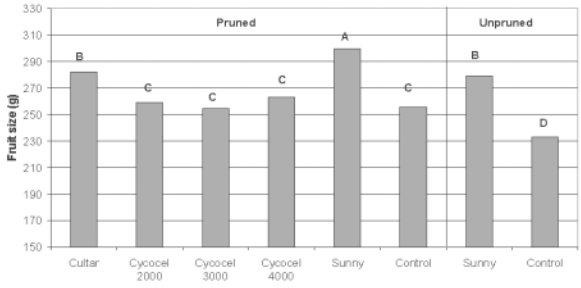

Figure 5 Effect of pruning and growth inhibitors on average fruit size in Hass 1999

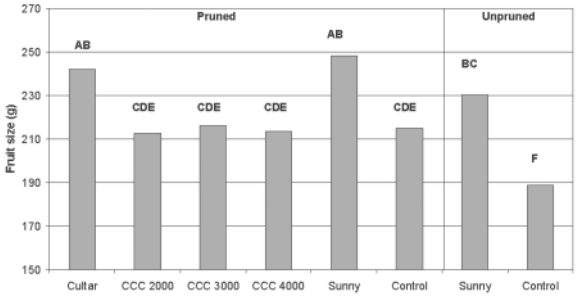

Figure 6 Effect of pruning and growth inhibitors on average fruit size in Hass 2000

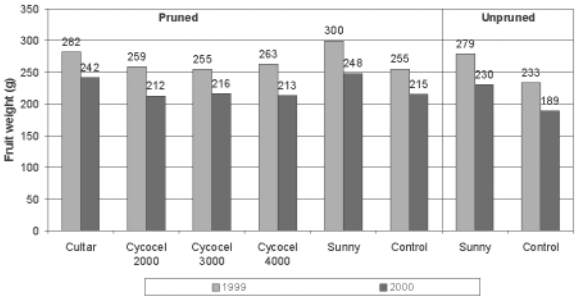

Figure 7 Hass fruit size in trees treated for two seasons with growth inhibitors

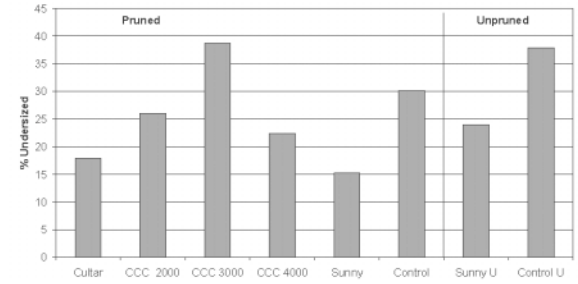

Figure 8 The effect of growth inhibitors on the percent undersized fruit in Hass 2000

inhibitors have considerable benefits with regard to improving fruit size.

CONCLUSIONS AND RECOMMENDATIONS

A number of conclusions can be drawn from the current study:

1. Mineral oils do not seem to improve the performance of the growth inhibitors. It is thus not recommended at this stage that oils be used as an adjuvant for these products.
2. The effect on yield varies according to whether the orchard is in an on-year or off-year. Growth inhibitors seem to have a more significant effect on yield in off-years, and may thus be used to increase yields where a smaller crop is expected.
3. CCC may not have been very effective in 1999 but was the best performer in 2000. This may be due to a residual effect. It is recommended that this effect be evaluated in the coming season.
4. Despite little difference in yield, all the growth inhibitors have some beneficial effect on fruit size – even where there is a larger crop. It is thus recommended that growth inhibitors be used where fruit size is expected to be smaller than required for successful marketing.
5. At present only Sunny and Cultar are registered for use in avocados. It is strongly recommended that only these products are used and that the relevant withholding period is strictly observed.

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