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Field trial using paclobutrazol foliar sprays on Hass avocado trees

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INTRODUCTION

The chemical paclobutrazol offers opportunities not previously available for tree size control (Martin, Yoshikawa & LaRue, 1987), increased yields and fruit quality improvements (Quinlan, 1980; Williams, 1982; Erez, 1984; Shearing & Jones, 1986). Effective growth inhibition and increased yields have resulted from the use of this chemical on deciduous trees (Williams, 1984) and tests on mature citrus trees have given some success (Aron, Monselise, Goren & Costo, 1985). Avocados have also generally responded favourably to treatment (Köhne & Kremer-Köhne, 1987; Köhne, 1988; Whiley, Wolstenholme & Saranah, 1988; Wolstenholme, Whiley, Saranah, Symons, Hofman & Rostron, 1988; Wolstenholme, Whiley & Saranah, 1990).

In avocados the balance between vegetative and reproductive growth can be tipped in favour of excessive growth during the spring flush, with consequent poor fruitset and low calcium content in fruit of some cultivars (Witney, Wolstenholme & Hofman, 1986). Therefore, controlling vegetative growth, especially during the early phase of fruit growth and development may improve yields by reducing competition so more assimilates are available to sustain fruit growth (Costa, Baraldi, Ramina & Masia, 1984).

This trial was undertaken to test the effect of paclobutrazol on Hass avocado trees.

MATERIALS AND METHODS

Six-year-old Hass on clonal Duke 7 root-stocks, growing in an Inanda soil possessing excellent physical properties, at Bruyns Hill, near Wartburg, Natal were used. These trees are irrigated with microjets based on tensiometer readings. The climate is warm sub-tropical with 830 mm average rainfall.

The experimental design is a randomised block with six replications (including control) of chemical applied at one of three times. Sprays of 500, 1 000 and 2 000 mgf^{1} paclobutrazol and 1% Reverseal sticker were applied at a rate of approximately 5ℓ $tree^{-1}$ using a motorised knapsack sprayer. The sprays were applied at either:

a) early spring flush elongation
b) estimated full bloom
c) three weeks after full bloom (3WAFB).

At harvest, individual tree yields were determined and fruit samples were recorded. The fruit were then placed in cold storage at 6°C for five weeks. After ripening at ambient

temperature, the fruit were cut open to assess the percentage cross-sectional area of any post-harvest physiological dis-

GROWTH PARAMETERS

orders apparent after being exposed to the atmosphere for 30 minutes.

RESULTS

Canopy area

The trees that were sprayed at 3WAFB showed the lowest increase in canopy area (Table 1).

TABLE 1 Increment in canopy area (m^2) of trees sprayed with paclobutrazol at different times (A = early spring flush elongation, B = estimated full bloom, C = 3WAFB)

Time	A	B	C
Control			
Sprayed 5,07a	5,37a	5,05a	2,87b
Mean separation within row by LSD, 5% level			

Trunk circumference

There were no significant differences between trunk circumferences of trees treated with different concentrations of paclobutrazol or at different times (data not shown). The average increase was 11,8 cm.

FRUIT

Shape

Fruit shape was determined as ratio of length: diameter (Table 2). Fruit from treated trees (1,30) were significantly rounder than control fruit (1,26) due to an increased diameter (P>0,001). Length was not affected by the paclobutrazol treatments.

TABLE 2 Fruit shape measured as length: diameter when treated with paclobutrazol at one of three different times (A = early spring flush elongation; B = estimated fullbloom; C = 3WAFB)

Control	A	B	C
1,30c	1,25a	1,26ab	1,28bc
Mean separation within row by LSD, 5% level			

Yield

Although the yields were not significantly different, there were some interesting trends in the data (Table 3):

a) At each time, the highest yield corresponded to the highest concentration of chemical applied.

b) Time A was the only time that yields appeared generally higher than the control.

Undersized fruit

The mass of undersized fruit present at the time of harvest was significantly reduced (P= 0,05) in the treated trees (7,15 kg/tree $-^{1}$) compared to the control (4,76 kg/tree-^{1}). Although non-significant, the highest concentration appeared to have the lowest mass of undersized fruit.

TABLE 3 Yield (kg/tree^{-1}) of Hass avocado trees sprayed with four concentrations of paclobutrazol (0 500, 1 000 and 2 000 mgℓ^{-1}) at one of three times A = early spring flush elongation, B = estimated full bloom, C = 3WAFB(

Time	A	B	C
Control 125,6			
Concentration			
500	133,8	117,5	120,0
1 000	120,3	115,1	125,4
2 000	136,1	124,0	128,5
($\bar{x}$)	130,1	118,9	124,6

Post-harvest physiological disorders

For all disorders evaluated viz, vascular browing, grey pulp and pulp spot, there was no significant incidence, with pulp spot being entirely absent (data not shown).

DISCUSSION AND CONCLUSIONS

Sprays applied 3WAFB may have effectively controlled the increment in mean canopy area due to a greater surface area available for chemical absorption via longer succulent shoots and more young leaves than earlier sprays. Furthermore the greater uptake of chemical may have provided a more lasting effect in the plants.

Unlike the situation observed in non-bearing potted Hass avocado trees (Symons, Hofman & Wolstenholme, 1989) the trunk circumference was unaffected, possibly because the assimilates were diverted preferentially to the fruit.

The rounder fruit shape determined may result from cells enlarging more radially than longitudinally, as occurred in peach root tips (Williamson, Costón & Grimes, 1986). Since fruit length remained constant, the increase in diameter could mean a larger fruit was produced; a possible advantage for Hass, which tends to have a small fruit problem in older bearing trees. This effect is possibly reflected in the marginally higher yields produced by trees treated with the high rate of paclobutrazol. However, the primary cause for this observation may be that at 2000 $mg\ell^{-1}$ the growth check was sufficient to divert enough assimilates into the reproductive effort.

The success of the early spray to produce yields exceeding the control may be due to the chemical being applied before the flowers were open. Quite possibly the later sprays interfered with the flowering/fruitset process either directly through phytotoxicity or from mechanical injury to the flowers and/or fruitlets, incurred by the blast of spray received from the motorised knapsack sprayer during application.

Hass fruit quality, not typically problematic, remained unaffected by paclobutrazol application. These fruit normally contain sufficient calcium, which seems to be linked to fruit storage disorders (Bangerth, 1979).

Unfortunately, the generally high tree-to-tree variability encountered detracted from the significance of some very interesting trends. This problem could be alleviated by conducting the trial over a longer period and/or by increasing the replications. Whiley *et al* (pers comm), have shown significant yield increases in vigorous trees when data were collected over at least two seasons.

Yield increases using paclobutrazol foliar sprays applied at early spring flush elongation on avocados have been reported from various parts of the world and indications are that the same effect may be achieved in Natal. If this increased yield takes the form of larger fruit it may well be worthwhile to consider timed foliar sprays as a supplementary management option on Hass trees. However, these results require further evaluation and attention should be paid to fruit size.

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