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Vegetative growth and fruit retention in avocado as affected by a new plant growth regulator (Paclobutrazol)

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SYNOPSIS
The spring growth flush on branches of avocado trees (Fuerte) treated with paclobutrazol was significantly reduced using either a foliar application (0,4 per cent ai) or an injection (1,0 per cent ai dissolved in methanol). Both methods of application of paclobutrazol increased fruit retention.

INTRODUCTION

Avocado trees grown in the warm and humid Tzaneen area tend to grow very vigorously, especially since most commercial orchards have been cured of Phytophthora root rot. In the avocado the balance between vegetative and reproductive growth is easily tipped in favour of excessive vegetative growth during the spring growth flush, especially in Fuerte, with consequent poor fruit-set and low calcium content in the fruit (Witney, Wolstenholme & Hofman, 1986). The calcium content plays an important role in pulpspot susceptibility, a post-harvest physiological disorder commonly found in Fuerte (Ginsburg, 1985). Now that the fears of root rot have somewhat abated due to the availability of effective chemical control methods, reduced tree vigour should be stressed. This would not only increase fruit calcium content, but also provide for earlier orchard returns in young orchards by favouring greater allocation of the tree's resources to fruiting. It would also delay the inevitable tree removal associated with high density plantings (Witney, 1985). Furthermore, orchard management practices which reduce the spring flush of avocado may also improve yields and reduce biennial bearing (Scholefield, Sedgley & Alexander, 1985). A field trial was therefore conducted to test the potential use of the new growth retardant paclobutrazol on Fuerte avocado trees.

MATERIALS AND METHODS

Plant material

Nineteen Fuerte trees grafted onto Duke seedling rootstocks were selected for uniformity before four branches per tree were marked in spring 1985. The orchard from which the trees were chosen was planted in 1975 at a density of 277 trees per hectare but every second tree was removed in 1984 to prevent crowding. The experiment was carried out in a commercial orchard at Westfalia Estate, situated in the North-Eastern Transvaal (latitude 24°S). This is a summer-rainfall area (average 1 300 mm per year) with deep lateritic clay soils. The orchard is irrigated by microjet systems using tensiometers, *ie* replenishment of soil moisture to field capacity when soil moisture tension reaches 50-60 kPa.

Treatments
The growth regulator paclobutrazol [PP-333 or (2RS,3RS)-1-(4-chlorophenyl)-4,4-dimethyl-2-(1,2,4-triazol-1-yl)pentan-3-ol] was applied to the marked branches of the Fuerte trees at full bloom using two methods of application, *viz* spray and injection. Spraying onto the foliage was carried out with a knapsack sprayer (CP 3, Mark 2); the branches were sprayed until run-off. Syringes of 5 ml capacity containing 1 mf fluid were used for the injections; the injection method being basically the same as that described by Darvas, Toerien & Milne (1984). On each tree four branches were treated. Paclobutrazol was applied to one branch as a foliar spray at a concentration of 0,4 per cent ai, the control branch was sprayed with water. One branch was injected with paclobutrazol (1,0 per cent ai) dissolved in methanol, the control branch for this treatment was injected with methanol only. Date of application was September 18, 1985.

Shoot growth
After treatment the increase in vegetative growth (flush) of the apical indeterminate inflorescence of every treated branch was measured 7, 19, 36, 51, 64, 77, 92, 106, 120, 134, 148 and 162 days after treatment until flushing had virtually stopped at the end of the 1985/86 growing season.

Fruit retention
The number of fruit remaining at the apical indeterminate inflorescence of every treated branch was counted at the same intervals as mentioned above for the shoot growth measurements, leaving out the first two dates.

Statistics
A co-variance analysis was conducted for the data obtained from the flush measurements. The adjusted means were compared according to Wishart (Steel & Torrie, 1960). Fruit retention data were analysed according to the Friedman test (Zöfel, 1985).

RESULTS
In the Tzaneen area vegetative growth of avocado trees is normally most active in September and October, with heavy fruit drop occurring from October to December.

Shoot growth
Flush increase on Fuerte branches treated with paclobutrazol in September was significantly reduced using either a foliar spray or a methanol based injection (Figures 1 and 2). Leaves on treated branches appeared to be darker green in colour and slightly curled.

The total flush increase for the period monitored (September 1985 - February 1986) amounted to 40,1 mm in the branches sprayed with paclobutrazol (control: 70,2 mm) and 26,6 mm in the branches injected with paclobutrazol (control: 75,1 mm). There was no significant difference between the two paclobutrazol treatments while both spray and injection of paclobutrazol, differed significantly from their control (P = 0,05).

Fruit retention

During the first four months after application, heavy fruit drop occurred in all treatments; thereafter fruits remained on the branches until harvest in March (Figure 3). Fruit retention on the branches treated with paclobutrazol differed significantly (P=0,01) from that on the control branches. However, there was no significant difference in fruit retention between the branches sprayed and the ones injected with paclobutrazol or between the branches sprayed with water and those injected with methanol.

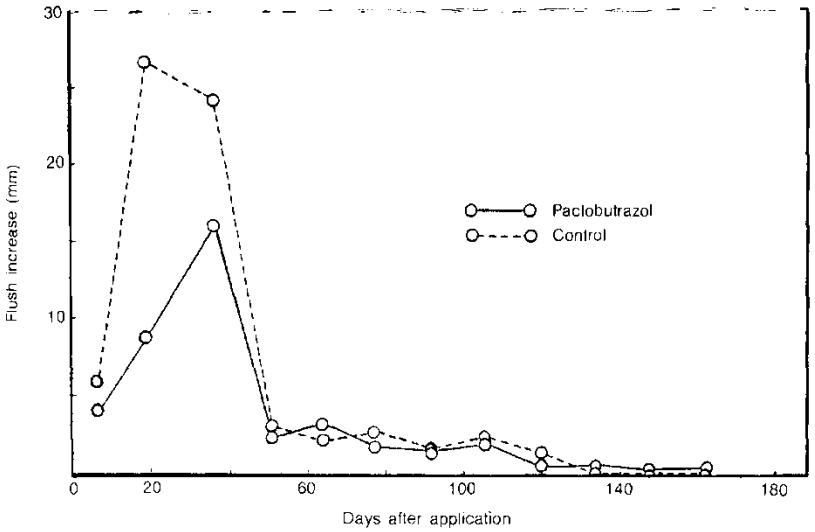

Fig 1 Flush increase of Fuerte branches sprayed with paclobutrazol (0,4 per cent ai) and of branches sprayed with water only (*ie* control). Nineteen replicates per mean.

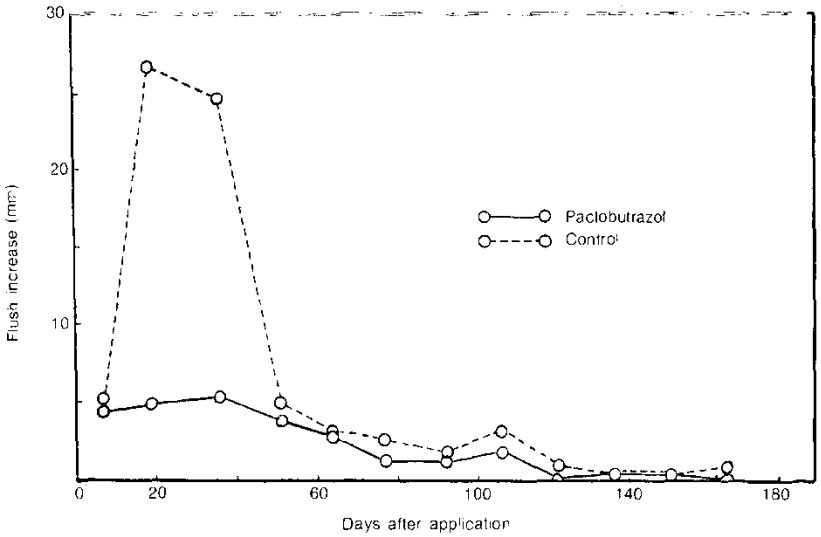

Fig 2 Flush increase of Fuerte branches injected with paclobutrazol (1,0 per cent ai dissolved in methanol) and of branches injected with methanol only (*ie* control). Nineteen replicates per mean.

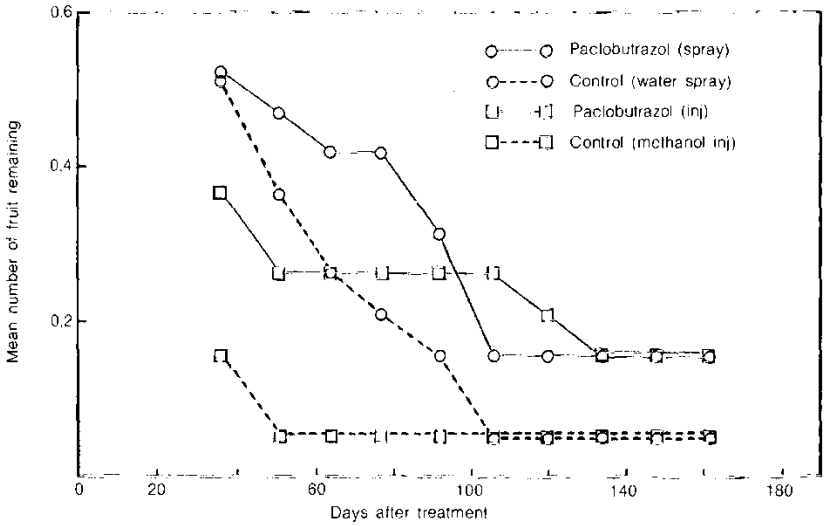

Fig 3 Fruit retention on Fuerte branches in response to paclobutrazol spray (0,4 per cent ai) or injection (1,0 per cent ai dissolved in methanol). Nineteen replicates per mean.

DISCUSSION

In this trial, shoot length of avocado branches (Fuerte) treated with paclobutrazol was significantly reduced due to shortening of the internodes. On the branches in which vegetative growth was retarded, more fruit was retained. The results clearly indicate that shoot growth during the early part of the season competes with the retention of fruit, a conclusion drawn also by Biran (1979).

By using growth regulators such as paclobutrazol, vegetative growth can be reduced while fruit retention may increase. In established orchards application of paclobutrazol could delay crowding whereby tree removal is postponed and production per hectare increased.

Further work is necessary to determine the optimum rates and methods of application of paclobutrazol on different tree ages and cultivars and to determine long-term effects (eg influence on alternate bearing). The effect of paclobutrazol on fruit quality and shelf life must also be investigated, as Greene (1986) found retarded fruit ripening in apples due to increased calcium content in the fruit following paclobutrazol treatment.

An integrated approach combining horticultural practices, such as tree training and chemical growth control, could play a useful role in the management of future high density avocado orchards.

ACKNOWLEDGEMENTS

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