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Spring vegetative flush removal: The effect on yield, size, fruit mineral composition and quality

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INTRODUCTION

The physiological problems associated with the long distance transport of avocados at about 5,5°C have been extensively discussed and reviewed in recent years (Cutting *et al* 1988; Bower and Cutting, 1988; Cutting and Bower, 1989; Cutting *et al,* 1990). Bower (1985) found that avocado fruits with a low Ca level had a greater potential for physiological disorders and poor post-harvest quality. Whitney *et al,* (1986) found that avocado fruits on trees with reduced vegetative vigour accumulated more calcium. Investigating the theory of dominance phenomena (Bangerth, 1989), a positive relationship between vigour, basipetal indole-3-acetic acid (IAA) export and Ca allocation was shown in avocado (Cutting & Bower, 1989). The same study showed actively growing vegetative structures to be larger exporters of IAA and consequently stronger accumulators of Ca. In this paper the authors report upon the early results of a field trial to reduce vegetative vigour and the effect of these manipulations on some fruit varíates in Hass.

MATERIALS AND METHODS

A vegetative flush pruning experiment was carried out using 4-year-old (in 1988) Mass trees on a farm in the Bushbuck Ridge area of the Eastern Transvaal. The orchard was on an east facing slope and not irrigated. All the trees were in a healthy state and little *Phytophthora* pressure was evident. There was only one replication per treatment and four trees per replication.

The vegetative flush which emerged from the centre of the flower panicle was removed either once at 50% flowering or weekly for six weeks from 50% flowering. A paclobutrazol injection treatment without vegetative flush removal and a control were also included. The paclobutrazol was injected 2-3 weeks prior to 50% flowering. Fruit were harvested during July 1989 when legally mature.

The effect of the different treatments on fruit set, final fruit size and yield were determined. Trunk non-structural carbohydrate reserves were determined using an enzyme digestion method and a colourimetric quantitation method (Sigma 510 kit). All values are presented as glucose equivalents. After harvest fruit from each tree were stored at 5,5°C for four weeks after which the fruits were allowed to ripen. The fruits were then assessed for internal quality and a sample was then freeze-dried and stored

for PPO and mineral analyses. Fruit mineral analysis was done by a commercial analysis laboratory. PPO activity was determined by the method of Van Lelyveld & Bower (1984).

TABLE 1 Effect of vegetative pruning on various parameters in Hass avocado on a per tree basis

Parameter	Control	PP-333	Prune (1)	Prune (6)
Fruit set	472	440	499	654
Starch content (30:11:88)	9,9%	9,5%	9,5%	9,2%
Yield (kg)	98,5	100,25	98,0	89,25
av. fruit mass (g)	213	212	218	241
Fruit no.	460	438	447	376

TABLE 2 Fruit mineral composition of mature Hass avocado fruit as % dry mass

Treatment	P	K	Ca	Mg	$\frac{Ca + Mg}{K}$
Control	0,092	1,652	0,028	0,082	66
Single prune	0,116	1,744	0,028	0,088	66
6-week-prune	0,134	1,744	0,033	0,092	72
PP-333	0,106	1,716	0,040	0,028	93

TABLE 3 Fruit mineral composition of mature Hass avocado fruit expressed as g per 100 g dry mass

Treatment	P	K	Ca	Mg
Control	0,19	3,51	0,059	0,175
Single prune	0,25	3,79	0,061	0,192
6-week-prune	0,32	4,19	0,080	0,222
PP-333	0,22	3,63	0,084	0,254

TABLE 4 Relationship between fruit mineral content and PPO (potential post-harvest quality)

Mineral	r value
Ca	0,6
K	– 0,3
Mg	0,8
Ca + Mg/K	0,92

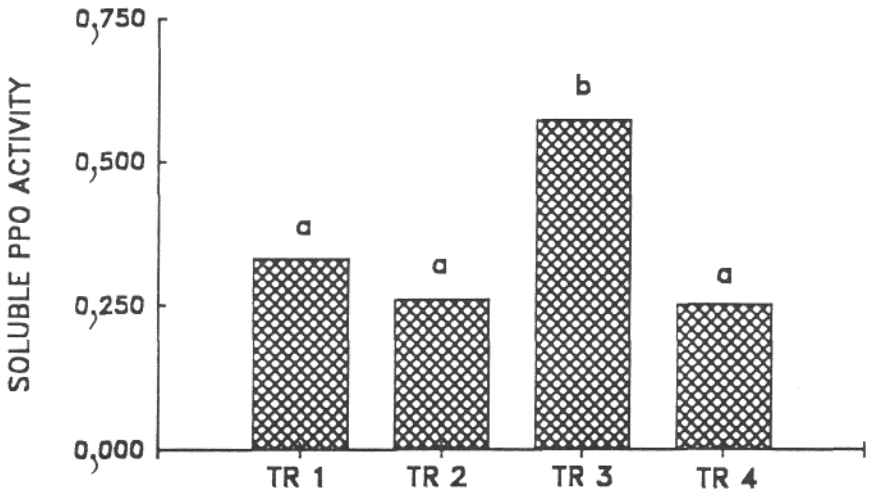

Fig 1 Soluble PPO activity at full softness (eating ripeness) of Hass fruit after storage from a single prune at 50% flowering (TR 1), pruned weekly for six weeks from 50% flowering (TR 2), PP-333 injected three weeks prior to 50% flowering (TR 3) and untreated control trees (TR 4). Values followed by the same letter do not differ significantly at P = 0,01.

RESULTS AND DISCUSSION

Effect of vegetative flush removal on fruit set, carbohydrate status and yield

Vegetative flush removal resulted in increased initial fruit set as well as an increase in the late January fruit drop (Table 1). Final yields (in kg) were very similar for all four treatments. Fruit from the six-week-pruned treatment were 13% larger than control fruit (an average increase of 28 g). The different treatments had no effect on non-structural starch content.

The effects of the different treatments on a second and preferably a third season need to be determined before the programme's benefits or otherwise can be assessed. The early benefits in fruit size in this poor sized cultivar and the chemical free manner in which this was achieved indicate some promise for this type of research. The negative aspects of a heavy late summer fruit drop and fruit with sunburn need to be investigated.

Effect of vegetative flush removal on fruit mineral composition and post-harvest quality

Pruning had an effect on the mineral composition of the fruit (Table 2). Pruning increased the concentration of P, K, Ca and Mg. Generally the fruits from the six week pruning treatment showed more mineral accumulation. However, when expressed on a mass per fruit basis, the treatments that most severely reduced vegetative vigour showed the greatest mineral accumulation (Table 3).

There were no visual symptoms of any internal physiological problems. This is to be expected as the fruits were properly stored and Hass only develops physiological problems when the fruits are stored outside their optimum storage requirements.

Therefore all reference to quality is actually quality potential as determined using PPO activity (Bower & Cutting, 1988). The different vegetative vigours that resulted from the different treatments had an effect on fruit PPO activity levels (Figure 1).

An investigation of the relationship between mineral composition and PPO activity indicated that high Mg levels and a high Ca + Mg/K ratio were positively related to a high PPO activity (Table 4). There were no significant differences between the control and the two pruned treatments, but the use of a chemical growth inhibitor markedly increased the potential for poor physiological post-harvest quality. The physical manipulations did not reduce post-harvest quality despite the size increase and did not excessively disrupt the mineral ratios as did the chemical treatment with a resultant drop in post-harvest quality potential. The effects of the treatments on return bloom and alternate bearing will be reported upon in the future.

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