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The Effect of Vegetative Pruning on Fruit Mineral Composition and Postharvest Quality in 'Hass' Avocado

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Abstract. **The effect of reducing vegetative competition on mineral allocation in avocado was investigated. Avocado trees were either chemically treated with a growth retardant or the competing vegetative flush removed by hand either once at 50% flowering or continuously for six weeks from 50% flowering. The results were then compared to an untreated control. Final yields were similar for all four treatments. Fruit size was increased by the continuous pruning. None of the treatments had any effect on starch reserves. Vegetative pruning increased the concentration of Ca, Mg, K and P. Those treatments which reduced vegetative vigor showed increased mineral accumulation. Removal of vegetative flush did not increase PPO activity.**

The physiological postharvest problems associated with long distance transport of avocados at temperatures of about 5.5C have been extensively discussed and reviewed in recent years (Bower and Cutting, 1988; Cutting *et al.,* 1988; Cutting and Bower, 1989; Cutting *et al.,* 1990). Bower (1985) found that avocado fruit with a low calcium concentration had a greater potential for physiological disorders and poor postharvest quality. Witney *et al.* (1990) showed that avocado fruits on trees with reduced vegetative vigor accumulated more calcium than fruit from vegetatively vigorous trees. Investigating the theory of dominance phenomena proposed by Bangerth, (1989), a positive relationship between vigor, the growth regulator in-dole-3-acetic acid (IAA) export and calcium allocation was shown in avocado (Cutting and Bower, 1989). This study showed actively growing vegetative structures to be larger exporters of IAA and consequently stronger accumulators of calcium.

In this paper the early results of a field trial to reduce vegetative vigor and the effect of these manipulations on fruit size, mineral composition and the activity of the browning enzyme polyphenol oxidase (PPO) are reported.

Materials and Methods

A vegetative flush pruning experiment was carried out using four-year-old 'Hass' trees on a farm in the Eastern Transvaal escarpment of South Africa. The orchard was located on an east-facing slope and was not irrigated. The trees appeared to be healthy with little *Phytophthora* pressure evident. There were four trees per treatment in a single replication.

The vegetative flush which emerged from the center of the flower panicle was removed either once at 50% flowering or weekly for six weeks from 50% flowering. A paclobutrazol injection treatment (PP-333) without vegetative flush removal and a control were also included. The paclobutrazol was injected 2 to 3 weeks prior to 50% flowering. Fruit were harvested the following July when legally mature.

The effect of the different treatments on final fruit size and yield were determined. Non-structural trunk carbohydrate reserves were determined using an enzyme digestion method and a colorimetric quantitation method (Sigma 501 kit). All values are presented as glucose equivalents. After harvest, fruit from each tree were stored at 5.5C 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 analysis. Fruit mineral analysis were done by a commercial laboratory. PPO activity was determined by the method of van Lelyveld and Bower (1984).

Results and Discussion.

Effect of vegetative flush removal on fruit size, carbohydrate status and yield. Vegetative flush removal resulted in an initial fruit set as well as an increase in the summer fruit drop (results not presented here). The final yields (in kg per tree) were very similar for all four treatments (Table 1). Fruit from the six-week continuously pruned treatment were an average of 13% larger than control fruit (an average increase of 28 g). The different treatments had no effect on non-structural starch treatment.

The effects of different treatments on a second, third and preferably a fourth season need to be determined before the program's benefits or otherwise can be assessed. Unfortunately the second season's crop was lost due to drought and hail and no data was forthcoming. 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. However, 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 postharvest quality. Pruning had an effect on the mineral composition of the fruit (Table 2). Pruning increased the concentration of P, K, Ca and Mg in the fruit. 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 vigor showed the greatest mineral accumulation (Table 3).

There were no visual symptoms of any internal physiological problems. This is to be expected as all the fruits were properly stored and 'Hass' only develops physiological problems when the fruits are stored outside their optimum storage requirement. Therefore all reference to quality is actually quality potential as determined using PPO activity (Bower and Cutting, 1988). The different vegetative vigors 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 pruned treatments, but the use of chemical growth inhibitor markedly increased the potential for poor physiological postharvest quality. The physical manipulations did not reduce postharvest quality potential despite the increased size and did not excessively disrupt the mineral ratios as did the chemical treatment with a resultant drop in postharvest quality potential. The effect of the treatments on return bloom and alternate bearing are being investigated.

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Table 1. Effect of vegetative flush pruning on some parameters in 'Hass' avocado on a per tree basis.

	Treatment			
Parameter	Control	PP-333	Prune (1)[z]	Prune (6)[y]
Starch content (1 1-30-1988)	9.9%	9.5%	9.5%	9.2%
Yield (kg)	98.5	100.3	98.0	89.3
Average fruit mass (g)	213	212	218	241
Number of fruit	460	438	447	376

[z] Trees pruned once at 50% flowering.
[y] Trees pruned weekly for 6 weeks from 50% flowering.

Table 2. Fruit mineral composition of mature 'Hass' avocado fruit as % of dry mass.

	Treatment				
Parameter	P	K	Ca	Mg	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			
Parameter	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 polyphenol oxidase activity (postharvest quality potential).

Mineral	r value
Ca	0.6
K	-0.3
Mg	0.8
Ca + Mg/K	0.92

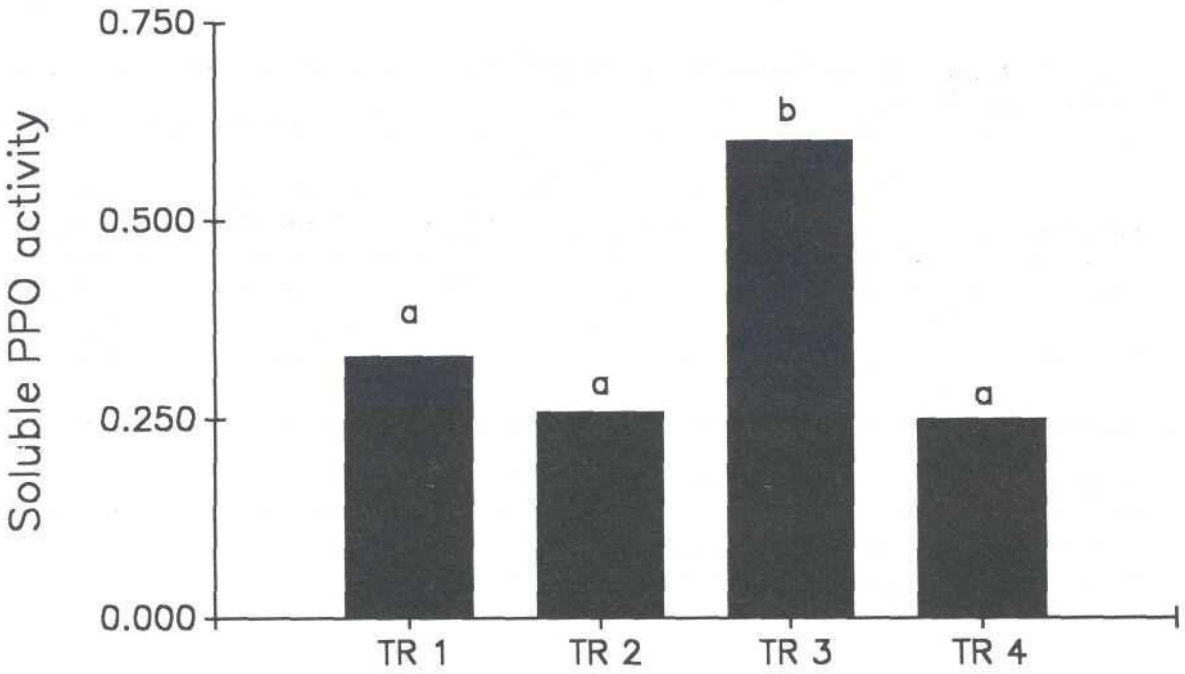

Fig. 1. Soluble PPO activity at full softness (eating ripeness) of 'Hass' avocado fruit after storage from a single prune at 50% flowering (TR 1), pruned weekly for six weeks from 50% flowering (TR 2), PP-333 injected three weeks prior to 50% flowering (TR 3) and untreated control trees (TR 4). Values followed by the same letter do not differ significantly at $P \leq 0.01$.