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Evaluation of systemic fungicides as pre-harvest treatments of avocados

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ABSTRACT

Various systemic fungicides and a non-systemic fungicide (copper ammonium carbonate) were evaluated as possible alternatives to copper-oxychloride and benomyl, for control of pre- and postharvest diseases of avocados. Foliar applications of cyproconazole, flusilazol or copper ammonium carbonate were as effective in controlling Cercospora spot as copper-oxychloride and benomyl, but were less effective in controlling sooty blotch. Visible spray residues were significantly lower where the systemic compounds cyproconazole, flusilazol, triadimenol and the non-systemic fungicide (copper ammonium carbonate), were applied in the final January spray round, instead of copper-oxychloride.

INTRODUCTION

Avocados are susceptible to numerous diseases. Cercospora spot caused by *Pseudocercospora purpurea* (Darvas, 1982) and sooty blotch caused by an *Akaropeltopsis* sp (Theron *et al,* 1981), are important preharvest diseases. The major postharvest diseases are stem-end rot, caused by any of 10 organisms, with *Thyronectria pseudotricha* the most important (Darvas, 1978); anthracnose caused by *Colletotrichum gloeosporioides* (Kotzé, 1978) and the *Dothiorella/Colktotrichum* rot complex (Darvas, 1978). In all the above instances, infection of fruit takes place in the orchard prior to harvest. Pre-harvest applications of fungicides are therefore a feasible means of partially controlling these diseases.

Copper-oxychloride and benomyl are currently registered for the control of preharvest diseases of avocados in South Africa (Vermeulen *et al,* 1990). As yet, no fungicides have been registered for the pre-harvest control of postharvest diseases. However, preharvest applications of copper-oxychloride and benomyl are reported to control these diseases to some degree (Darvas, 1981; *et al,* 1981; Kotzé *et al,* 1982; Labuschagne & Rowell, 1983 and Lonsdale & Kotzé, 1989). The disadvantages in using copper-oxychloride and benomyl are: Firstly, copper-oxychloride leaves unsightly residues on the fruit, which have to be removed in the packhouse prior to packing. It is estimated that the removal process slows the packing tempo by as much as 50%, according to Dr J J Bezuidenhout (personal communication, 1991). Secondly, Darvas (1982) reported tolerance of *Pseudocercospora purpurea* to benomyl.

The purpose of this study was to screen various new systemic fungicides as well as a non-systemic fungicide (copper ammonium carbonate), as possible replacements for pre-harvest copper-oxychloride and benomyl sprays.

A randomised block design was used, with five single tree replicates per treatment. A high volume applicator with hand lances was used to apply the fungicide sprays. Fruit were evaluated in the first week of April 1991 for the incidence of pre-harvest diseases.

Fruit was also evaluated for the presence of visible spray residues at time of picking on a 0-3 scale, where:

MATERIALS AND METHODS

Three trials were carried out during the 1990/91 season at Westfalia Estate on 10- and 15- year- old Fuerte trees. The chemicals used in the trials were:

– Benomyl	50%	WG
– Copper-oxychloride	85%	WP
– Copper ammonium carbonate	66,1%	SL
– Cyproconazole	10%	SL
– Flusilazol	10%	EC
– Triadimenol	1%	GR

A randomised block design was used, with five single tree replicates per treatment. A high volume applicator with hand lances was used to apply the fungicide sprays. Fruit were evaluated in the first week of April 1991 for the incidence of pre-harvest diseases.

Cercospora spot was rated on a 0-3 scale, where:

0=Clean

1=1-5 spots

2=6-10 spots

3= >10 spots

and sooty blotch was rated on a 4-0 scale, where:

0=Clean

1=1-10% infected

2=11-25% infected

3=26-50% infected

4= >50% infected

TABLE 1 TRIAL A

Treatment	Rate (g ai/100 ℓ)	Time of Application
Control	–	–
Cu-oxychloride	255 g	23/10/90
Cu-oxychloride	255 g	22/11/90
Cu-oxychloride	255 g	11/01/91
Cu-oxychloride	255 g	23/10/90
Cu-oxychloride	255 g	22/11/90
Benomyl	25 g	11/01/91
Cu-oxychloride	255 g	23/10/90
Cu-oxychloride	255 g	22/11/90
Flusilazol	2 g	11/01/91
Cu-oxychloride	255 g	23/10/90
Cu-oxychloride	255 g	22/11/90
Cyproconazole	4 g	11/01/91
Cu-oxychloride	255 g	23/10/90
Cu-oxychloride	255 g	22/11/90
Triadimenol*	0,04 g/m² drip area	11/01/91
Flusilazol	2 g	23/10/90
Cu-oxychloride	255 g	22/11/90
Cu-oxychloride	255 g	11/01/91
Cyproconazole	4 g	23/10/90
Cu-oxychloride	255 g	22/11/90
Cu-oxychloride	255 g	11/01/91
Triadimenol*	0,04 g/m² drip area	23/10/90
Cu-oxychloride	255 g	22/11/90
Cu-oxychloride	255 g	11/01/91

* Soil Applied

TABLE 2 TRIAL B

Treatment	Rate (g ai/100 ℓ)	Time of Application
Control (untreated)	–	–
Cu-oxychloride	255 g	23/10/90
Cu-oxychloride	255 g	22/11/90
Cu-oxychloride	255 g	11/01/91
Cu-ammonium carbonate	330,5 g	23/10/90
Cu-ammonium carbonate	330,5 g	22/11/90
Cu-ammonium carbonate	330,5 g	11/01/91

TABLE 3 TRIAL C

Treatment	Rate (g ai/100 ℓ)	Time of Application
Control (untreated)	–	–
Cu-oxychloride Cu-oxychloride	255 g 255 g	19/11/90 21/01/91
Cu-ammonium carbonate Cu-ammonium carbonate	330,5 g 330,5 g	19/11/90 21/01/91
Cu-ammonium carbonate Cu-ammonium carbonate	198,3 g 198,3 g	19/11/90 21/01/91
Cu-oxychloride Cu-ammonium carbonate	255 g 330,5 g	19/11/90 21/01/91

TABLE 4 Cost of applying various fungicides on avocado trees

Product	Price kg/ℓ	Rate (g ai/100 ℓ)	* Cost/tree
Cu-oxychloride	R 4,90 – R 8,00	255 g	R1,47 – R2,40
Benomyl	R 89,00	25 g	R4,45
Copper ammonium carbonate	R 12,60	330,5 g 198,3 g	R6,30 R3,78
Flusilazol	R130,00	2 g	R1,04
Cyproconazole	R138,00	2 g 4 g	R2,78 R5,56
Triadimenol	R 8,52	0,4 g/m² drip area	R0,68/20 m²

*100 litres of spray mix/tree, except for Triadimenol.

Fruit was also evaluated for the presence of visible spray residues at time of picking on a 0-3 scale, where:

0=Clean (no visible spray residues)

1=Slight (<10% covered)

2=Moderate (11-50% covered)

3=Heavy (>50% covered)

30-35 fruit per tree were packed into cartons and stored for 28 days at 6,5° C to simulate sea export. Fruit were then allowed to ripen at 18° C. Once the fruit reached the eat ripe stage, it was evaluated for the incidence of postharvest diseases on a 0-10 scale, as used by Darvas (1982).

Results are expressed in terms of percentage clean fruit. Data were statistically analysed, by analysis of variance. Duncan's multiple range test was used to determine mean separation at P = 0,05.

RESULTS AND DISCUSSION

In Figure 1, it can be seen that two rounds of copper-oxychloride alternated with a round of cyproconazole or flusilazol, was as effective in controlling Cercospora spot as three rounds of copper-oxychloride. Visible spray residues were significantly lower where systemic fungicides were applied in the final spray round, instead of copper-oxychloride (Figure 3).

Soil-applied triadimenol, applied in the final January round, preceded with an October and November copper round, was significantly less effective in controlling Cercospora spot than three rounds of copper-oxychloride (Figure 1). This is probably due to the time needed for the product to be taken up by the roots and transported to the fruit, since there was a significant increase in Cercospora spot control when this fungicide was applied in October (Figure 1).

The non-systemic fungicide, copper ammonium carbonate, effectively controlled Cercospora spot (Figures 4 & 6) without leaving any visible spray residues (Figure 8). This fungicide is, however, expensive to apply, at a cost of R6,00 per tree versus R1,47 per tree for copper-oxychloride (Table 4).

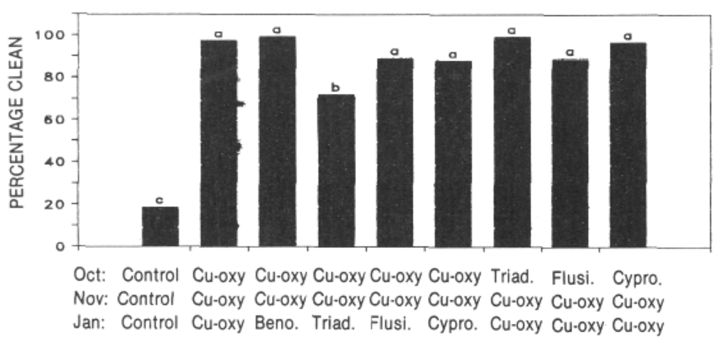

Fig 1 Effect of systemic fungicide treatments on Cercospora spot. Bars not sharing a common letter are significantly different (P = 0,05).

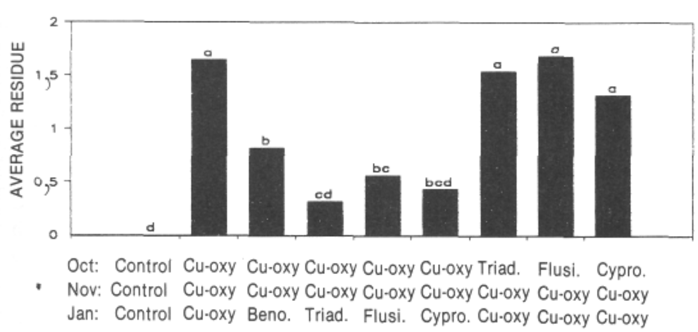

Fig 3 Average visible residue on fruit after pre-harvest treatments with various fungicides. Bars not sharing a common letter are significantly different (P = 0,05).

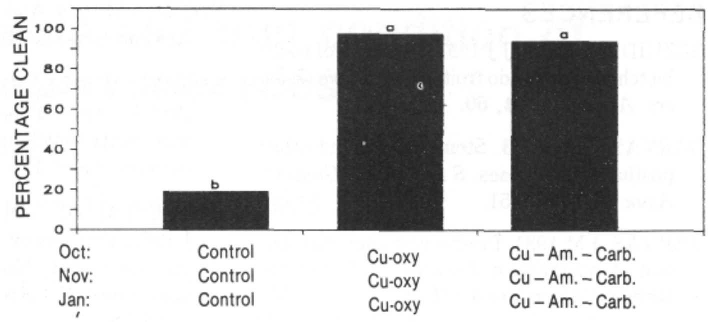

Fig 4 The effect of copper ammonium carbonate (330,5 g ai/100 ℓ) on Cercospora spot. Bars not sharing a common letter are significantly different (P = 0,05).

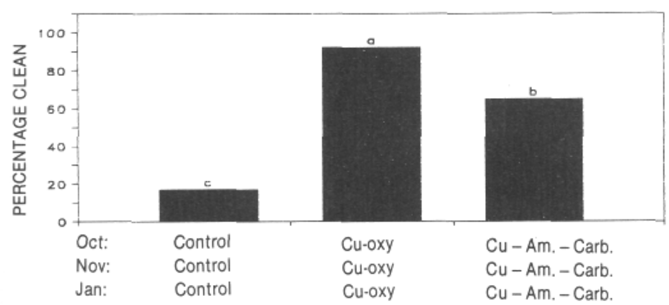

Fig 5 The effect of copper ammonium carbonate (330,5 g ai/100 ℓ) on Sooty blotch. Bars not sharing a common letter are significantly different (P = 0,05).

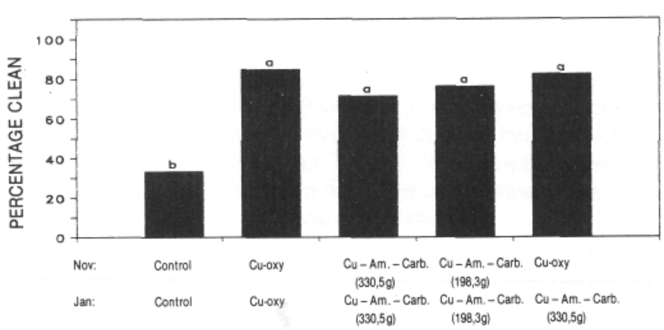

Fig 6 The effect of copper ammonium carbonate (198,3 g and 330,5 g ai/100 ℓ) on Cercospora spot. Bars not sharing a common letter are significantly different (P = 0,05).

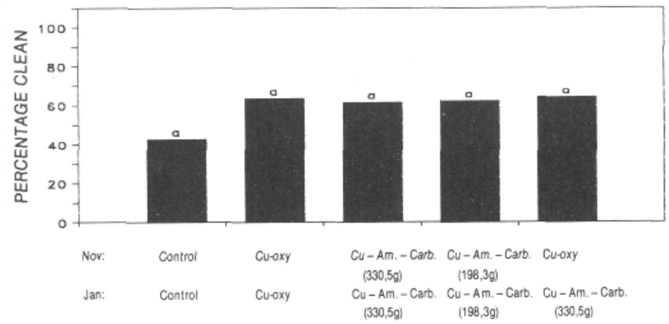

Fig 7 The effect of copper ammonium carbonate (198,3 g and 330,5 g ai/100 ℓ) on Sooty blotch. Bars not sharing a common letter are significantly different (P = 0,05).

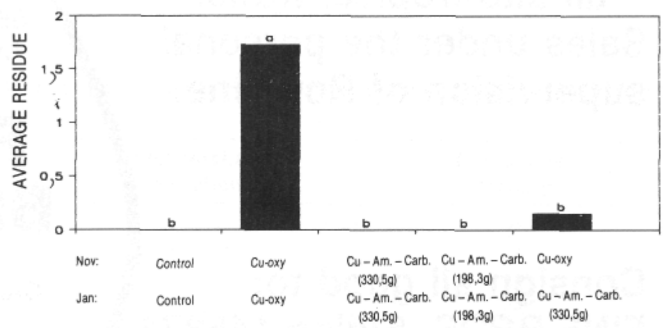

Fig 8 Average visible residue on fruit after pre-harvest treatments with copper ammonium carbonate. Bars not sharing a common letter are significantly different (P = 0,05).

All the systemic fungicides, as well as copper ammonium carbonate, were less effective than copper-oxychloride in controlling sooty blotch, especially under high disease pressure (Figures 2 and 5). Since sooty blotch can be removed in the packhouse using the chlorine process described by Bezuidenhout (1991), the importance of the pre-harvest control of this disease is questionable.

Due to a relatively low incidence of postharvest diseases in fruit obtained from these experiments, no significant differences between the various treatments and the untreated controls were obtained (data not presented). Therefore the effect of these treatments on the incidence of postharvest diseases was not established.

Future research will be aimed at optimising the timing of pre-harvest treatments, as well as carrying on with screening of these fungicides, with the aim of having them registered. At present none of the fungicides mentioned in this paper, with the exception of copper-oxychloride and benomyl, are registered for use on avocados.

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