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CONTROL OF ANTHRACNOSE ON AVOCADOS IN QUEENSLAND

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SUMMARY

Spraying from fruit set until harvest with copper fungicides at 14 and 28-day intervals controlled anthracnose (*Glomerella cingulata*) of avocado (*Persea americana*). Benomyl plus Agral 60[R] at 14-day intervals was also effective. Propineb and captan were ineffective. The surfactant Triton B1956[R] added to copper oxychloride or cupric hydroxide failed to improve anthracnose control.

I. INTRODUCTION

Anthracnose caused by the fungus *Glomerella cingulata* (Stonem.) Spauld. and Schrenk var. *minor* Wr. is an important disease of avocado (*Persea americana* Mill.) in Queensland. Besides causing serious postharvest losses of fruit harvested early in the season (April–May), anthracnose lesions also develop around injuries on fruit in the field producing premature abscission. *G. cingulata* var. *minor* can infect fruit at any stage of development (Peterson 1978) and remain latent until the fruit is damaged or ripens (Binyamini and Schiffmann–Nadel 1972). Damage from fruit spotting bug *Dacus tryoni* (Froggatt) and Queensland fruit fly *Amblypelta nitida* Stal. can break the latency in green fruit (Peterson, unpublished data). The cultivar Fuerte, the most common in Queensland, flowers in September and conditions favourable for infection occur during the summer and autumn.

Chemical control of anthracnose in the field would require a coating of a protectant fungicide on the fruit from set until harvest. This may not be necessary with systemic fungicides which could penetrate the cuticle of the fruit and affect the latent fungal structures in the tissue. Copper fungicides are used in Florida to control a number of avocado diseases including anthracnose (Ruehle 1963; McMillan 1971). On mangoes copper is used in combination with other fungicides such as benomyl and the dithiocarbamates for anthracnose control (Ruehle and Ledin 1960; Conover 1965; McMillan 1972, 1973). Surfactants such as 'Nu-Film 17' and 'Triton B1956' are reported to enhance the effectiveness of copper sprays on avocado (McMillan 1970) and mango (McMillan 1972).

Field trials to evaluate fungicides for anthracnose control in Queensland were conducted during the 1972–73 and 1973–74 seasons at Palmwoods in south-east Queensland using copper oxychloride, captan, propineb, benomyl, cupric hydroxide and the surfactant 'Triton B1956'. The Palmwoods area has a high annual rainfall (1 685 mm) and as half this total falls from January to March, losses from anthracnose are severe.

II. MATERIALS AND METHODS

Six to seven-year-old Fuerte trees in a commercial orchard were used. Experiments were laid out in randomised blocks with three replications and single tree plots. Fungicides were applied with a Rega power unit with adjustable hand nozzles and 18 to 20 *l* of spray were applied to each tree.

Experiment 1 (1972–73)

The following materials were used: 50% copper oxychloride as Cuprox^{R}*; 83% propineb (zinc propylenebisdithiocarbamate) as Antracol^{R}; 50% benomyl (methyl N-(1-butylcarbamoyl-2-benzimidazole carbamate) as Benlate^{R} and non-ionic wetting agent as Agral 60^{R}. Frequency of application and fungicide concentrations are listed in table I. Spraying commenced (24 October) approximately 14 days after end of flowering and continued until 9 April. Sprays of DDT for insect control were applied by the grower at monthly intervals from October to January.

Twenty fruit, free of blemishes, were harvested from each tree on 26 April and ripened at 24 to 27°C. Fruit free of lesions and those with only one or two small lesions (1-cm diameter) at the edible ripe stage were regarded as marketable fruit.

Treatments were evaluated by comparisons of numbers of marketable fruit. Data were examined by analysis of variance after $\sqrt{x + \frac{1}{2}}$ transformation. Pairwise comparisions were made using the least significant difference (l.s.d.) procedure.

Experiment 2 (1973–74)

Two formulations of copper were used: 50% copper oxychloride as Superfine Copper Spray^{R} and 83% cupric hydroxide as Kocide 101^{R}. The surfactant Triton B1956^{R} (modified phthalic glycerol alhyd resin) was used in combination with the copper fungicides. Details of treatments are listed in table 2. Spraying commenced at flowering (18 September) and continued until 2 April. DDT was applied with the copper sprays at monthly intervals from September to January (insecticide applied alone to check trees). Spot sprays of maldison in protein hydrolysate bait were applied from January to March, 1974.

Twenty fruit, free of blemishes were harvested from each tree on 11 April. Fruit were held at 24 to 27°C for the first 6 days, then due to a malfunction in the airconditioner the temperature ranged from 16 to 27°C. Treatment comparisons of marketable fruit were made in the same way as in Experiment 1.

III. RESULTS

Experiment 1 (1972–73)

The season was wet especially during the January to March period when a number of prolonged moist periods occurred. Incidence of disease was high in fruit from unsprayed trees although incidence was variable between replications. Copper oxychloride and benomyl were the only sprays to give control (table I and figure 1).

A number of fruit were damaged by insects after January when DDT was not applied. Anthracnose lesions developed around most of the injuries on fruit not sprayed with a fungicide and premature fall was heavy. On trees sprayed with copper, few lesions developed around the injuries and fall was minimal.

* R—Registered Trade Name.

TABLE 1

INCIDENCE OF ANTHRACNOSE IN AVOCADO FRUIT AFTER VARIOUS SPRAY SCHEDULES (EXPERIMENT 1)

Treatment			*Number of Marketable Fruit	
Fungicide	Rate (g l^{-1}) (a.i.)	Spray Interval (Days)	† Trans. Means	Equiv. Means
Copper oxychloride	2·00	14	‡4·335 a	18·3
Copper oxychloride	2·00	28	3·244 ab	10·0
Benomyl + 'Agral 60' (0·25 ml l^{-1}) ..	0·50	14	3·238 ab	9·9
Propineb	1·40	14	2·623 bc	6·4
Captan	1·66	14	2·213 bc	4·4
Captan	1·66	28	2·147 bc	4·1
Nil	..	..	1·268 c	1·1
Standard error	..	..	0·749	..

* Sample of 20 fruit used.
† $\sqrt{x + \frac{1}{2}}$ transformation used.
‡ Means followed by the same letter do not differ significantly at P = 0·05.

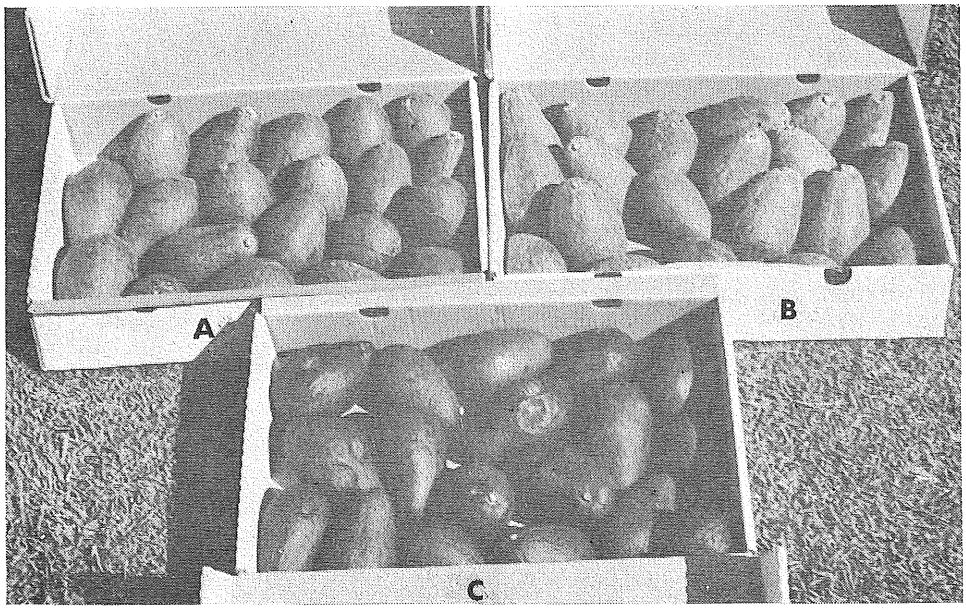

Figure 1. Avocado fruit sprayed with copper oxychloride (2·0 g l^{-1} a.i.) at 14 day intervals (A), at 28 day intervals (B) and unsprayed fruit (C) (experiment 1).

Experiment 2 (1973–74)

The weather was very wet and many periods with conditions suitable for infection occurred from December to April. Anthracnose incidence however was not as high as in the previous experiment. Copper oxychloride and cupric hydroxide gave a good control (table 2). The addition of 'Triton B1956' did not improve the effectiveness of the sprays.

Insect damage was minimal and premature fruit fall was very light.

TABLE 2

INCIDENCE OF ANTHRACNOSE IN AVOCADO FRUIT AFTER VARIOUS COPPER SPRAY SCHEDULES (EXPERIMENT 2)

Treatments			*Number of Marketable Fruit	
Chemicals Applied	Rate (g l^{-1}) (a.i.)	Spray Interval (Days)	†Trans. Means	Equiv. Means
Copper oxychloride	2·00	14	‡4·415 a	19·0
Copper oxychloride	2·00	28	4·250 ab	17·6
Copper oxychloride 'Triton B1956' (0·125 ml l^{-1})	2·00	28	3·844 ab	14·3
Copper oxychloride	1·00	14	4·023 ab	15·7
Copper oxychloride 'Triton B1956' (0·125 ml l^{-1})	1·00	14	4·020 ab	15·7
Copper oxychloride 'Triton B1956' (0·125 ml l^{-1})	1·00	28	3·574 b	12·3
Cupric hydroxide	1·66	14	4·416 a	19·0
Cupric hydroxide 'Triton B1956' (0·125 ml l^{-1})	1·66	14	4·372 a	18·6
Cupric hydroxide + 'Triton B1956' (0·125 ml l^{-1})	1·66	28	4·057 ab	16·0
Nil	..	..	2·889 c	7·8
Standard error	..	..	0·230	..

* Sample of 20 fruit used.
† $\sqrt{x + \frac{1}{2}}$ transformation used
‡ Means followed by the same letter do not differ significantly at P = 0·05.

IV. DISCUSSION

Anthracnose in ripened Fuerte avocado fruit was reduced by copper oxychloride (2·0 g l^{-1} a.i.) and cupric hydroxide (1·6 g l^{-1} a.i.) applied from fruit set until harvest during two abnormally wet seasons. Application at 14-day intervals was no better than at 28-day intervals.

The failure of 'Triton B1956' to enhance the effectiveness of copper sprays in experiment 2 is in contrast to findings of McMillan (1970, 1972). 'Triton B1956' may reduce the persistance of copper fungicides in prolonged heavy rain as occurred in January 1974 (1 075 mm). The addition of 'Agral 60' to benomyl in experiment 1 could well have had a similar effect.

The lower incidence of disease in unsprayed fruit in 1973–74 could be due to a reduction in the quantity of inoculum in the trial area. In 1972–73 the orchard was not sprayed with a fungicide whereas in 1973–74 the grower used a regular programme of copper oxychloride throughout the orchard.

The copper compounds used in these trials should be well suited for commercial use. They are long weathering which allows extended intervals between sprays. It is possible that their continued use over a number of seasons could so reduce inoculum levels within the plantation that the level of control would be better than we obtained in these trials.

V. ACKNOWLEDGEMENTS

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