EFFECT OF ERGOSTEROL BIOSYNTHESIS INHIBITOR FUNGICIDES DURING BLOSSOMING ON LEAF CURL IN NECTARINES

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SUMMARY

A field trial evaluated ergosterol biosynthesis inhibitor fungicides (EBIs), applied during blossoming period, for control of leaf curl (*Taphrina deformans*) on nectarines. Severe disease developed, with 83% of shoots on untreated trees infected. Standard fungicides (captafol and chlorothalonil) gave excellent control of the disease, but none of the EBIs tested were satisfactory. SAN 703 reduced disease to 4% of shoots infected, and propiconazole, myclobutanil and A7402 gave disease levels not significantly different from captafol. Bitertanol, triforine, hexaconazole, S3308L and flusilazole were less effective. Some EBIs, when used to control blossom blight (*Sclerotinia fructicola*) could, as a side effect, reduce leaf curl in stone fruit.

INTRODUCTION

Leaf curl, caused by the fungus *Taphrina deformans*, is a disease of peaches and nectarines that is potentially devastating both to crop yield and tree longevity. Traditionally, it has been effectively controlled by copper based fungicides applied at leaf bud movement. However, in the past five seasons, growers have been very concerned about the increasing difficulty of maintaining effective control of this disease.

Timing of fungicide application at bud movement is very critical and complete tree coverage with sprays is essential for effective results. Tate and van der Mespel (1984) demonstrated that improved control of primary infection resulted from the combined effects of leaf fall and bud movement sprays with copper fungicides. Captafol was an effective alternative, but this chemical is soon to be withdrawn from the market.

Laboratory tests (Cheah and Tate 1986) have shown that six systemic EBI fungicides can completely inhibit growth of the yeast state of *T. deformans* at 1 ppm. In a field evaluation (Tate *et al* 1987) four EBI fungicides were found to be very effective for leaf curl control. The development of an effective systemic fungicide treatment would constitute a break-through in the control of this disease.

Currently, there are two systemic EBI fungicides registered for control of blossom blight (caused by *Sclerotinia fructicola*) in stonefruit. It was hoped that these and other EBI fungicides which are effective against blossom blight could also control leaf curl when sprayed during the blossom period.

The objective of this trial was to evaluate EBI fungicides for leaf curl control in nectarines when used during the blossom period.

METHOD

The trial was carried out at Hawke's Bay Agricultural Research Centre on 2 year-old 'Fantasia' nectarines. The trial design was a randomised block with 6 replications. Plots were single trees planted at 3 × 2.8 m spacing.

All plants were inoculated with *T. deformans* on 17 August 1987 by spraying with a spore suspension obtained by washing leaf curl infected leaves in water. Crop management followed normal commercial practice.

Fungicides (Table 1) were applied by knapsack hand sprayer to run-off. SAN703
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was applied at 90 g/litre which was 30 times the rate of hexaconazole, more than 11 times the rate of flusilazole, and 9 times the rate of A7402. Five applications of each fungicide were made at 7-10 day intervals from 25 August to 29 September, 1987, between growth stages late pink (leaf emergence) and petal fall (25 mm leaf) (Fig. 1). Captafol and chlorothalonil were used as standards for comparison. Untreated 'control' plots were also included. The trees were shrouded on three sides with polyethylene sheet screens during spraying to prevent drift.

To identify the occurrence of infection periods, a mechanical temperature/leaf wetness recorder was installed at 1 m height in a Stevenson weather screen at the centre of the block. Daily rainfall data was also collected from the Whakatu weather station 230 m away to the S.E.

Disease assessment was carried out on September 29 by two methods; firstly by observing 100 shoots on each plot tree, working upwards from the laterals at the base of the tree and classifying each shoot as either diseased (regardless of severity) or healthy; and secondly by assigning a disease severity rating to each tree. This rating was based on the severity of infection of individual leaves or shoots, where 1 = no disease, 3 = slight disease, 6 = moderate disease and 9 = severe disease level. Percentage diseased shoots were calculated from the first assessment method. As this data was not normally distributed, it was subjected to the Friedman Test (Noether 1971) whereby the percentages were transformed into rank sums and a significance test applied. The rating data could not be statistically analysed but served to qualify the data for percent diseased shoots.

RESULTS

Weather, tree growth and disease development

Due to the exceptionally mild winter, seasonal growth of the trees was advanced by about 2 weeks, with blossom commencing about 25 August. Spring was generally dry, with the only significant wet periods occurring on 23-24 August, 26-29 August and 8-9 September (Fig. 1). Little further rain then fell until late October. The second wet spell (26-29 August) possibly constituted the key infection period for leaf curl in this trial, with average air temperatures of 12 °C and 48 hours of leaf wetness. The first symptoms of leaf curl were observed on 16 September, 2 weeks after this wet period.

Fungicide effectiveness

In untreated trees 83% of shoots were affected by leaf curl (Table 1). All fungicides except flusilazole significantly reduced disease but the level of control provided by all EBI fungicides was considered unsatisfactory. Captafol gave 100% control and

Fig. 1 Timing of fungicide applications in relation to growth stages, conditions and leaf curl development in 'Fantasia' nectarine.

chlorothalonil was considered to be as effective with only 0.2% diseased shoots. SAN703 reduced disease to 4%. Results for three EBI fungicides (propiconazole, myclobutanil and A7402) were not significantly different to that for captafol.

The disease severity ratings for each plot generally confirmed the data for percent diseased shoots. Exceptions were S3308L and hexaconazole treatments, which were generally lower in disease ratings than was indicated by percent diseased shoots.

TABLE 1: Effect of fungicides applied to 'Fantasia' nectarine trees during blossom period on development of leaf curl disease.

Fungicide	Product	Formulation	Rate (g ai/ 100 litres)	% Shoots diseased trans-formed data ^a	% Shoots diseased (Means)	Mean rating of disease severity ^d
captafol	Difolatan 5F	50%S	160	6.5	0.0	1.0
	SAN703	30%EC	90	9.0	4.0	1.0
propiconazole	Tilt	25%EC	8	28.0	24.0	4.0
myclobutanil	Systhane	12.5%EC	25	31.0	24.6	3.0
	A7402	25%EC	10	31.5	25.2	3.0
bitertanol	Baycor	50%WP	25	43.5	40.7	5.0
triforine	Saprol	19%EC	19	45.0	43.0	6.0
hexaconazole	Anvil	5%SG	3	48.0	46.9	4.5
diniconazole	S3308L	12.5%WP	15	50.0	48.5	4.0
flusilazole	Nustar	20%DF	8	58.0	51.7	7.0
Untreated	-	-	-	81.5	83.3	7.5
chlorothalonil ^e	Bravo	50%S	115	-	0.2	1.0

LSD (5%) = 30.4

* S = suspension; EC = emulsifiable concentrate; WP = wettable powder; SG = water soluble granule; DF = dry flowable.

a Rank sums derived from Friedman Test on % diseased shoots.

b Vertical line indicates treatments not significantly different from captafol.

c Vertical line indicates treatments that are significantly different from the untreated.

d 1 = complete healthy 3 = slight infection 6 = moderate 9 = complete infection

e Late entry. On adjacent guard tree — could not be included in analysis.

DISCUSSION

The main objective of this trial was to evaluate EBI fungicides sprayed during blossom period for control of leaf curl on stonefruit. It was thought that because of the systemic activity of many EBI fungicides, the most suitable timing for them might be during blossom, when green leaf first appeared. This would make use of any eradicator potential they had against leaf curl and provide a back-up to the leaf bud movement sprays, in addition to their use against blossom blight (*S. fructicola*). However, eradicator activity against leaf curl infection has not been demonstrated and these fungicides should be regarded only as protectants against leaf curl.

The high efficacy of the non-systemic chemicals captafol and chlorothalonil indicates that leaf curl was controlled by protectant rather than systemic activity of the fungicides. The first blossom application was sprayed just before the main infection period (26-29 August) and this resulted in good control of the disease. The situation was similar in 1986 (Tate *et al* 1987) when infection occurred in mid-September during full bloom; leaves were 20 mm long, and sprays for leaf curl control were effective up to the start of this period (15 September).

The reduced effectiveness of EBI fungicides in 1987 compared with 1986 (Tate *et al* 1987) was probably because 'disease pressure' was greater in 1987 and the fungicide

rates used may have been too low to cope with such a severe epidemic.

If label claims are to be made for leaf curl control by EBI fungicides, higher rates will need to be proven to be effective in severe epidemics or the claim should be limited to a 'useful side effect only' category. Higher rates of some of the compounds (e.g. hexaconazole) could give leaf curl control equivalent to that achieved with SAN703. However, chlorothalonil appears to be highly effective when used during blossom period, fully justifying the present label claim for this product.

In the absence of resistance the excellent results for captafol and chlorothalonil in this trial suggest that growers who are having problems with leaf curl control may be failing to obtain adequate spray coverage. In this trial, excellent control of leaf curl was achieved by obtaining complete spray coverage to run-off.

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