FIELD EVALUATION OF AVERMECTIN B1 FOR PEST CONTROL ON KIWIFRUIT

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SUMMARY

A trial was conducted in the 1989-90 season to evaluate avermectin B1 used full season for kiwifruit pest control. Two applications of chlorpyrifos were made during dormancy on the avermectin B1-treated vines. Avermectin B1 gave a commercially acceptable level of caterpillar control. Avermectin B1 reduced fruit infestation by mites, including *Anystis baccarum* cocoons. Thrips infestation of leaves and fruit was also reduced to low levels.

Keywords: avermectin B1, kiwifruit, leafroller, thrips, mites

INTRODUCTION

Kiwifruit pest control currently relies on the regular application of broad-spectrum insecticides during the growing season. This limits the potential for developing integrated pest management systems (IPM) which use biological control. Use of insecticides with less broad-spectrum activity would facilitate the development of IPM and reduce dependence on insecticides alone for pest control.

Avermectin B1 is an insecticide with activity against several key kiwifruit pests including leafrollers (Suckling *et al* 1985) and armoured scale insects (Peleg 1987; Greaves *et al* 1992) as well as such secondary pests as thrips (Grout and Morse 1986) and mite contaminants (Green and Dybas 1984). Avermectin B1 is also known to be relatively safe to biological control agents (Peleg 1987).

The aim of this trial was to evaluate the efficacy of avermectin B1 for control of leafrollers, primarily the brownheaded leafroller (*Ctenopseustis obliquana*); *Stathmopoda* spp.; armoured scale insects including greedy scale (*Hemiberlesia rapax*) and oleander scale (*Aspidiotus nerii*); and various species of thrips including the greenhouse thrips (*Heliothrips haemorrhoidalis*). The effect of avermectin B1 on armoured scale insects is reported elsewhere (Greaves *et al* 1992).

METHODS

The trial was conducted on a block of mature kiwifruit vines cv. Hayward, located at Rukuhia near Hamilton. No applications of any pesticide had been made to the trial vines for several previous seasons. Treatments were replicated six times. Plots consisted of single vines, buffered by at least one unsprayed vine within and between rows. For comparison, data has been included from vines in a second trial, conducted in an adjacent block in the same season and treated with phosmet (Imidan 75WP) full season, using the same methods of application (water rates, dates of application) as this trial.

The rates and timing of the applications of phosmet and avermectin B1 are listed in Table 1. Chlorpyrifos was applied to both trials during the dormant season on 2 September and 18 October 1989. Timing of applications followed conventional recommendations from the current export spray programme. Spreader/sticker (Agral) was used at 50 ml/100 litres with phosmet. All treatments were applied at a water rate of 2250 litres/ha up to and including the 30 November 1989 application and then at 4667 litres/ha for the remainder of the season due to increased vine growth, using a Hardi handgun at 1750 kPa.

Fruit damage and infestation were determined on 50 fruit randomly harvested from each vine on 10 January and 100 fruit taken on 10 May 1990. The fruit were

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cool-stored at 4°C until microscopic examination for the presence of insects or mites. Thrip feeding damage to leaves was assessed by collecting 20 mature leaves per vine on 7 May 1990. The level of damage was classed according to the area of leaf damaged by thrip rasping as severe (> 4 cm² in area per leaf), moderate (1 - 4 cm²), slight (< 1 cm²) or none.

ANOVA was used after log_e transformation of the number + 1 of lepidopterous larvae or pupae, adult thrips and whirlygig mite (*Anystis baccarum*) moulting cocoons per 100 fruit. The percentage of fruit infested by lepidopterous larvae or pupae and the numbers of mites per infested fruit were analysed by logit analysis. The data from vines treated with phosmet in an adjacent trial are presented as raw means.

RESULTS

The level of fruit damage or contamination by lepidopterous larvae on the avermectin B1-treated vines was significantly lower ($P < 0.01$ and $P < 0.001$ for 10 January and 10 May respectively) than that on the unsprayed vines. The level of damage or infestation of fruit (Table 1) from avermectin B1-treated vines was of the same order as vines treated with phosmet in the adjacent trial. A three-fold increase in the percentage of fruit damaged or infested occurred between January and May. Only *Stathmopoda* larvae were found on the unsprayed fruit sampled in January and May. A single unidentified leafroller pupa was found on fruit sampled in May from the avermectin B1-treated vines.

The number of adult thrips on fruit from vines treated with avermectin B1 was lower than on unsprayed vines, although the difference was not significant (Table 2). The proportion of the leaves on the avermectin B1-treated vines damaged by thrips feeding (11%), was significantly lower ($P < 0.01$) than the proportion of leaves damaged on unsprayed vines (54%) (Fig. 1). Ten percent of the leaves on the vines treated with phosmet in the adjacent trial were damaged by thrips, divided equally among minor and moderate ranked damage.

Fig. 1: Levels of thrip damage on kiwifruit leaves collected on 7 May 1990.

TABLE 1: Percentage of fruit damaged or infested by lepidopterous larvae or pupae.

Treatment ^a	Rate g ai/ 100 litres	% Damaged or ^b infested		Live larvae/pupae ^c /100 fruit	
		10 Jan	10 May	10 Jan	10 May
unsprayed	-	4.6(1.4)	13.8(1.5)	0.3(1.5)	0.9(2.6)
avermectin B1 (Abamectin 1.8EC)	0.7	1.0(0.7)	0.3(0.2)	0	0.1(1.1)
SED	0.50				
SEM	0.24				
phosmet ^d (Imidan 75WP)	112.5	1.2	0	0	0

^a Applied: pre-flowering (7 November); post-blossom (30 November); 21 days later (21 December 1988), then at 3-4 weekly intervals until withholding period (10 January, 8 February, 8 March and 5 April 1989);

^b s.e. in brackets;

^c $\log_e (X+1)$ transformed with back-transformed means in brackets;

^d untransformed.

Fruit infestation by moulting cocoons of the predatory whirlygig mite increased between 10 January and 10 May (Table 2). Avermectin B1 had reduced fruit infestation significantly ($P < 0.01$) by the time fruit were sampled on 10 May. None of the fruit sampled from phosmet-treated vines at this time were infested by the cocoons.

TABLE 2: Fruit infestation^a by adult thrips and whirlygig mite (*Anystis baccarum*) moulting cocoons.

Treatment	No. of thrips/ 100 fruit 10 May	No. of <i>Anystis baccarum</i> cocoons/100 fruit	
		10 January	10 May
unsprayed	1.5(4.9)	2.9(18.2)	3.3(28.9)
avermectin B1	0.7(2.0)	1.5(4.5)	2.5(11.9)
SED	0.40	0.46	0.30
phosmet ^b	0.0	3.6	0.0

^a $\log_e (X+1)$ transformed with back-transformed means in brackets;

^b untransformed.

Infestation of fruit by mites doubled between 10 January and 10 May 1990 on both unsprayed and avermectin B1-treated vines (Table 3). However, the proportion of fruit infested by mites was lower on the vines treated with avermectin B1 for both assessments, although the difference was only significant initially ($P < 0.01$) (10 January). Avermectin B1 also reduced the numbers of mites per infested fruit, compared with those found on the unsprayed vine fruit, although this was not significant for fruit sampled on 10 January or 10 May.

TABLE 3: Percentage of kiwifruit infested by mites.

Treatment	% Fruit infested		Mean no. of mites/ infested fruit	
	10 January	10 May	10 January	10 May
unsprayed	5.4(1.7) ^a	9.0(3.2)	1.2(0.8)	1.9(0.22)
avermectin B1	1.0(0.7)	1.8(1.5)	1.0(0.2)	1.3(0.50)
phosmet ^b	3.6	2.4	1.2	1.5

^a s.e. in brackets;

^b untransformed.

Fig. 2: Percent composition of mite fauna on fruit sampled on 7 May 1990.

Mites belonging to six families were found on avermectin B1-treated fruit and only two on unsprayed vine fruit (Fig. 2). All mites on the fruit from phosmet-treated vines were oribatids.

DISCUSSION

In this trial, avermectin B1 provided a level of control of lepidopterous pests similar to that provided by the standard, phosmet. Caterpillar control with avermectin B1 was similar to that achieved for lightbrown apple moth (*Epiphyas postvittana* (Walker)) in laboratory trials (Suckling *et al* 1985). Armoured scale insect numbers were also reduced by avermectin B1 in this trial, although the level of control was below that of other registered insecticides (Greaves *et al* 1992). However, a low rate of avermectin B1 was used in this trial and improved scale insect control could be expected with a higher rate of avermectin B1 (Peleg 1987).

In addition to controlling key pests, avermectin B1 also reduced the incidence of some secondary pests and contaminants. It may have some activity against oribatid mites as shown by the general reduction in the level of fruit infestation by mites and the reduced proportion of oribatids in the mite fauna. Thrips were also effectively controlled conforming to the results of Grout and Morse (1986).

Reduced populations of two biological control agents were found on treated vines during this trial. These were predatory whirlygig mites and an unidentified parasitoid of armoured scale insects. Whirlygig mites are general predators capable of predating leafroller larvae (Baker 1983). Reduced populations of whirlygig mites and armoured scale insect parasitoids survived on avermectin B1-treated vines. However, no parasitised greedy scale were found on leaves sampled between December and May on avermectin B1-treated vines, even though a few (4%) of the second and third instar greedy scale were parasitised on unsprayed vine leaves. Two percent of the second and third instar greedy scale were parasitised on unsprayed vine fruit harvested on 10 May compared with 8% on the avermectin B1-treated vine fruit (A.R. Tomkins unpub. data). Thus, avermectin B1 shows some initial promise for use in IPM in kiwifruit. However, further detailed studies are required on its effect on biological control agents of armoured scale insects and of the other insects and mites present in kiwifruit orchards such as the predatory mite *Phytoseiulus persimilis* Athias-Heriot used to control two-spotted spider mite (*Tetranychus urticae* Koch) in kiwifruit orchard shelter-belts.

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