AN INSECT GROWTH REGULATOR FOR CONTROLLING LEAFROLLERS ON KIWIFRUIT

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SUMMARY

The insect growth regulator tebufenozide was tested for efficacy against leafroller caterpillars which damage kiwifruit in New Zealand. A field trial was carried out comparing three rates of tebufenozide (4, 6, and 12 g/100 litres) with a standard leafroller insecticide (diazinon) and an untreated control. All rates of tebufenozide successfully controlled leafrollers. The compatibility of tebufenozide mixed with two other chemicals likely to be applied at the same time (a mineral oil and a dicarboximide fungicide) was tested in a field trial. No phytotoxicity was observed.

Keywords: kiwifruit, tebufenozide, leafrollers, mineral oil, fungicide

INTRODUCTION

One of the key components of Integrated Pest Management (IPM) programmes is the use of selective control methods. The insect growth regulator tebufenozide (RH5992, or Mimic), is an ecdysone agonist which stops feeding by some lepidopteran larvae by inducing a premature moult (Wing *et al.* 1988). Tebufenozide has already been found to give good control of the leafrollers in pipfruit orchards in Havelock North (Walker *et al.* 1991). An efficacy trial was carried out to assess whether tebufenozide gave equally effective control of the leafroller species in kiwifruit.

The most important leafrollers damaging kiwifruit are the native species *Ctenopseustis obliquana* and *C. herana* (brownheaded leafrollers), as well as *Cnephasia jactatana* (the black-lyre leafroller). The Australian import *Epiphyas postvittana* (light brown apple moth) damages kiwifruit to a much lesser extent than these (Steven 1990). Most leafroller damage to kiwifruit occurs soon after fruit set (Steven 1990), and the first two post-flowering sprays are to cover this critical period.

Kiwifruit is a sensitive crop with regard to some spray materials so a second trial aimed to check that tebufenozide could be safely applied with the two materials which could conceivably be applied at the same time. A mineral oil could be used for armoured scale control, and a dicarboximide fungicide may be used for sclerotinia protection. Mineral oils in particular have been found to be phytotoxic to kiwifruit during early fruit growth, causing a black specking of the skin (McKenna and Steven 1993). Current recommendations for the use of mineral oil on kiwifruit are for 1% applications at either the end of flowering or from the beginning of February until harvest as needed for scale control (McKenna and Steven 1993). The label recommendation for the fungicide vinclozolin (Ronilan FL) is for an application after flowering, and again 1 day before harvest. An additional vinclozolin spray may be applied in January for sclerotinia control.

METHODS

Both trials were carried out at the Kumeu Research Orchard in a block of kiwifruit vines cv. "Hayward" grown on a winged T-bar structure. Treatments were applied to single vine plots. All sprays were applied high volume to run-off at about 2000 kPa using a Universal handgun from a Comet P48 pump. In each trial a randomised block design was used with no guard vines between treatments, although no fruit were sampled from where plots adjoined. There were six replicates in the efficacy trial and five in the compatibility trial. Results were analysed by ANOVA using SAS on the angular transformed percentages of fruit damaged.

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Efficacy trial

Three rates of tebufenozide (4, 8 and 12 g/100 litres) were compared with the standard rate of diazinon (Basudin WP) at 50 g/100 litres, and an untreated control. The spreader/sticker Triton B-1956 was added to the tebufenozide spray mixtures at 15 ml/100 litres. The first tebufenozide spray was applied on 7 December 1992, at about 95% flowering. The diazinon spray was applied a week later when the bees had been removed from the orchard. A second spray of all treatments was applied on 28 December 1992. Three weeks after the second spray, an interim assessment was made of 110 fruit on the vine for leafroller damage. Damage was recorded in four categories according to severity:

- negligible = superficial, totalling less than the area of a circle of 5 mm diameter
- light = superficial, more than negligible but less than a circle of 11.3 mm diameter (<1 cm²)
- moderate = superficial, between light and heavy
- heavy = any penetrating damage (>2 mm), or surface damage more than the area of a circle of 15 mm diameter

The fruit checked in this assessment were marked for a final assessment at harvest. At harvest the marked fruit were collected and assessed under a microscope for leafroller damage, using the same damage categories.

After the first assessment, half the replicates were not sprayed again and half received a 'standard' spray programme for the remainder of the season. This consisted of a diazinon (16.2.93) and a chlorpyrifos (22.4.93) application. These sprays were applied with an airblast sprayer at 2000 litres/ha.

Compatibility trial

Tebufenozide, in combination with mineral oil (Sunspray Ultrafine Spraying Oil) and vinclozolin (Ronilan FL), was applied at petal fall (23 December 1993). Standard and double rates of all materials were used (Table 1). On 28 January 1994 a tebufenozide plus vinclozolin combination was applied at both standard and double rates. One hundred fruit per plot was harvested at the end of March and was examined carefully in the laboratory for any skin marking.

TABLE 1: Treatments and application times for the compatibility trial.

Application time	Tebufenozide (g ai/100 litres)	Oil (%)	Vinclozolin (g ai/100 litres)
23.12.93 (petal fall)	6	1	-
	12	2	-
	6	-	50
	12	-	100
	6	1	50
	12	2	100
	untreated		
28.1.94	6	-	50
	12	-	100
	untreated		

RESULTS

Efficacy trial

Most of the main species of leafroller found damaging kiwifruit have been collected from the trial block (*Ctenopseustis obliquana*, *Epiphyas postvittana* and *Cnephasia jactatana*). At harvest there was no significant difference ($P>0.05$) in leafroller damage between vines which received a full season spray programme and vines which received the early season sprays only, so the results were combined. At both the interim and harvest assessments vines sprayed with tebufenozide had

significantly less leafroller damage than the diazinon or untreated standards. Tebufenozide gave excellent control of leafrollers at all rates (Table 2). The vines sprayed with diazinon had significantly less damage than the untreated vines.

TABLE 2: The percentages of leafroller damaged fruit (means of raw data) at the interim and harvest assessments.

Treatment	Rate g ai/100 litres	Interim leafroller damage (18.1.92)	Harvest leafroller damage (18.6.93)
tebufenozide	4	0.3a ¹	2.9a
tebufenozide	6	1.8a	3.1a
tebufenozide	12	0a	2.6a
diazinon	50	5.5b	14.2b
untreated	-	14.6c	21.2c

¹Numbers within a column with the same letter are not significantly different (Tukey's studentised range test, $P>0.05$).

The separation of treatments was not affected by carrying out the assessments at different times and using different techniques. However the actual number of fruit damaged by leafrollers increased significantly between the interim and the harvest assessment (two way ANOVA, $P<0.05$). This was probably due to the difference in assessment techniques, as there was no difference in leafroller damage at harvest between the replicates which received the full season programme and those only having the early season sprays. Some leafroller damage would have occurred after the interim assessment although observations on the timing of leafroller damage, collected concurrently from the same block (P. S. Stevens unpublished), indicates this would have been minimal.

Fruit in either the moderate or heavy damage category would be automatically rejected for export. At harvest none of the tebufenozide treatments had any fruit in the 'heavy' damage category (Table 3). In contrast 18.2% and 40.6% of all damaged fruit from the diazinon and unsprayed vines respectively were in this category. This result would be a reflection of tebufenozide's mode of action as a feeding inhibitor.

TABLE 3: The number of leafroller damaged fruit in each damage category at harvest.

Treatment	g ai/100 litres	Number of fruit in each damage category at harvest			
		Negligible	Light	Moderate	Heavy
tebufenozide	4	8	6	4	0
tebufenozide	6	6	6	8	0
tebufenozide	12	8	8	1	0
diazinon	50	27	24	21	16
untreated		13	24	42	54

Compatibility trial

No evidence of phytotoxicity was observed on any of the fruit.

CONCLUSIONS

Tebufenozide has been demonstrated to be an effective material for controlling leafrollers in kiwifruit. As well as preventing the incidence of damage there is also evidence that the severity of leafroller damage is decreased which will result in fewer fruit being rejected for export. Tebufenozide, a selective leafroller insecticide, was also safely applied in combination with a mineral oil spray to add armoured scale

control, and a dicarboximide fungicide to protect against sclerotinia. This compatibility will allow selective pesticides to be mixed, and will enable a more flexible approach to insect pest management depending on the specific insect pest pressures at different times and locations.

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