CONTROL OF LEAFROLLERS IN AVOCADOS

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ABSTRACT

Brownheaded leafrollers *Ctenopseustis obliquana* and *C. herana* can cause significant damage to young avocado fruitlets and terminal shoots. Field trials were performed in 1996/97 and 1997/98 on avocado trees to evaluate leafroller control with tebufenozide, taufluvalinate, *Bacillus thuringiensis* var. *kurstaki* (*Btk*) and abamectin. Leafroller levels were assessed on leaves and fruit. The most effective treatments were tebufenozide, taufluvalinate and abamectin.

Keywords: Avocado, brownheaded leafroller *Ctenopseustis obliquana*, *Ctenopseustis herana*.

INTRODUCTION

Leafrollers are the most serious pests of New Zealand avocados, with larvae of several species feeding on both leaves and fruit (Stevens 1998). The most important leafroller species damaging avocados are the brownheaded leafrollers *Ctenopseustis obliquana* and *C. herana* (Stevens 1998). The leafrollers are classed as actionable pests for those exporting the fruit.

With restrictions on the existing chemicals used for leafroller control, growers are left with few alternatives for control throughout the season. One of the control options available is *Bacillus thuringiensis* var. *kurstaki* (*Btk*) but the short persistence of *Btk* results in regular applications of the product and extra costs to the grower. The short residual activity of *Btk* plays an important role in determining the timing of an application (Bryant 1991). There is also a greater risk of feeding damage to fruit during this period. Sale (1997) found taufluvalinate reduced leafroller damage to avocado foliage by 80% whereas *Btk* achieved approximately 50% control, compared with the untreated control.

Tebufenozide (marketed as Mimic in New Zealand) is an insect growth regulator that is highly specific to lepidopteran larvae and is safe for many beneficial insect species. The success of tebufenozide in the control of leafroller and codling moth in pipfruit (Walker *et al.* 1991) is an indication of its potential suitability for the avocado industry.

Abamectin (marketed as Avid) was fully registered (Section 3) in the US for use on apple and pear in the 1996 season. Abamectin has been used successfully as a miticide/psyllacide on pear for several years (Beers and Dunley 1997). Foliar surface deposits of avermectins are rapidly degraded with the result that many beneficial organisms do not receive significant exposure to the toxic entity. However, avermectins seem to penetrate the leaf lamellae and are then available as a pesticidal reservoir against mites and insects (Babu 1988).

Tebufenozide and abamectin are not currently registered in New Zealand for use on avocados. This paper describes trials to determine the level of efficacy of abamectin and tebufenozide in controlling leafroller caterpillars over the flowering and early fruitset period of avocados. These chemicals were compared with existing registered materials *Btk* and taufluvalinate.

MATERIALS AND METHODS

Two spray trials were conducted in the 1996/97 and 1997/98 seasons at Tara Road, Mangawhai, Northland and Rea Road, Katikati, Bay of Plenty. Each trial was a randomized complete block design and was established on 4 year old avocado trees. There were four single tree replicates.

The insecticides and rates used are shown in Table 1. The wetting agent Citowett was added to all treatments at 25 ml/100 litres during the first season only. *Btk* applications ceased on the 24/11/97 at the Mangawhai site and 26/11/1997 at the Katikati site and were replaced by abamectin. Applications were made using a turbo handgun with a 1.5 mm braglia nozzle. Trees were sprayed to the point of runoff at a pressure of 2067 kpa with a water rate equivalent to 2000 litres per hectare. Spraying commenced at the growth stage defined as “cauliflower” that runs from early to mid October. Flower stalks at this stage are about 20mm long, creating a cauliflower appearance. Flowering follows soon after. Applications were made at 14 day intervals initially in the first season, then at 21 day intervals (Table 2).

TABLE 1: Treatments and rates used in field trials.

Treatment	Trade name	Rate (g ai/100 litres)	
		1996/1997	1997/1998
tebufenozide	Mimic 70W	3	3
tebufenozide		6	6
tebufenozide		12	12
tauflluvalinate	Mavrik Flo 24SC	4.8	4.8
<i>Btk</i>	Abamectin	NA	NA
Delfin WG	Avid 1.8 EC	50	.675
Control		-	-

At each assessment (Table 2), 15 terminal shoots per tree were sampled for the presence of leafroller larvae. At Mangawhai, 15 fruit/plot were checked for leafroller damage on the 25/2/97, 31/3/98 and 25 fruit/plot on the 4/3/97 and 31/12/97. At Katikati, 15 fruit/plot were checked for leafroller damage on the 16/12/96, 10/3/97 and 17/2/98.

TABLE 2: Timing of applications and leafroller assessments for 1996/97 season.

Site		Date	
1996-97	Mangawhai	Treatment	10/10, 24/10, 7/11, 11/12, 14/1, 04/2, 25/2
		Assessment	14/1, 25/2, 04/3
	Katikati	Treatment	01/10, 15/10, 30/10, 21/11, 16/12, 15/1, 13/2
		Assessment	16/12, 10/3
1997-98	Mangawhai	Treatment	13/10, 03/11, 24/11, 12/12, 31/12, 26/1, 20/2
		Assessment	24/11, 31/12, 26/1, 31/3
	Katikati	Treatment	09/10, 30/10, 26/11, 18/12, 6/1
		Assessment	17/2

All data were transformed to $\sqrt{x}+1/2$, due to the number of zero recordings of leafroller levels, and then subjected to analyses of variance and Duncan's Multiple Range Test using the Multistat computer package.

RESULTS

Mangawhai: 1996/97 season

On 14/1/97 in assessment one (Table 3), all chemical treatments had lower ($P<0.05$) leafroller levels than the control and *Btk* treated plots. On 25/2/97, in assessment 2, leafrollers were present only in the new shoot growth of the untreated control. The number of fruit with skin damage was greater in the untreated control than all the chemical treatments ($P<0.05$). On 4/3/97, *Btk* treated fruit had a significantly higher level of leafroller damage than the chemical treatments ($P<0.05$).

TABLE 3: Mean¹ number of leaves infested by leafroller and mean number of fruit damaged by leafroller at the Mangawhai site, 1996/97.

Treatment (g ai/100 litres)	Terminal shoots	Fruit damaged	
	14.1.97	25.2.97	4.3.97
Tebufenozide (3)	0.0 a ²	0 a	0 a
Tebufenozide (6)	0.3 a	0 a	0 a
Tebufenozide (12)	0.3 a	0 a	0 a
Taufluvalinate (4.8)	0.3 a	0 a	0 a
<i>Btk</i> (50)	2.0 b	0.5 ab	1.0 b
Control	3.0 b	1.3 b	0.3 ab

¹ Values in the tables are untransformed data from assessments.

² Means followed by the same letter are not significantly different ($P>0.05$).

Katikati: 1996/97 season

Sufficient numbers of leafroller were present at assessment 1 for statistical analysis (Table 4). The level of infestation in the control plots was significantly different from tebufenozide 6 and 12 g treated plots ($P<0.05$). In assessment 2 (10/3/97), only one juvenile leafroller was found in the control plot indicating very low leafroller activity during early March.

TABLE 4: Mean number of terminal shoots infested by leafroller, 16/12/96.

Treatment (g ai/100 litres)	Terminal shoots infested
Tebufenozide (3)	0.5 ab
Tebufenozide (6)	0.0 a
Tebufenozide (12)	0.0 a
Taufluvalinate (4.8)	0.3 ab
<i>Btk</i> (50)	0.8 ab
Control	1.8 b

Means followed by the same letter are not significantly different ($P>0.05$).

Mangawhai: 1997/98 season

There was no significant difference ($P<0.05$) in leafroller levels between tebufenozide 3 g, taufluvalinate, abamectin and the untreated control in the first assessment (Table 5). Tebufenozide 6 g and 12 g were significantly lower ($P<0.05$) than the control. In all other assessments, the incidence of leafroller in terminal shoots and the number of fruit damaged was significantly higher ($P<0.05$) in the untreated control when compared to all other treatments. Fruit in Table 5 assessed on the 31/12/97 had set the previous year. This fruit was fully developed and ready for harvest, whereas the current season's fruit assessed on the 31/3/98 had only set in December 1997.

TABLE 5: Mean number of leafroller larvae on shoots and mean number of fruit damaged by leafroller at the Mangawhai site during 1997/98.

Treatment (g ai/100 litres)	24.11.97		31.12.97		26.1.98		31.3.98
	shoots	fruit	shoots	shoots	fruit	shoots	
Tebufenozide (3)	0.75 ab ¹	0.0 a	0.30 a	0.25 a	0.00 a	0.75 a	
Tebufenozide (6)	0.00 a	0.0 a	0.00 a	0.00 a	0.00 a	0.00 a	
Tebufenozide (12)	0.00 a	1.2 a	0.00 a	0.00 a	0.00 a	0.00 a	
Taufluvalinate (4.8)	0.25 ab	0.0 a	0.50 a	0.00 a	0.00 a	0.00 a	
Abamectin (.675)	1.50 ab	0.8 a	0.80 a	0.00 a	0.25 a	0.50 a	
Control	2.25 b	2.3 b	3.00 b	7.25 b	2.75 b	3.00 b	

¹ Means followed by the same letter are not significantly different ($P<0.05$).

Katikati: 1997/98 season

Leafroller activity was lower in the Katikati site and as a result there was less opportunity to detail assessments due to low infestation levels or fruit damage. In assessment 2 (17/2/98), the untreated control had a significantly ($P<0.05$) higher level of terminal shoots and fruit with leafroller damage when compared to all other treatments (Table 6).

TABLE 6: Mean number of leafroller larvae on terminal shoots and mean number of fruit damaged by leafroller at the Katikati site during 1997/98.

Treatment (g ai/100 litres)	terminal shoots	fruit damage
Tebufenozide (3)	0.75a ¹	0.0 a
Tebufenozide (6)	0.50a	0.0 a
Tebufenozide (12)	0.25a	0.0 a
Taufluvalinate (4.8)	0.00a	0.0 a
Abamectin (.675)	0.25a	0.5 a
Control	2.75b	2.5 b

¹ Means followed by the same letter are not significantly different ($P<0.05$).

DISCUSSION

Tebufenozide and taufluvalinate were effective in controlling leafroller damage, even where spray intervals were extended up to 42 days. In contrast, the efficacy of *Btk* was probably limited due to its short persistence. Tatchell (1997) stated the relatively short persistence of micro-organisms in the environment contributes to the variability in the control achieved by biopesticides. During both seasons, leafroller levels and fruit damage were consistently higher in *Btk* than the tebufenozide and taufluvalinate treatments. *Btk* is most effective against young caterpillars (<5mm long) (Smith *et al.* 1995). Knight (1997) suggested the best approach for leafroller control in pipfruit is to time the first spray after newly hatched larvae are found.

Control of leafroller with abamectin in 1997/98 was not significantly different from that with tebufenozide and taufluvalinate. If the emphasis in spraying moves from a calendar schedule to the use of action thresholds, based on monitoring or pheromone trap catches, there may be greater intervals between spraying. These intervals would have to be related to product efficacy, with shorter intervals between applications of *Btk* and longer intervals for other products.

The advantage of tebufenozide over taufluvalinate is target specificity, allowing survival of natural enemies in the orchard. Previous studies have found a high level of activity against Lepidoptera and low toxicity to pest natural enemies including predatory mites (Tomkins *et al.* 1995). Similarly, abamectin does not disrupt activity of beneficial insects when used at appropriate times (Babu 1988). The observations of spider and lacewing activity indicated greater activity of beneficial insects in the tebufenozide treatments, abamectin and control plots than taufluvalinate. Taufluvalinate has a low toxicity to bees once the spray has dried on the plant, but as the label states, it must be applied when bees are not actively foraging (Sale 1997).

Low leafroller activity in 1997/98 season at the Katikati trial site may be due to geographical and climatic factors.

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REFERENCES

- Babu, J.R., 1988. Avermectins; Biological and pesticidal activities. *In*: Biologically Active Natural Products: Potential Use in Agriculture. H. Cutler (Ed.). American Chemical Soc. Symposium Series No. 380.

- Beers, E.H. and Dunley, J.E., 1997. Evolution of Agri-Mec use on apple and pear. *Good Fruit Grower* 48: 44.
- Bryant, J.E., 1991. Application strategies for *Bacillus thuringiensis*. Report for Sandoz Crop Protection Chicago, USA.
- Knight, A., 1997. Optimizing the use of Bts for leafroller control. *Good Fruit Grower April 15*: 47-49.
- Sale, P., 1997. More plant protection options for avocado growers. *The Orchardist, September 1997*: 42-44.
- Smith, M., Cole, P. and Kreidl, S., 1995. *The Australian Grapegrower & Winemaker*: 71-74.
- Stevens, P., 1998. Control of leafrollers in organic avocado orchards. *Bio News April 1998*.
- Tatchell, G.M., 1997. Microbial Insecticides and IPM: Current and future opportunities for the use of biopesticides. Pp 191-200. *In*: BCPC Symposium Proceedings 68. Microbial Insecticides: Novelty or Necessity?
- Tomkins, A.R., Thomson, C. and Wilson, D.J., 1995. Effect of tebufenozide on *Encarsia citrina*, an armoured scale parasitoid. *Proc. 48th N.Z. Plant Prot. Conf.*: 139-142.
- Walker, J.T.S., Baynon, G.T. and White, V., 1991. Insect control on apples with RH-5992 a novel insect growth regulator. *Proc. 44th N.Z. Weed and Pest Conf.*: 66-69.