CONTROL OF GRASS GRUB BEETLES IN BLUEBERRIES WITH PYRETHROID INSECTICIDES

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SUMMARY

Bioassays of treated foliage showed that bioresmethrin and pyrethrum markedly reduced defoliation of blueberries (*Vaccinium corymbosum*) by grass grub (*Costelytra zealandica*) beetles on the day of treatment, compared to at least 2 to 4 days control by alphamethrin, cypermethrin, deltamethrin and permethrin. In field trials, daily applications of bioresmethrin (3 g ai/100 litres) or pyrethrum (10 g ai/100 litres), and inter-row applications of permethrin (200 g ai/ha) at 4 to 5-day intervals gave large reductions in berry damage.

INTRODUCTION

Damage by grass grub beetles to foliage, flowers and developing berries has emerged as a major pest problem of the rapidly expanding export blueberry industry in the northern North Island (Verbene *et al* 1985). The insecticides currently registered for use on export blueberries do not prevent serious feeding damage by grass grub beetles, but synthetic pyrethroid insecticides provide effective protection against beetle damage (East *et al* 1983; Blank and Olson 1984; East and Holland 1984). The availability of synthetic pyrethroids which can be applied to flowering crops without seriously affecting bees (Fisher *et al* 1984; Shires *et al* 1984) will allow one difficulty in the use of insecticides against grass grub beetles to be overcome, but direct use of synthetic pyrethroids on export blueberries will not be permitted until residue tolerance levels have been set in overseas markets (East and Holland 1984).

This paper reports the results of trials aimed at overcoming this problem by either spraying the bushes with transient pyrethroids, or spraying the inter-row areas with a more persistent pyrethroid while avoiding the bushes.

METHODS

Bioassay

Two transient pyrethroids, pyrethrum (Pyrox 1.2 EC, which includes 2.4% piperonyl butoxide) and bioresmethrin (Bioresmethrin 5 EC), were compared to the synthetic pyrethroids alphamethrin (Fastac 10 EC), cypermethrin (Ripcord 20 EC), deltamethrin (Decis 2.5 EC) and permethrin (Ambush 50 EC). Other chemicals included were the insecticide phosalone (Zolone 30 WP), which is of low toxicity to bees, and the antifeedant fungicides fentin-acetate (Brestan 60 WP, which includes 18% maneb), fentinhydroxide (Du-ter 19 WP) and copper oxychloride (Cupravit 50 WP). Treatments (Table 1) were applied to individual mature blueberry bushes (sprayed to runoff) at the Moanatuatua Research Area, where defoliation by grass grub beetles and other insects was negligible. Bioassays were carried out by picking 10 to 15 cm long shoots (4 shoots per treatment) at varying intervals after spraying and exposing them to attack by grass grub beetles in pots. The methods used and defoliation scoring from 0 (no defoliation) to 5 (severe defoliation) were as described by East *et al* (1983).

Field Trials

Trial 1 compared daily applications of three insecticides (Table 2) to mature blueberry bushes. Each plot comprised a single bush with an adjacent unsprayed bush as a buffer on each side. Treatments were applied by spraying to runoff in the late afternoon each day for 5 days, from 29 October to 2 November 1984.

Trial 2 compared an inter-row spray of permethrin (200 g ai/ha), using a covered boom to avoid the bushes while spraying the mown sward between the rows, with

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permethrin (20 g ai/100 litres) sprayed to runoff directly on to the bushes. Each treatment was applied four times, at 4 to 5-day intervals from 19 October to 2 November 1984. Plot size varied from 20 m × 15 m to 23 m × 55 m; each plot included sections of at least four adjacent rows of blueberry bushes. Grass grub beetle flight activity was assessed by sweeping from 0 to 30 cm above ground level with a sweep net. This was done while walking slowly along the centre of the inter-row areas within each plot shortly after dusk, when flight activity was at its peak for the evening.

The field trials were conducted at the Rukuhia Horticultural Research Area. Damage was assessed on 3 November 1984 by inspecting each berry (15 to 47 per bunch) in tagged bunches (3 bunches/plot in trial 1, 10 bunches/plot in trial 2) from which all berries damaged prior to the trial had been removed. Each treatment was replicated four times.

TABLE 1: Results of bioassays with blueberry foliage. D = mean defoliation score; M = percentage of beetles affected.

Chemical (g ai/100 litres)	Days after spraying									
	0		1		2		4		7	
	D	M	D	M	D	M	D	M	D	M
bioresmethrin (300)	0	25	2	19	4	5	—*	—	—	—
bioresmethrin (30)	0	15	3	0	5	1	—	—	—	—
bioresmethrin (3)	1	3	3	1	5	0	—	—	—	—
pyrethrum (40) + piperonyl butoxide (80)	0	35	3	0	3	0	—	—	—	—
pyrethrum (20) + piperonyl butoxide (40)	0	20	3	2	5	1	—	—	—	—
pyrethrum (10) + piperonyl butoxide (20)	0	10	4	1	4	3	—	—	—	—
alphamethrin (5)	0	58	2	52	2	40	2	21	4	37
cypermethrin (10)	1	30	2	42	2	49	2	24	4	31
deltamethrin (2.5)	0	45	2	71	2	14	4	9	5	13
permethrin (20)	0	28	1	36	2	24	2	2	4	10
phosalone (120)	4	0	5	6	5	3	—	—	—	—
phosalone (60)	4	0	3	1	4	1	—	—	—	—
fentinhydroxide (80)	1	15	4	3	4	2	—	—	—	—
fentinacetate (100) + maneb (33)	0	35	3	0	5	2	—	—	—	—
copper oxychloride (250)	3	8	4	0	5	0	—	—	—	—
control	5	0	4	0	5	1	5	0	5	0

* not assessed

RESULTS AND DISCUSSION

Bioassay

All of the chemicals tested except phosalone and copper oxychloride significantly ($P < 0.05$) reduced defoliation on the day of application, compared to the unsprayed control (Table 1). A defoliation score of 2 or less represents an acceptable level (less than 5% defoliation). Only the synthetic pyrethroids alphamethrin, cypermethrin, deltamethrin and permethrin gave significant ($P < 0.05$) reductions in defoliation compared to the control for a longer period (2 to 4 days). The number of beetles affected, i.e., dead or unable to rebury in soil, was significantly greater ($P < 0.05$) for these four pyrethroids than the control at each assessment up to 7 days after application (Table 1), even when they no longer prevented severe defoliation. Bioresmethrin was phytotoxic at the highest application rate used but not at the lower rates.

These results suggest that daily sprays of bioresmethrin or pyrethrum would be as effective as applications of more persistent synthetic pyrethroids at 5 to 9-day intervals

(East *et al* 1983; East and Holland 1984). Pyrethrum is a natural plant product and, like bioresmethrin, breaks down very quickly and is unlikely to create residue problems. Fentin-acetate and fentinhydroxide also gave effective short-term suppression of defoliation (Table 1). Tin and copper-based fungicides are known to inhibit insect feeding (Chapman 1974; Hare *et al* 1983).

TABLE 2: Effects on fruit damage of spraying blueberry bushes daily with insecticides (trial 1).

Insecticide	Rate (g ai/100 litres)	% Berry Damage	
		Mean	Range
bioresmethrin	3	0.9	0.0 — 1.7
pyrethrum	10	1.1	0.7 — 1.7
phosalone	60	28.1	14.2 — 38.3
control	—	33.0	20.3 — 62.5

Field Trials

The results of trial 1 (Table 2) confirm the effectiveness of daily applications of bioresmethrin and pyrethrum in protecting blueberries from grass grub beetle damage.

In trial 2, both insecticide treatments gave significant reductions ($P < 0.01$) in berry damage below that of the unsprayed control (50.2%). Damage did not differ significantly ($P > 0.05$) between the inter-row treatment (13.1%) and the sprayed bushes (5.9%). The inter-row treatment caused a marked decline in flight activity compared to the control for at least 2 days after treatment (Table 3). This approach to grass grub beetle control depends on the beetles being exposed to insecticide on the grass between the rows of blueberries during primary emergence from the soil, or when returning to the soil after feeding on the bushes each night and during subsequent re-emergence. Beetles flying in from outside the treated areas to alight on the bushes would not be affected until after their first night's feeding. The results suggest that most of the damage in the unsprayed control was caused by resident rather than immigrant beetles. Nevertheless, the relatively small plot sizes in trial 2, compared to treating an entire orchard, may have allowed sufficient flight of beetles into treated plots to underestimate the effectiveness of inter-row treatment.

TABLE 3: Effects of inter-row sprays of permethrin (200 g ai/ha) on grass grub beetle flight activity (trial 2).

Days After Spraying	Total No. Caught / 280 Sweeps	
	Sprayed	Unsprayed
0	5	49
1	6	58
2	4	45
4	5	9

CONCLUSIONS

Daily applications to bushes of transient pyrethroids such as pyrethrum and bioresmethrin, and less frequent applications of more persistent pyrethroids such as permethrin to the inter-row areas only, appear to be effective methods for controlling grass grub beetles in blueberries while avoiding unacceptable insecticide residues on the fruit. The feasibility of the former method will be limited by the size of the area to be treated each day. Inter-row treatment will be more effective against resident beetles than those flying in from outside the orchard. Complete protection may require a combination of either of these two approaches and/or the use of soil adulticides (Blank *et al* 1985) with the application of persistent pyrethroids to shelter belts to suppress immigration.

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