INSECTICIDE PROTECTION OF KIWIFRUIT VINES FROM ATTACK BY GRASS GRUB BEETLE

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SUMMARY

Grass grub beetle (*Costelytra zealandica*) severely defoliated unsprayed young kiwifruit vines (*Actinidia chinensis*) by 50-70%. Four applications of insecticides at 7 day intervals over the beetle flight season significantly reduced damage. Cypermethrin gave better protection than methiocarb or azinphos-methyl. Cypermethrin killed 60-88% of beetles recovered from trays placed under vines during the first five nights after application but kills declined to 13-41% on the sixth and seventh night. Cypermethrin-protected vines produced 1.5 m more cane than severely damaged unsprayed vines; a 65% increase in summer growth.

INTRODUCTION

During their spring flights, grass grub beetles feed on kiwifruit foliage and that of other subtropical fruit crops and can cause considerable damage particularly to developing orchards (Blank and Olson 1982). Many growers confuse grass grub damage with wind or leaf roller caterpillar damage as the symptoms are similar. The protectant ability of a range of insecticides have been screened on tamarillo (*Cyphomandra betacea*) (Blank *et al* 1983) and willows used as shelter (East *et al* 1983). In those trials the synthetic pyrethroids and the carbamates gave better protection than organophosphate or organochlorine insecticides.

This study compares the protectant ability of cypermethrin and methiocarb with azinphos-methyl, an organophosphate commonly used as a pre-blossom spray on kiwifruit for leaf roller and greedy scale (*Hemiberlesia rapax*) control. This study also provides further information on the timing and interval between spray applications needed to protect sub-tropical fruit trees from defoliation by grass grub.

MATERIALS AND METHODS

A developing orchard at Maunu near Whangarei, with 3 year old grafted kiwifruit vines was used for these trials. The orchard contained 6 ha of vines protected with 5 m high artificial shelter and was on a Maunu silty loam soil. Plot size was approximately 35 x 30 m. The four treatments (Table 1) were randomised amongst four replicates.

Insecticides were applied with a tractor motorised pump and handgun at 700 kPa with D7 nozzles and No. 45 swirl plates. Vines were sprayed to run off on the 18, 25 October and 2, 9 November.

Male beetle flight activity was monitored using four sex attractant traps (Henzell *et al* 1979) which were cleared each morning from unsprayed plots. Two of these traps were positioned on a kiwifruit post at vine canopy height (1.8 m) and two traps on the ground.

Beetle activity on the vines was monitored using four tinfoil trays (480 x 280 mm) which were placed on the ground under kiwifruit foliage in each plot. Beetles were collected each morning and assessed for mortality (Blank *et al* 1983). In addition, four trays were positioned at least 2 m from kiwifruit foliage in the untreated vine rows and cleared daily from 2-16 November.

Vines were assessed for damage on the 14 and 15 November using a scale of:

- 1 = very slight defoliation (1-5%), traces of chewing evident
- 2 = slight defoliation (5-10%), loss of part of leaf margin and a few small holes
- 3 = light defoliation (10-20%), most of leaf margin chewed and a few medium sized holes

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TABLE 1: Insecticidal protection of kiwifruit vines from grass grub attack.

Treatment	g ai/100 litres	damage scale
untreated	-	5.2
azinphos-methyl (Gusathion 50 WP)	50	4.1
methiocarb (Mesurol 75 WP)	113	3.8
cypermethrin (Ripcord 20 EC)	10	3.1
standard error of differences		0.3

4 = moderate defoliation (20-40%), leaf margin eaten and a few large holes

5 = severe defoliation (40-60%), most of the leaf consumed

6 = very severe defoliation (60-80%), leaf completely shredded, mainly leaf veins remaining

The damage score was averaged over the complete vine. Vines were independently assessed by two people to obtain an average damage scale. Four large and small female as well as male vines were assessed at random from each plot.

Assessments of growth were made from 12 female vines of similar size, which were selected from each of the cypermethrin and unsprayed plots. Each replicate used vines with the same trunk diameter. Two vines were selected from each of the six rows to avoid bias due to wind protection. Trunk diameter was measured with callipers 100 mm below the division of the main leaders (approximately 1.3 m above ground level). Total cane length of each vine included main leaders attached to the centre wire and all side branches.

Vines were selected, tagged, and first measured in late November 1983. The orchardist carried out normal summer pruning including cutting off weak and twisted canes. Growth from tagged vines was assessed on the 24 January.

Treatment effects were investigated using an analysis of variance of the untransformed damage and growth data.

RESULTS

Feeding and flight activity

Grass grub mating and feeding flight began in October 1983, following the emergence of beetles from pupae in the soil and continued until mid-December. The beetles became active and then flew rapidly from vine to vine just before dusk. The female beetles settled on the vines with their abdomens in the air and wings partly extended. Male beetles searched out and mounted the females which then commenced to feed. This was usually along the leaf margin or between the leaf veins but stems or flowers were also eaten. Male beetles fed later in the night when fewer copulating pairs were observed. Feeding continued past midnight and then beetles dropped to the ground to bury into the soil before dawn. On any one night beetles were concentrated in groups but there was no preferred location on the kiwifruit vines as both aerial shoots and the main leader suffered similar levels of feeding damage.

Male grass grub flight activity measured using sex attractant traps located on the ground, commenced in mid-October and had three periods of high activity which then declined in mid-November (Fig. 1). Fewer beetles were collected in sex attractant traps located at vine canopy height and high catches were made in late October and early November.

Fig. 1: Male grass grub beetle nightly flight activity assessed using attractant traps on the ground and at the level of the kiwifruit canopy.

Fig. 2: Numbers of beetles recovered from trays under foliage of un-treated kiwifruit vines. Insecticide application times are shown by arrows.

Trays beneath the untreated kiwifruit foliage captured 11 beetles/tray over 14 days whereas trays away from foliage captured one beetle/tray. Trays were mainly intercepting beetles dropping from the foliage during or after feeding rather than randomly due to flight activity. Live beetle catches recovered from trays placed beneath the vines commenced in mid-October, steadily rose to a peak over late October and early December and then persisted at lower levels until recording ceased in mid-November (Fig. 2). Catches in these trays did not always mirror activity measured by male attractant traps. For example on the 29 October the high peak catch in the tray trap indicates that beetles were active on the foliage and feeding probably occurred although the moderate winds and light rain disrupted catches in the male attractant traps.

Insecticide killing potency

Beetles were observed to begin feeding on all kiwifruit vines irrespective of insecticide treatment indicating that none were repellent. Total catches of beetles collected in trays under vines did not differ significantly between treatments. Of the beetles collected in trays from cypermethrin and methiocarb treatments an average of 60% and 52% respectively were dead over the 4 weeks of assessment (Fig. 3). These kills were significantly higher ($P < 0.05$) than the 40% obtained from azinphos-methyl which was significantly higher ($P < 0.01$) than the 10% mortality recorded in untreated plots.

Cypermethrin treatments had significantly ($P < 0.05$) higher kills over the first five nights after spray application ranging from 60-88%, than were achieved on night six and seven (13-14%). Methiocarb and azinphos-methyl gave high kills on the first night followed by a significant rate of decline ($P < 0.01$) amounting to 8 and 13% mortality per night respectively.

Damage

There was no sign of grass grub feeding damage to kiwifruit vines when insecticides were first applied, but became obvious by the end of October. Leaf damage, which was cumulative, became severe by the first week of November.

There was no significant difference in the levels of damage on small and large female vines. Male vines were significantly less ($P < 0.01$) damaged than female vines but this difference was less than 0.5 of a damage category and so the combined damage assessments are shown in Table 1. All insecticide treatments afforded significant ($P < 0.01$) protection from beetle chewing damage. Under the conditions of severe beetle attack, cypermethrin provided significantly better protection than methiocarb ($P < 0.05$) or azinphos-methyl ($P < 0.01$). Typically the leaf margins of untreated vines were completely chewed and large ragged holes were present in the leaves. The cypermethrin treated vines suffered much lower levels of damage although most leaves had obvious chewing damage along the margins and small holes between the leaf veins.

Fig. 3: Dead (shaded) and live grass grub beetles (not shaded) recovered from trays placed under kiwifruit vines following insecticide application. Tray catches are the total for the four insecticide application times.

TABLE 2: The effect on the summer growth of kiwifruit vines following the application of four cypermethrin sprays during October and November to protect vines from defoliation by grass grub beetles.

Date	Assessment	Untreated	Cypermethrin	SE (diff.)	Significance
22 Nov '83	Trunk diam. (mm)	20.3	20.3	0.1	NS
	Cane length (m)	3.8	3.9	0.5	NS
24 Jan '84	Trunk diam. (mm)	21.4	21.7	0.2	NS
	Cane length (m)	6.1	7.6	0.4	P < 0.05

Cypermethrin treated vines produced 1.5 m more cane than unsprayed vines, an increase of 65% in summer growth (Table 2). These differences could have been greater, as some canes were blown out by gale force northerly winds with the vigorously growing vines most affected.

DISCUSSION

Tray traps placed on the ground under the vines gave the best indication of feeding activity as catches were not reduced by windy or wet nights as were male trap catches. Long term information from traps is useful for predicting when to commence spray applications in future years. After 3 years of monitoring grass grub feeding flights in the Whangarei area it appears that applications should begin by 16 October.

Cypermethrin and methiocarb gave worthwhile protection of vines although damage still occurred under heavy beetle attack. Protection may be improved if insecticides were applied at 5 day intervals as killing potential declined markedly after this time. Six spray applications would then be needed as the main period of feeding activity extends over about 30 days. It may be preferable to improve the length of effectiveness by using higher than currently recommended rates of insecticide. Applications made at dusk may enhance the first night's kill particularly if this follows wet unsettled weather.

Young kiwifruit vines undergo a rapid growth phase in spring using stored food reserves. Growth after flowering appears to be dependent on the further accumulation of food reserves through photosynthesis. Young vines with an undamaged leaf canopy usually undergo further growth surges in January and/or February after which growth diminishes. When the spring-grown leaves suffer 50-70% defoliation due to grass grub attack then summer growth was shown to be markedly checked.

The superior summer growth and vigour shown by the cypermethrin protected vines compared to untreated vines was sufficiently great to recommend the application of specialist grass grub protectant sprays to young vines. In orchards where severe grass grub attack occurs a full protective spray programme of 4-6 sprays over the flight season may be warranted. However, on many orchards the level of attack may be much lower and a reduced spray programme of 2-3 sprays early in the flight season may be sufficient to reduce damage to acceptable levels.

The use of a specialist grass grub protectant spray such as cypermethrin could be used in a developing orchard which does not produce fruit. In producing orchards a pre-blossom spray of azinphos-methyl applied in early November can kill large numbers of grass grub. However, a single application of any of the short lived organophosphates will not give adequate long term protection. There is a need for the registration of a longer lived pyrethroid insecticide for use against grass grub adults in sub-tropical orchards. Although in kiwifruit orchards the main beetle attack occurs before flowering the effect on bees needs to be considered with other sub-tropical crops.

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