INSECTICIDES FOR ADULT GARDEN WEEVIL AND PROBLEMS WITH CONTROL ON GLASSHOUSE GRAPES

P.L. LO, R.H. BLANK and R.E. PARKER

MAF Technology, P.O. Box 943, Whangarei

SUMMARY

Adult garden weevils chew the leaves, young shoots and fruit stalks of grape vines and spoil the grapes with their faeces. Fourteen insecticides were screened in laboratory trials. Acephate, endosulphan, chlorpyrifos, lindane and deltamethrin produced the highest mortality levels (94-100%). The first three insecticides were tested in a commercial glasshouse, and none was significantly better than the others, although only acephate gave significantly higher mortality than untreated. Practical limitations on the use of the most effective insecticides make it difficult to achieve control of the weevils. Some alternative methods of protecting the crop are suggested.

INTRODUCTION

The garden weevil (*Phlyctinus callosus*) attacks various crops including pipfruit, stonefruit, grapes, citrus, root crops and asparagus in Australia (Sproul 1982), South Africa (Barnes 1988) and New Zealand (Prestidge and Willoughby 1989; Scott 1984). Although the garden weevil is presently a minor pest in horticultural crops in New Zealand, overseas quarantine restrictions, particularly in Japan, make it a potentially major problem for some exports.

On grapes, adult garden weevils feed on the leaves and young shoots (Scott 1984; Sproul *et al* 1982). Little damage usually occurs to the fruit itself, but the crop is spoiled by the deposition of faeces and chewing on the fruit stalks. Although these weevils are a minor pest to the glasshouse grape industry overall, they are a major problem for some individual growers.

The objectives of this study were to test the efficacy of a range of different types of insecticides against adult garden weevil and to test the most effective ones on glasshouse grapes.

MATERIALS AND METHODS

Laboratory trial

The efficacy of 14 insecticides (Table 1) to adult garden weevil was investigated using treated leaves to assess feeding plus contact activity, and treated vials to assess contact activity alone. The trial was conducted in October 1988 on adult weevils supplied by a commercial grape grower in west Auckland.

Mature grape leaves were trimmed to cover an 85 mm diameter petri dish. Three leaves per treatment were individually dipped for 5 seconds into 1 litre solutions of insecticide at label rates as well as a water control. Once dry, the leaves were placed in separate dishes, three weevils were introduced per dish and the dishes covered.

Each insecticide was dissolved in 50 ml of petroleum ether at label rates. For each treatment 0.25 ml of this mixture was pipetted into each of three glass vials. The interior surface was evenly coated with liquid before the ether evaporated. Control vials received ether only. Three weevils were placed in each vial which was then capped.

The weevils were assessed after 72 hours and categorised as dead, affected (on back or side, legs moving feebly), or alive (moving normally). All affected weevils died within 96 hours so these figures were combined with the number of dead weevils. An analysis of variance was performed on the number of dead weevils in the laboratory tests. The percentage of leaf area consumed was estimated visually.

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Glasshouse trial

In November 1989, three of the most effective insecticides from the laboratory trial were tested on glasshouse grape vines at the property that supplied weevils for the laboratory screening. The glasshouse was divided into 4 x 6.5 m plots and treatments were randomly assigned within the three replicates. No buffers were used. The vine canopy and trunk, plus the interior wall of the glasshouse were sprayed to run-off with a high volume hydraulic sprayer. The floor was not sprayed. The chemicals were used at label rates and control plots were sprayed with water. Approximately 5 litres of spray mixture was used per plot. The glasshouse doors and vents were closed to minimise spray drift.

The efficacy of the various treatments was assessed by collecting dying weevils which dropped from vines into trays. Two trays (45 x 60 cm) were positioned in the centre of each plot, under a main vine leader close to the glasshouse wall, where weevil numbers were highest. Weevils were counted daily for 4 days after spraying. The number of dead weevils in each treatment was compared by a rank analysis using Dunnett's test with a significance level of 5%.

TABLE 1: Mortality of adult garden weevil from 14 insecticides using a leaf and vial laboratory toxicity test.

Treatment	Trade Name	Rate (g ai/100 litres)	% Mortality		
			vial	leaf	combined
acephate	Orthene 75	75	100	100	100
endosulphan	Thiodan 35 EC	70	100	100	100
lindane	Lindane 20 EC	48	100	100	100
chlorpyrifos	Lorsban 50 WP	37	100	89	94
deltamethrin	Decis 2.5 EC	1.3	89	100	94
azinphos-methyl	Azinphos-methyl 50 WP	50	56	78	67
carbofuran	Furadan 75 WP	19	56	67	61
pirimiphos-methyl + permethrin	Attack 47.5 EC + 2.5 EC	47.5 2.5	100	22	61
dieldrin	Dieldrex 50 WP	50	89	22	56
methomyl	Lannate 20 EC	36	44	56	50
diazinon	Basudin 50 WP	50	56	11	33
carbaryl	Carbaryl 80 WP	120	33	22	28
methiocarb	Mesurool 75 WP	112.5	0	22	11
oxamyl	Vydate 24 EC	48	0	11	6
untreated control	—	—	0	0	0

RESULTS

Mortality from leaves and vials were not significantly different overall, $P=0.14$, so were combined for analysis. Five insecticides, acephate, endosulphan, lindane, chlorpyrifos and deltamethrin gave high levels of control (94-100% mortality) in the laboratory screening (Table 1). Another group of five chemicals gave intermediate levels of control (50-67%). This group included methomyl which killed 50% of the weevils, ranking it in the bottom half of the chemicals tested. The remaining four insecticides produced low mortality levels (6-33%). Pirimiphos-methyl/permethrin and dieldrin had lower mortality for leaves compared with vials. For individual leaves the area consumed ranged between 0-10%, but was less than 5% overall in all treatments.

In the glasshouse trial, none of the three insecticides proved significantly better, than the others, with only acephate significantly different ($P=0.04$) from the control. In the three insecticide treatments, the highest number of dead weevils was recorded on day one and except for two plots, none were found after day three.

TABLE 2: Mortality of adult garden weevil collected in trays under glasshouse grape vines sprayed with three insecticides.

Treatment	Rate (g ai/100 litres)	Total no. of weevils				
		Day 1	2	3	4	mean
acephate	75	12	4	8	5	7.3
endosulphan	70	8	2	5	1	4.0
chlorpyrifos	37	1	3	0	0	1.0
untreated	—	0	1	0	0	0.3

DISCUSSION

Five insecticides proved to be highly toxic to garden weevil in the laboratory. However, two of them cannot be used by growers. The pyrethroid deltamethrin is unsuitable in glasshouses due to the risk of inducing two-spotted spider mite (*Tetranychus urticae*) outbreaks (Penman and Chapman 1988), while the organochlorine lindane has been withdrawn from sale.

Results from the glasshouse trial suggest that the three insecticides became ineffective after about 3 days, but we did not demonstrate that one insecticide was significantly better than the others. Acephate showed the most promise for killing weevils on the vines. It was also effective against garden weevils on apple trees (Sproul *et al* 1982), but performed poorly in an asparagus plot (Prestidge and Willoughby 1989), when applied at a lower rate than we used. Our findings that chlorpyrifos performed better in a small scale bioassay than in the field were similar to the findings of Prestidge and Willoughby (1989). The effectiveness of the three insecticides tested on glasshouse grapes needs to be verified, however, since we did not directly assess weevil mortality on the vines.

None of the remaining insecticides were effective in the vial and leaf tests. This included methomyl, which is registered for use on glasshouse grapes after flowering. It is used principally against mealy bug (*Pseudococcus* spp.) and to a lesser extent against garden weevil. In our study it gave poor control of the weevils. Pirimiphos-methyl/permethrin and dieldrin were effective only in the vial test which perhaps indicates a greater fumigant effect or some repellent property of the leaf discs.

The control of garden weevil on glasshouse grapes is made difficult by the extended period of emergence of the adults. This occurs from October to December (Prestidge and Willoughby 1989; Scott 1984), and coincides with flowering of the vines. During this time a high labour input is required to thin fruit bunches and tie down leaf shoots, making it impractical to spray frequently. There is a conflict between the need for short lived sprays to minimise the danger to workers and the continual emergence of adult weevils. Asparagus growers face similar problems (Prestidge and Willoughby 1989).

Problems encountered in attempting to control weevils in the glasshouse suggest that alternative approaches may be necessary. The weevils appear to be invading the glasshouse from outside, but may also be emerging inside. The flightless adults can be targeted before they enter the glasshouse. Potential ways of keeping them out are a physical barrier such as a water filled moat or a sticky strip around the glasshouse, or a chemical barrier in the form of a long lasting residual insecticide or slow release encapsulated granules. The soil dwelling larvae could be controlled by treating the glasshouse floor and surrounding area with a residual insecticide.

More research is necessary to refine control methods and confirm the longevity of sprays for garden weevil on glasshouse grapes. Keeping weevils off the grape vines by physical or chemical means may be a preferable solution.

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