SCREENING INSECTICIDES TO PROTECT TAMARILLO AGAINST GRASS GRUB ADULTS

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SUMMARY

Sixteen insecticides were applied to tamarillo (*Cyphomandra betacea*) trees after grass grub (*Costelytra zealandica*) feeding flights commenced. In a 1982 trial, fifteen of these insecticides gave a significant reduction in feeding damage compared to the unsprayed controls. Timing of insecticide application was crucial to the prevention of damage.

INTRODUCTION

Subtropical fruit production in Northland is largely confined to the free-draining red and brown loam soils which can harbour high populations of grass grub. The mass flights of adult beetles which occur in the spring can cause severe defoliation of grafted kiwifruit (*Actinidia chinensis*) avocados (*Persea americana*) and tamarillos. Up to 80% of leaves can be affected by chewing damage (Blank and Olson 1982). Diazinon sprays are ineffective at preventing damage to tamarillos.

A number of studies have investigated the activity of insecticides against grass grub adults (Fenemore 1968; du Toit 1978; Holland *et al* 1981; Henzell *et al* 1983) and have stressed the importance of time of application in controlling grass grub in pasture (East *et al* 1979). These studies have concentrated on insecticides with a high contact action and rapid knockdown, such as the synthetic pyrethroids. In an orchard situation, protection may also be obtained through stomach action and antifeedant effects.

In this study a range of insecticides was screened for their ability to protect tamarillos from grass grub adult feeding damage.

MATERIALS AND METHODS

Insecticides were applied to seven-year-old red tamarillo trees at a Maunu orchard in 1981, and three-year-old yellow tamarillo trees at a Poroti orchard in 1982. Trees in the 1981 trials had been hard pruned in October and had vigorous new growth but an incomplete canopy. Trees in the 1982 trial were lightly pruned in September and had a full canopy at spray application.

Traps for monitoring male grass grub flight were made from 1.2 litre AH1 standard plastic jars with three horizontal slits (900 x 350 mm) cut 800 mm from the base. Traps were baited with a diazonium resin formulation (0.4 g) of the grass grub male attractant supplied by Dr R.F. Henzell (Ruakura Agricultural Research Centre). The resin was held in a glass vial suspended beneath the lid of the jar and above the detergent water collecting fluid. Two traps were placed on the ground and two traps in the tamarillo canopy in unsprayed areas of each trial area.

Insecticides were applied to tamarillo trees on the 19th and 28th of November in 1981 and on the 3rd, 11th and 23rd of November in 1982. Trees were sprayed to run-off using a Solo knapsack sprayer with a No. 6 tip and No. 25 swirl plate. Insecticides at the rates recommended for foliar pests (Table 1) were applied to plots comprised of a single tree separated by guard trees along the rows. Sprayed rows were separated by unsprayed guard rows. Treatments were randomly allocated amongst the five replicates in 1981 and eight replicates in 1982.

Beetles which had dropped into a tinfoil tray (480 x 280 mm) covered with bird netting, one per tree, were collected early each morning. Beetles were considered dead if after being placed on soil they had not burrowed into the soil within 4 hours.

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Damage assessments were made in the 1981 trials from five randomly selected bunches of five terminal leaves. The percentage of leaf area lost due to chewing damage was visually assessed. In the 1982 trials, five bunches of five undamaged terminal leaves were tagged following insecticide application. Tagged leaves were assessed for damage using a scale of

- 0 = nil damage
- 1 = slight marginal chewing damage
- 3 = one leaf or more greater than 5% of area eaten
- 9 = three leaves or more greater than 25% of area eaten.

Damage assessments were made before each spray application with final assessments made on the 11th of December in 1981 and the 3rd of December in 1982. Data from the three assessments were combined for an analysis of variance and presentation of results.

RESULTS

Male grass grub flights commenced each season in mid-October, but remained at low levels until November when mass flights commenced (Fig. 1). Ground trap catches were of similar magnitude in both seasons. Tree trap catches were greater in the 1982 season with 11 nightly catches greater than 15 per trap compared with one in 1981. Maximum and minimum air temperatures were 3-4°C warmer over the major flight period in 1982 compared with 1981 and this may have encouraged the greater flight activity in the tree canopy in 1982.

Fig. 1: Male grass grub beetle flight activity assessed using sex attractant traps on the ground and in the tamarillo tree canopy in 1981 and 1982.

In both seasons, the first spray applications were applied following the commencement of flight activity in the crop canopy but on both occasions feeding damage had already occurred. This was particularly noticeable in the 1982 trials when considerable feeding damage occurred over the two nights that the trial was being set up. This background level of damage reduced the sensitivity of treatment damage assessments, in particular when leaves were randomly assessed in the 1981 season. Also, in the 1982 season it meant that many of the high branchlets which are more prone to damage could not be tagged and lower branchlets had to be used.

There was no significant difference between treatments in the numbers of total or dead grass grub recovered from trays. Total catches were highly variable between treatments and seasons. For example, untreated trees had the lowest catches in 1981 but the highest catches in 1982.

Damage due to grass grub feeding was low in 1981 (0.5 — 2.2%) and there was no significant difference between treatments. Damage was higher in 1982 with all insecticides, with the exception of acephate, reducing damage significantly ($P < 0.05$).

The relationship between numbers of dead grass grub collected in trays underneath tamarillo trees and grass grub chewing damage in the 1982 trial is illustrated in Fig. 2.

Fig. 2: The relationship between tamarillo leaf damage and the total dead grass grub collected in trays under eight trees in 1982 for a range of insecticides. The damage ranking scale used (see text) was the total of three assessments.

TABLE 1: Insecticides screened as protectants against grass grub beetle damage to tamarillo.

Group	Insecticide	g ai/100 litres water
carbamate	carbofuran (Furadan 75 WP)	157
	carbaryl (Carbaryl 100 WP)	150
	methiocarb (Mesurol 75 WP)	113
	cypermethrin (Ripcord 20 EC)	7.1
pyrethroid	deltamethrin (Decis 2.5 EC)	0.7
	fenvalerate (Sumicidin 10 EC)	9.4
	chlorpyrifos (Lorsban 50 WP)	25
organophosphate	azinphos-methyl (Azinphos Methyl 50 WP)	50
	diazinon (Basudin 50 WP)	50
	acephate (Orthene 75 WP)	75
	dimethoate (Rogor 20 WP)	32
	dichlorvos (Vapona 100 EC)	100
organochlorine	isazophos (Miral 50 EC)	140
	lindane — 20 EC	50
	endosulfan (Thiodan 35 WP)	70
pyrethroid/organo-phosphate mixture	pirimiphos-methyl/permethrin (Attack 47.5/2.5 EC)	47.5/2.5

There was no apparent relationship between an insecticide's protectant ability and knockdown activity. Materials such as pirimiphos-methyl/permethrin may have given protection through a repellent action, whereas materials such as cypermethrin appeared to give protection through a quick-acting knockdown effect.

Grass grub beetles appeared to be concentrated in certain parts of the orchards as significant differences ($P < 0.01$) were found between replicates for both grass grub collected in trays and damage (1982). Beetle flight was concentrated along shelter tree lines but flight between tamarillo trees appeared to be random. Feeding activity was often concentrated on certain parts of the tamarillo with groups of copulating beetles clustered together.

DISCUSSION

These trials were frustrated by difficulties in predicting when major feeding flight would occur and by the variable movement of beetles throughout orchards with apparent concentrations in some areas, possibly because of shelter proximity, wind protection, higher ground or mating groups. The single tree plots used were too small to minimise random movements effectively between plots, as illustrated by the high number of dead beetles under untreated tamarillos in 1982, which probably originated from insecticide-treated trees. These screening trials have, however, identified a number of insecticides capable of providing some protection against grass grub attack. In the 1982 trial, acephate showed considerable knockdown activity but was apparently too slow-acting to prevent some chewing damage (Fig. 2). All of the other chemicals tested in this trial gave a significant reduction in leaf damage. While differences in damage between these chemicals were not significant, at the application rates used the three carbamates and cypermethrin had the lowest damage rankings (Fig. 2).

Protection from leaf feeding beetles may be mediated through contact and oral ingestion of insecticides resulting in knockdown, toxicity or antifeedant effects which may vary according to concentration (persistency). Holland *et al* (1981) found, in a laboratory study, that pyrethroids had the quickest knockdown activity against grass grub beetles with carbamates more effective than organophosphates. The antifeedant and irritancy effects of cypermethrin and permethrin are well known (Tan 1981) but carbaryl has also been used as an antifeedant to protect apples from defoliation by beetles (Chowdhuri and Verma 1979). The protection afforded by the carbamates against grass grub feeding activity may have been due to a combination of knockdown, toxicity and possibly antifeedant effects.

The choice of insecticide for use in various orchard systems will be governed by activity against other insect pests as well as grass grub and compatibility with current spray programmes. However, a specialist grass grub spray may be appropriate for young unproductive grafted plants and for subtropical fruits which do not flower until late November.

This study has shown that the timing of insecticide applications is crucial if damage is to be avoided. Insecticide applications were withheld until feeding flights began after the clearance of wet rainy weather. It took 2 days to set the trials up, by which time two massive feeding flights had already occurred.

Grass grub damage is not always severe each season and appears to depend on warm, calm conditions without rain for mass flights to occur. Growers are therefore faced with the application of an insurance spray approximately mid-October with repeat applications, depending on the persistency of the spray used, until early December. The application of insecticides as a blanket spray throughout an orchard and shelter should give superior protection than was achieved in this trial using individual trees.

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