EVALUATION OF CYPERMETHRIN FOR CONTROL OF ADULT GRASS GRUB

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Summary

Two trials were conducted at Paewhenua and Takapau comparing three and four rates of cypermethrin respectively, applied as a foliar spray to pasture against the adult stage of grass grub (*Costelytra zealandica*). Applications were made at 5-13 day intervals, so that some plots were sprayed once, others twice and the remainder three times during the beetles flight period. At both sites, three applications gave significant reductions in the subsequent larval population (50-70% at Takapau; and 76-94% at Paewhenua), with no differences between rates. Double and single applications, in most cases, did not give significant reductions below control.

INTRODUCTION

Prior to 1964, the use of insecticides to control the adult stage of grass grub had received little attention (Fenemore, 1964). Perrott (1964) topically screened a range of chemicals and evaluated them in a simulated spray trial. Only trichlorfon, which breaks down to dichlorvos, showed promise. Subsequent field trials which included DDT, trichlorfon and chlorpyrifos were considered largely unsuccessful (Fenemore and Perrott, 1970; Fenemore, 1970). The materials evaluated in these trials failed for a number of possible reasons. Either the insecticides were not persistent enough between treatments, lacked effective contact and/or vapour action or; the behaviour of the beetles prevented contact with the applied chemical. W.M. Kain (pers comm) has observed that mating can occur in the ground and that adult activity on pasture is adversely affected by weather conditions.

Control of grass grub beetles is theoretically a sound concept, as mortality on the adult stage added to mortalities on the preceding age intervals in the life cycle, must have a better chance of allowing generation mortality to exceed the constant mortality rate (Pottinger 1967) and consequently, effect a decline in the size of the next generation. If insecticide can be used to regulate populations in this manner, then infestations of grass grub could be maintained below damaging levels from one year to the next.

Over the past decade attention has been given to grass grub attractants and sex pheromones (Osborne and Hoyt 1969, 1970; Henzell

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and Lowe 1970). One means of utilizing pheromones and attractants is in conjunction with insecticides. In 1975, G.O. Osborne, R.B. Chapman and J. Boyd (pers comm) investigated several insecticides, including the synthetic pyrethroids, cypermethrin and permethrin, (two formulations, WL 43479 and NRDC 143) with this objective. Non-commercial preparations of all three materials were successfully applied as two applications of 0.6 kg/ha during the flight period, the highest reduction in size of the next generation being achieved with cypermethrin.

The trials with cypermethrin reported in this paper are part of a series conducted by MAF, Shell Chemicals and Lincoln College to establish the timing, rate and method of application of synthetic pyrethroids used alone and in conjunction with Durez 12687 (male grass grub attractant), against grass grub beetles.

METHODS

Two randomized trials were conducted in 1976, at Paewhenua near Otorohanga and at the Takapau Research Station to compare rates of cypermethrin, with three times of application combinations for each rate. The chemical used was an emulsifiable concentrate containing 400 g cypermethrin/litre. Each treatment was replicated four times. The time of application combinations used were:—

- one application applied at pre-peak flight activity
- two applications applied consecutively at pre- and post-peak flight activity
- three applications applied consecutively at inception of noticeable flight, (and commencement of oviposition) pre-, and post-peak flight activity.

As most grass grub flight occurs within a 3-4 week period, after first significant flight and mating commences, it was planned to apply the insecticide at 7-10 day intervals. Because of adverse weather conditions these intervals could not always be met.

The times of application of treatments for each trial were established by monitoring grass grub activity each day with the aid of Durez 12687 resin baited traps (C.P. Hoyt and G.O. Osborne, pers comm) and dissection of female beetles collected from the soil each week for reproductive condition. The dates of pertinent flight information and dates of treatment applications are given in Table 1.

Both trials were sampled for grass grub with a 10 cm diameter soil corer, 12 samples being taken at each sampling at Paewhenua and 15 samples at Takapau, from each plot. All samples were hand sorted, except the sample to estimate egg and first instar larval populations at Paewhenua which were sorted by wet sieving and flotation in magnesium sulphate solution (Kain and Atkinson 1976). Prior to emergence of adult beetles in the spring the Paewhenua trial area had a mean population of 129/m² and Takapau site 105/m².

Each trial was grazed two days before application of the first and third spray treatments. Throughout the duration of both trials, weather conditions were wetter, windier and cooler than average, adversely affecting above ground activity of the beetles and the precise

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timing of insecticide applications. Rain did not fall immediately following application of the cypermethrin, which is strongly absorbed on foliage and not affected by rain after the spray has dried.

TABLE 1: Data on grass grub flight activity and dates of cypermethrin application at Paewhenua and Takapau.

Trial Locality	Flight Activity	Date of spray application	
Paewhenua	First noticeable flight	15.10.76	21.10.76
	Peak flight	3.11.76	28.10.76
	End of noticeable flight	16.11.76	9.11.76
Takapau	First noticeable flight	8.11.76	12.11.76
	Peak flight	23.11.76	17.11.76
	End of noticeable flight	4.12.76	30.11.76

At Paewhenua cypermethrin was applied at 0.15, 0.3 and 0.6 kg/ha, through a standard boom in 200 litres/ha at 200 kPa, on 100m² plots. Pasture height varied from 3-10 cm during the trial.

Four rates of cypermethrin, 0.075, 0.15, 0.3 and 0.6 kg/ha in 250 litres were applied at Takapau at 250 kPa to 36m² plots. Pasture length varied from 2.5-12.5 cm during the trial.

RESULTS

The results of both trials are summarized in Table 2.

TABLE 2: Summary of timing and rate of application trials for cypermethrin applied to pasture for control of grass grub beetles.

Treatment		Takapau	Paewhenua	
Rate (kg/ha)	No. of sprays	3rd-instar larvae/m ²	eggs and 1st-instar larvae/m ²	3rd-instar larvae/m ²
0.60	1	151.5 abc	66.8 a	20.6 a
0.30	1	57.3 e	71.9 a	30.8 a
0.15	1	140.0 abcd	79.9 a	5.2 b
0.075	1	104.4 bcde		
0.60	2	108.2 b	10.2 b	25.6 a
0.30	2	120.9 abcde	20.6 b	25.6 a
0.15	2	187.1 a	120.8 a	18.0 a
0.075	2	95.5 cde		
0.60	3	50.9 e	25.6 b	5.2 b
0.30	3	70.0 de	10.2 b	2.6 b
0.15	3	72.5 de	15.4 b	10.2 b
0.075	3	85.3 cde		
untreated	—	170.0 ab	150.7 a	41.9 a

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At both sites, three applications of cypermethrin gave significant reductions in the size of subsequent larval populations (50-70% at Takapau; 76-94% at Paewhenua) with no differences between the rates. The single and double times of application did not consistently give reductions significantly below control.

Some of the variation in the results may reflect the high variability associated with samples from highly aggregated grass grub populations.

DISCUSSION

The results obtained indicate that cypermethrin can reduce the size of grass grub populations in the subsequent generation significantly, by controlling the adult stage and thus preventing oviposition. The superior performance of three over single and double applications is unlikely to have been due entirely to the effects of the first application (at the start of the noticeable flight), which was not included in the single and double treatments. The half-life of cypermethrin on pasture, for instance is 4 to 5 days (Lauren and Henzell 1977).

Some variability is apparent in the results with single and double spray applications and in the reductions achieved with triple applications at the two sites. This variability may be partly a result of variations in weather and height of pasture during the flight period. At both Paewhenua and Takapau, weather conditions inhibited flight on several evenings and may have induced mating in the soil, allowing eggs to be laid before the females came in contact with insecticide. In an independent trial at Takapau in 1976, W.M. Kain (pers comm) found that the height of pasture significantly affected the results achieved when applying insecticide against grass grub beetles. Pasture 120-200 mm long enhanced the effect of cypermethrin (92% reduction over control) compared with pasture 30-60 mm long (82% reduction over control). The pasture in both the Takapau and Paewhenua trials was relatively well grazed, although grazing pressure was discontinuous across both sites and could account for some of the variability apparent in the results.

The main conclusion that can be drawn is that cypermethrin offers a possible alternative insecticidal control for grass grub. From a practical point of view the projected high cost of the chemical and the number of treatments required on a pasture during the flight period mean that this chemical will have to be effective at low rates. The results in this study (Table 2) suggest that lower rates than those tested may be effective. Another possible problem with this approach is bee mortality in pastures with clover in flower. If these problems can be overcome, then synthetic pyrethroids such as cypermethrin, may extend the period in which insecticidal strategies can be applied against grass grub.

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