THE POTENTIAL OF ONE HIGH RATE APPLICATION OF SYNTHETIC PYRETHROIDS FOR CONTROL OF ADULT GRASS GRUB

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SUMMARY

A single application of deltamethrin WP gave good control of grass grub (*Costelytra zealandica*) adults in two successive years. In one trial, equivalent control was achieved on two different spray dates 6 days apart. These findings should considerably reduce the practical problems in using foliar adulticide sprays for grass grub control, and should reduce the overall precise timing requirement for applications. There was a trend to less reliable results from single applications of deltamethrin EC compared with deltamethrin WP, while single applications of a microencapsulated permethrin formulation were inferior.

INTRODUCTION

In the last 6 years, work has been done to establish the principle of controlling grass grub populations by the use of fast acting foliar insecticides applied to pasture at the time of beetle primary emergence and mating. Synthetic pyrethroids have been used and have given reductions in the subsequent larval populations in the range 60-95%, and generally above 80% under optimum conditions. Two reports (Lauren *et al* 1978; East *et al* 1979) showed that, for maximum effect, the insecticide application must be accurately timed. Other work (Henzell and Lauren 1981; Lauren *et al* 1981) has described the use of sex attractant trapping to predict the correct application date. One short-coming of the method has been that in order to obtain adequate control from even high application rates, multiple applications have been necessary (Pottinger *et al* 1977). In general, three applications at 6 day intervals have been needed to cover the entire grass grub mating period adequately with standard EC formulations of synthetic pyrethroids. This is because the rapid contact activity of the insecticides is lost within 4-9 days of application to pasture despite the continued presence of potentially active residue levels (Henzell and Lauren 1978). Alternative formulations have been tested in an attempt to overcome this problem and some have shown promise (Lauren *et al* 1979).

The requirement for multiple applications at a time when weather conditions are frequently unsettled is a major practical problem with this approach to grass grub control. Multiple applications also reduce acceptance of the method by their inconvenience, especially in view of the relatively precise timing required with each application for maximum effect. A successful one-spray treatment would make the method more acceptable and would reduce application costs. It would also facilitate implementation by effectively reducing the overall requirement for accuracy. East *et al* (1979) showed that provided the insecticide treatment commenced within a 6-7 day period around the optimum date, the level of control was relatively unaffected. This was for a spray programme able to maintain toxicity on the foliage for about 18 days.

This paper describes two trials in which single high rate applications of synthetic pyrethroids have been used to control grass grub populations. The treatments have included formulations other than the standard EC formulations as well as a comparison of two different application times.

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METHODS

Trial 1 — October 1980

The trial site was on a flat dairy farm at Horahora on Tirau mottled sandy loam. The plots (7 x 7 m) were surrounded on all sides by a 3 m buffer strip. One month prior to the first treatment all plots were sampled for grass grub by taking five 30 cm square divots from the inner 5 x 5 m of each plot. Pre-treatment grass grub populations in the plots were in the range 29-111/m². The plots were grouped into six blocks with respect to these larval numbers, and treatments randomly allocated within the blocks. Treatments were applied by hand held gas powered sprayer. The water rate was 250 litres/ha delivered by 730154 fan nozzles at 210 kPa. The chemical rates used at each application are given in Table 1. The pasture height at the first application date was 3-6 cm and the trial area was not grazed until at least 12 days after the final application. Post-treatment grass grub populations were assessed in April 1981 by taking 25 soil cores (10 cm dia.) from the inner 5 x 5 m of each plot.

Application dates were determined using the method outlined in Henzell and Lauren (1981) for the 'Ideal Mating Period' (IMP) starting date. The three preceding years' beetle flight data from the site were available, and predicted an IMP starting date of October 19. The single application treatments were applied on October 17, and the multiple application treatments on October 17, 23 and 29.

The chemicals used were deltamethrin (2.5 EC; Roussel Uclaf), deltamethrin (2.5 WP; Roussel Uclaf; 1.2 U0530) and cypermethrin (40 EC; Shell Chemicals). The sticker was 'Ortho Spray Sticker' added to the spray mix at 0.5 ml/litre.

Trial 2 — October 1981

The trial site was on a flat dairy farm at Cambridge on Horotiu sandy loam. The plots (6 x 4.8 m) were surrounded on all sides by a 1 m buffer strip. One month prior to the first treatment all plots were sampled for grass grub by taking 20 soil cores (10 cm dia.) from each plot. Pre-treatment grass grub populations in the plots were in the range 38-121/m². The plots were grouped into five blocks with respect to these larval numbers, and treatments randomly allocated within the blocks. Treatments were applied using a 'Mystifier' knapsack spray pump. The water rate was 300 litres/ha delivered by 730154 fan nozzles at 210 kPa. The chemical rates used at each application are given in Table 2. The pasture height at the first application date was 4-8 cm and the area was not grazed until at least 12 days after the final application. Post-treatment grass grub populations were assessed in April 1982 by taking 24 soil cores (10 cm dia.) from the inner 5 x 4 m for each plot.

Application dates were determined from the four preceding years' flight data. The predicted IMP starting date was October 23. The single application treatments were applied on October 20 or 27, an application of each chemical at each date. The multiple application treatment was applied on October 23, 29 and November 4.

The chemicals used were deltamethrin 2.5 EC, deltamethrin 2.5 WP (1.2 V0410), cypermethrin 40 EC and microencapsulated (micro-) permethrin (200 g/litre; ICI Tasman Ltd.).

For both trials, grass grub beetle flight was monitored with five sex attractant traps and samples of female beetles were collected from the soil profile at 3-7 day intervals over the trial period and examined for mated condition.

In trial 2, field results were backed up by bioassays and chemical residue analysis of the treated pasture.

Field results from both trials were assessed by analysis of variance of the log-transformed data.

RESULTS

All treatments in both trials (Tables 1 and 2) gave a significant reduction in subsequent larval populations ($P < 0.01$; $P < 0.05$ for micro-permethrin treatments). Trial 1 showed that a single high rate application of deltamethrin WP, with or without sticker, gave equivalent control to the two multiple application treatments. This result was repeated in trial 2 where single applications of deltamethrin WP were made on two different dates, and both gave equivalent control to the multiple application cypermethrin treatment. Trial 2 gave no significant overall difference

TABLE 1: Trial 1, summary of treatments and resulting reductions in the subsequent grass grub larval populations.

Chemical	Rate (g/ha)	Application	Control* (%)
deltamethrin 2.5 EC	35	Multiple	89
deltamethrin 2.5 WP	105	October 17	88
deltamethrin 2.5 WP + sticker	105	October 17	91
cypermethrin 40 EC	100	Multiple	85
untreated	-	-	0

* % reduction in larval population of treated plots compared to untreated plots.
The average population in untreated plots was 101/m².

TABLE 2: Trial 2, summary of treatments and resulting reductions in the subsequent grass grub larval populations.

Chemical	Rate (g/ha)	Application	Control* (%)
deltamethrin 2.5 EC	100	October 20	67
		October 27	78
deltamethrin 2.5 WP	100	October 20	81
		October 27	84
permethrin micro	600	October 20	58
		October 27	48
cypermethrin 40 EC	100	Multiple	82
untreated	-	-	0

* as for Table 1

Average population in untreated plots was 77/m².

between deltamethrin EC and WP and no significant effect of the date of single application treatments although there was a suggestion ($0.1 > P > 0.05$) that the deltamethrin EC application on October 20 was inferior to the other deltamethrin treatments. The permethrin treatments were inferior to all deltamethrin treatments ($P < 0.05$).

DISCUSSION

These trials have shown that the practical use of a single application of a sustained activity synthetic pyrethroid formulation for adult grass grub control is possible. In all applications of deltamethrin WP, a high level of control was obtained. Deltamethrin EC was seen to give reasonable control from a single high rate application, but there was a tendency to lower control at the earlier application date. This suggests that while it is possible to obtain good control with one application of the high rate of the EC, the use of this formulation would require more precise synchronisation of the application to the beetle mating period. This idea is supported by the mating data obtained from the site which showed that mating activity did not commence until after October 27 in 1981. This is at least 7 days after the first deltamethrin EC treatment, and as Henzell and Lauren (1978) have shown, the contact activity of even relatively high rates of synthetic pyrethroid EC formulations diminishes rapidly after about 7 days.

The lower levels of control obtained with micro-permethrin were disappointing. This formulation has consistently shown extended field life in bioassays (Henzell *et al* 1979; and further trials by the authors), and has worked well in a field application using two sprays 9 days apart (Lauren *et al* 1979). In addition, bioassays conducted in conjunction with trial 2 suggested that 600 g/ha of micro-permethrin retained activity

for at least 15 days, compared with 9 and 11 days for 100 g/ha deltamethrin WP and EC respectively. However, in practice, the order seems reversed. Deltamethrin has often performed better in practice than has been suggested by bioassays (Henzell *et al* 1979), and it is possible that in the field it has a different mode of action than permethrin or cypermethrin. Residue analysis of the treated foliage directly after spraying suggested that all treatments had been applied at the correct rates.

The timing of the single spray applications in both trials was determined using the IMP method described by Henzell and Lauren (1981). In trial 1, both single application treatments were applied 2 days before the predicted IMP date. In trial 2, single application treatments were applied 3 days before or 4 days after the predicted IMP date. The consistently high control obtained using deltamethrin WP at these different application times is consistent with the results of East *et al* (1979) and suggests that this formulation has a sufficiently long field activity to make single applications a practical proposition for adult grass grub control. Provided the application is made during a 6 day period about the predicted IMP date, good control may be expected. The alternative spray date prediction method outlined by Henzell and Lauren (1981), 'Trigger Point', is suitable for sites for which no previous flight information is available. The predicted 'Trigger' dates for trials 1 and 2 were October 21 and October 28 respectively. Since grass grub mating activity during trials 1 and 2 was estimated to commence about October 24 and October 31 respectively, and by extension of the trial 2 results, single applications of deltamethrin WP on the 'Trigger' dates should also have been successful in both trials 1 and 2.

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