NEW APPROACH AND CHEMICALS FOR GRASS GRUB ADULT CONTROL

D.R. LAUREN, R.F. HENZELL, N.R. WRENN
and N.A. THOMSON*

Ruakura Soil and Plant Research Station, MAF, Private Bag, Hamilton
**Taranaki Agricultural Research Station, MAF, Normanby*

SUMMARY

Five trials are reported comparing spray and granule treatments for control of adult grass grub, *Costelytra zealandica*. Compared to a multiple spray treatment of cypermethrin (65% control), single spray treatments of other synthetic pyrethroid formulations were found inferior. The best was cyhalothrin (49% control). This chemical also gave about 70% control with two sprays of 50 g ai/ha at an 8-day interval. The synthetic pyrethroid PP 993 was effective as a microgranule formulation but not as an EC. At 100 g ai/ha it gave from 23-49% control and at 200 g ai/ha, 62-74% control. Late spring applications of lindane (2 kg ai/ha) gave low control (26-53%) and this was attributed to insufficient surface coverage by the 20 G formulation. Three strategies for control of grass grub populations as adults are outlined.

INTRODUCTION

The technique of controlling grass grub populations with synthetic pyrethroids applied to pasture at the time of beetle primary emergence and mating has been extensively studied in recent years. The importance of timing the spray programme correctly has been established and a number of chemicals, rates and formulations have been tested (see Venning *et al* 1982 and references therein). The method is experimentally reliable, but several problems remain regarding the transition to a practical control measure. Most of these problems relate directly to the high cost of currently available synthetic pyrethroids.

This leads to a complex interaction of factors. Rates must be forced to the low limit of activity leaving little margin for timing or application error. Despite successes with single application treatments (Venning *et al* 1982), multiple applications appear to be necessary for consistent results (authors' unpublished data). Compounding this problem is the inefficiency of standard spray application equipment, which commonly achieves less than 50% of the theoretical application to short pasture surfaces (Lauren *et al* 1981; authors' unpublished data).

Attempts to avoid these problems with the synthetic pyrethroids have included the use of soil insecticides (Henzell *et al* 1983 and references therein). Of the chemicals tested, only lindane has given satisfactory results in the field (authors' unpublished data).

This paper reports on trials where two new synthetic pyrethroid chemicals were tested. Both sprays and granules were used. One chemical has the potential to reduce the cost of spray treatment while the other is a soil active pyrethroid applied as microgranules. It is therefore a new approach to attacking moving insects in pasture.

METHOD

Each trial except trial 1 (4 replicates) had 6 replicates of each treatment and used 6 x 4.8 m plots. Grass grub populations were assessed by taking 18-24 soil cores (10 cm diam.) from each plot. Pre-treatment assessments were made about 8 weeks before beetle emergence, and post-treatment assessments in the April after treatment. The plots were blocked with respect to pre-treatment larval numbers, and treatments and an untreated control randomly allocated within the blocks. The trial sites were grazed

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within 5 days of the first treatment, and stock were not returned until beetle mating activity had ceased.

Application dates for all treatments were based on the "Ideal Mating Period" (IMP) starting date (Henzell and Lauren 1981) for each site. Soil sampling was carried out at 3-5 day intervals during the flight season to monitor grass grub development and mating. Spray treatments were applied with a knapsack boom sprayer fitted with 730154 flat fan nozzles and delivering 300 litres/ha. Granule treatments were applied using small hand shakers.

Statistical evaluation was by analysis of variance on square root transformed data. Standard error of the difference (SED) of means of raw data given in Table 1 are therefore approximate.

Trial 1 - October 1982

On a flat dairy farm at Cambridge on Horotiu sandy loam. Pre-treatment grass grub populations in the plots were in the range 30-127/m². The IMP date for the site was October 23, and mating occurred between October 28 and November 8. The 11 treatments were cypermethrin (Ripcord 20 EC) with 3 applications at 6-day intervals, each at 100 g ai/ha; three formulations of deltamethrin (Decis 2.5 EC, WP and Flowable) each applied once at 100 and 50 g ai/ha; experimental pyrethroid PP 993 (10 EC from ICI Plant Protection Division) applied once at 100 and 50 g ai/ha; cyhalothrin (20 EC supplied by ICI Australia) applied once at 100 and 50 g ai/ha. All single applications and the first application of the multiple spray treatment were applied on October 22.

Trial 2 - October 1982

On a dairy farm at Normanby on Egmont brown loam. The pre-treatment population was in the range 140-200/m². The IMP date for the site was October 26 and mating occurred between November 2 and 12. The three treatments were deltamethrin (flowable formulation), one application at 200 g ai/ha on October 26; PP 993 (10 EC) applied once at 100 g ai/ha on October 26; PP 993 (1 G from ICI Plant Protection Division) applied once at 100 g ai/ha on October 22.

Trial 3 - October 1982

On a sheep and cattle farm near Tihoi on Taupo hill soil. The pre-treatment population was in the range 35-312/m². The IMP date was November 11, and mating occurred between November 18 and 30. The nine treatments were lindane (Shell Lindane Pellets 20 G) applied at 2 kg ai/ha on October 28; chlormephos (Dotan 20 G) applied at 2 kg ai/ha on October 28 (T 1) or November 8 (T 2); experimental pyrethroid R 119364 (1 G from ICI Plant Protection Division) applied at 100 g ai/ha on T 1 or T 2; PP 993 (1 G) applied at 100 g ai/ha on T 1 or T 2; R 119364 (10 EC) applied at 100 g ai/ha on T 2; PP 993 (10 EC) applied at 100 g ai/ha on T 2.

Trial 4 - September/November 1983

On the paddock adjacent to Trial 3. The pre-treatment population was in the range 21-319/m² and mating occurred between November 10 and 22. The five treatments were lindane (20 G) applied at 2 kg ai/ha on September 16; PP 993 (1 G) applied at 100 and 200 g ai/ha on November 4; cyhalothrin (5 EC from ICI Tasman Ltd) applied at 30 and 50 g ai/ha on November 10 and 18.

Trial 5 - September/November 1983

On a cattle farm near Atiamuri on Oruanui loamy sand. The pre-treatment population was in the range 71-418/m². The IMP date for the site was November 2 and mating occurred between November 2 and 18. The treatments were as for Trial 4 with application dates of September 16, October 26 and November 2 and 11 respectively.

RESULTS AND DISCUSSION

Trial 1 tested various spray treatments and further examined the potential of single applications following the successful trials reported by Venning *et al* (1982). The success with single applications of deltamethrin was not repeated. These treatments gave no significant differences from untreated controls, with numerical population reductions of about 30% for the higher rate. There were no differences between formulations. The experimental pyrethroid PP 993 gave no population reduction. Cyhalothrin gave 49% control ($P < 0.05$) at the higher rate, with 28% (non-significant) at the lower rate. The

multiple spray treatment of cypermethrin gave 65% control ($P < 0.01$). This is lower than the 70-95% control previously obtained with similar treatments applied by knapsack sprayer (Venning *et al* 1982 and references therein).

In Trial 2, only the single treatment of deltamethrin and the PP 993 microgranules showed drops in population compared to untreated controls. These were about 25%, but the differences were not significant.

Trial 3 tested insecticides that had shown activity against beetles in soil bioassays (Henzell *et al* 1983). Chlormephos, the experimental pyrethroid R 119364 either as microgranule or EC, and PP 993 as an EC gave no reduction in the following larval population. PP 993 microgranules gave 40% control ($P < 0.05$) at both application times. Lindane gave a non-significant 26% reduction.

The summation of results from these 1982 trials suggested that single spray treatments would not be reliable in practice and therefore a two-spray programme was tried in 1983. Cyhalothrin showed enough promise for further testing in view of its relatively low cost compared to earlier synthetic pyrethroids, and the microgranule formulation of PP 993 which, in Trial 3, gave equal activity from two treatments 11 days apart needed evaluation at higher rates.

The 1983 trials tested these options and compared them with an early spring application of lindane. The results are presented in Table 1. At both sites the untreated populations had increased with mean values of over 300 larvae/m². All treatments reduced grass grub numbers at both sites, with the higher rates consistently giving better control. Results from the September applications of lindane were again poor, 33-53% control. Cyhalothrin and PP 993 at the higher rates gave population reductions of 62-74%. The lower rates gave reductions of 42-61%. The results for the low rate of PP 993 are consistent with the 40% control measured in Trial 3.

TABLE 1: Reductions in grass grub numbers in Trials 4 and 5.

Treatment	Rate (ai/ha)	% Control ¹	
		Trial 4	Trial 5
lindane 20G	2 kg	33	53
cyhalothrin 5EC	2 x 30 g	44	61
cyhalothrin 5EC	2 x 50 g	69	72
PP 993 1G	100 g	49	42
PP 993 1G	200 g	62	74

¹ % reduction in larval population of treated plots compared to untreated plots. SED (approx.) was 14 and 11 for Trial 4 and 5 respectively with untreated means of 304 and 363 larvae/m².

From these and earlier trials, three strategies can be identified for insecticidal control of grass grub populations at the adult stage. The first is the use of lindane aimed more specifically at the adult, but with reference to the behaviour of lindane residues in the soil. While recent reports (Lauren *et al* 1982) have shown that lindane applications in September or October can give 80-98% control, this was not repeated in Trial 3, 4 or 5. Mid-winter applications may be preferable (authors' unpublished data). This is not due to any added effect on larvae as well as adults, but rather to the long residual life of lindane residues which remain relatively unchanged over the winter and cooler spring months. June-July applications would give longer environmental exposure and allow greater time for the prills to be broken down by rainfall and for the residues to be distributed within the top soil layer by stock movement. In Trial 3, since little rain fell between application and beetle flight, the lindane prills would have acted as point sources with 1 particle/10.5 cm².

The second option is a new one of using microgranules of a volatile and shorter lived chemical such as PP 993. The field life of PP 993, as with lindane, varies with temperature, but over the spring flight period it has a measured half life of 2-3 weeks.

This allows a degree of freedom for applications which could be made any time in the 2 weeks preceding a predetermined date such as the IMP date. Water-insoluble chemicals such as pyrethroids would not wash off the microgranules which would remain active as point sources, with a coverage of 1 particle/0.76 cm² at 200 g ai/ha. The future of this experimental chemical will depend on pricing, but it is likely that application to closely grazed pasture would be preferable to assist with even distribution.

The third option is the use of sprays. The timing requirements for this method have been outlined in several recent publications (Venning *et al* 1982). A two-spray programme is preferred over either a single or three-spray programme for reasons of reliability and practicality respectively. Cyhalothrin (currently marketed as a sheep dip) gave about 70% control at the higher rate (2 x 50 g ai/ha) which is a chemical cost of \$81.50. This is marginally acceptable, but is about two-thirds the cost of previously available synthetic pyrethroids at rates suitable for grass grub control. However, an over-riding problem remains with the inefficiency of standard spray equipment. With efficiencies of commonly less than 50% with conventional spray equipment (Lauren *et al* 1981; authors' unpublished data), a higher rate than that used in these trials could be required in practice.

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