CONTROL OF GRASS GRUB ADULTS WITH SYNTHETIC PYRETHROIDS

R.F. HENZELL and D.R. LAUREN

*Soil and Field Research Organisation, Ruakura Agricultural
Research Centre, MAF, Hamilton.*

Summary

The synthetic pyrethroids, cypermethrin and permethrin, were tested against grass grub (*Costelytra zealandica*) adults during the early and major spring flights in October/November, 1976. Treatment effects were assessed by measuring the subsequent third instar larval generation on treated and control plots. Effective grass grub control was achieved with both insecticides. Two or three blanket foliar applications of cypermethrin, each at a rate of 0.25 kg/ha, gave 92-96% control. A prill formulation of cypermethrin applied 4 times at 0.25 kg/ha/application gave about 90% grass grub control. Similar reductions (81-95%) were obtained with 3, 4 or 5 applications of permethrin at 0.5 kg/ha for each application.

INTRODUCTION

The current recommended method of chemical control of grass grub is to apply insecticides such as lindane, ethoprophos, fensulfothion, or diazinon to pasture in the autumn at the third instar larval stage. Compared with research into larval control, relatively little effort has been put into attempts to control grass grub as adults, despite the numerous advantages this would offer. This is probably due to the only moderate success achieved in the initial attempts to control grass grub as adults, and the non-availability of relatively safe insecticides with rapid knock-down activity. This latter property is essential, since, while grass grub mating flights take place over a 20-30 minute period, female beetles are mated fairly soon after emerging from the soil (Fenemore and Perrott 1970).

Fenemore and Perrott (1970) selected chlorpyrifos for field evaluation against grass grub adults but, at the rates used, control was not achieved. Wightman (1972), however, using a foam formulation of chlorpyrifos applied at high rates over the flight period, obtained 80% control.

During the 1975 grass grub flight season, Henzell and Lauren (1977) demonstrated that sex attractant traps could be used to monitor grass grub flight activity and suggested that this would assist in determining optimum times to apply either foliar or soil insecticides. Preliminary experiments with a synthetic pyrethroid, bioresmethrin, indicated that at 0.25 kg/ha it was very effective against grass grub beetles. Some newly introduced pyrethroids have greater persistence and faster insect knock-down activity than bioresmethrin (Elliott 1974).

Pasture Pests

This paper reports results of field trials with permethrin and cypermethrin as blanket foliar sprays and cypermethrin in a prill formulation. The aims of the trials were:

- (1) to relate optimum insecticide application times to flight activity,
- (2) to attempt to increase the efficiency of the foliar insecticides by using them in conjunction with the grass grub sex attractant, phenol (Henzell and Lowe 1970), and
- (3) to assess the effect of an insecticide with rapid knock-down activity applied to the pasture in prill form.

METHODS

Pre-treatment

Trials were carried out on a dairy farm about 30 km South of Hamilton. A flat area of pasture (ca. 8 ha; four paddocks) with a history of grass grub damage and no interference from nearby trees or hedges was selected for the trials.

Twenty 30 x 18 m plots placed alongside one another were used for the permethrin treatments while the cypermethrin trials were carried out on 10 x 10 m plots 10 m apart. Prior to the trials, in August 1976, all the plots were sampled for grass grub by taking 100 random soil cores (10 cm dia.) from the inner 20 x 8 m of each of the permethrin plots and 42 random cores from the inner 4 x 4 m of each of the cypermethrin plots. The plots were blocked with respect to these larval numbers to give four and three replicates respectively for each permethrin and cypermethrin treatment.

The pasture on all plots was cut as low as possible (0-3 cm) between 11 and 13 October, 1976.

Monitoring

Twenty sex attractant traps as described by Henzell and Lauren (1977) were used to monitor flight over the trial site (5 traps were placed in each of four adjacent paddocks incorporating the trial plots). Grass grub development in the soil during the flight period was assessed by taking 200 soil cores at random from an untreated area (80 x 40 m) on each of 10 occasions, at roughly 4-day intervals between 6 October and 18 November, 1976. Ten traps were also placed on this area to monitor flight. Female beetles found in the soil cores were stored in Pampel's fluid and later assessed for their mated condition by the presence or absence of a spermatophore in the bursa copulatrix or sperm in the spermathaeca.

Trial for optimum blanket spray applications

Permethrin was applied at various times throughout the flight period. The treatments consisted of

- (1) untreated control
- (2) application at times A, B, C, D, and E (refer to figure 1)
- (3) application at A, B, and C
- (4) application at B, C, and D
- (5) application at B, C, D and E

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Each application of permethrin (50% EC) was made with a boom sprayer at 0.5 kg/ha in 600 litres/ha of water using Delavan FS 6.5 (73⁰) spray nozzles at a boom pressure of 414 kPa.

Trials to assess sex attractant/insecticide combinations and prill formulations

Attractant formulations were combined with cypermethrin spray treatments in an attempt to increase efficiency of the latter. Confusion of the male beetle should increase its time on the foliage.

The treatments consisted of

- (1) untreated control
- (2) cypermethrin (0.25 kg/ha) applied at B and C
- (3) cypermethrin (0.25 kg/ha) applied at B, C, and D'
- (4) cypermethrin (0.5 kg/ha) applied at B, C, and D'
- (5) cypermethrin applications as in (3) plus four applications of a slow release phenol formulation * broadcast over the foliage at roughly 4-day intervals commencing at B
- (6) insecticide applications as in (3) plus nine attractant point sources on a 5 m grid. Each point source consisted of the attractant formulation* (2-3 g) embedded in polystyrene sheet (20 x 9 cm) at about 20 cm above ground level
- (7) applications as in (3) of an emulsion containing cypermethrin (0.25 kg/ha), phenol and a water insoluble oil
- (8) attapulgate clay prills containing a mixture of cypermethrin (0.25 kg/ha), phenol and a water insoluble oil, broadcast over the foliage on 4 days at roughly 4-day intervals commencing at B.

Spray equipment for this trial is described elsewhere (Lauren and Henzell 1977)

Post Treatment

Treatment effects were assessed by sampling the subsequent grass grub larval population in March 1977. For the permethrin trials, 100 soil cores were taken at random from the inner 20 x 8 m area of each plot. For the cypermethrin trials, 50 random soil cores were taken from the inner 4 x 4 m area of each plot.

RESULTS AND DISCUSSIONS

Figure 1 shows the pattern of flight activity recorded on the area used to study grass grub development. It also shows the percentage of female beetles, found in the soil, that had mated on the sampling dates. The flight patterns recorded by traps near the treatment areas were essentially the same as that shown. The major flight period was between 20 October and 3 November, 1976, which more-or-less corresponded with the 1975 flight recorded on the same trial site (Henzell and Lauren 1977). However, the number of beetles trapped was considerably less over the 1976 flight season. The trial site was cut for silage on 16 and 17 November, 1976 which resulted in increased monitor trap catches for the two following evenings.

* N.Z. Patent applied for: 182, 940

Pasture Pests

FIG. 1: Average beetle catches in ten sex attractant traps and the percentage female beetles mated on the trial site throughout the 1976 grass grub flight season.

In the permethrin trials a comparison could only be made between the subsequent grass grub larval numbers on treated and untreated plots in one paddock. The results indicated that there was a significant difference ($P < 0.1$) between the treated and untreated plots with the treatments giving 81-95% grass grub control. The effects of applying permethrin at different times could not be determined, however, due to the collapse of the grass grub population on the other paddock, which contained twelve of the twenty plots.

The flight activity on the trial site appeared to be somewhat abnormal in that major flights were not recorded between 27 and 31 October, 1976, when conditions seemed suitable for flight activity. In contrast to previous observations, which showed that substantial mating occurred during the first week or so of major flights (Henzell and Kain 1972; Henzell and Lauren 1977), mating took place over a protracted period. For example, on 27 October, none of the females found in soil cores had mated, and on 10 November, only 36% had mated.

These unusual effects were probably caused by the 82 mm rainfall, recorded between 15 and 23 October, which left most of the trial site flooded for several days. During this period about 50% of the grass grub population was present as pupae. The waterlogged soil conditions apparently upset normal grass grub development, for in subsequent soil sampling, 15-20% of the population consisted of dead or deformed pupae.

In the cypermethrin trials, differences between the controls and the treatments were highly significant ($P < 0.001$) with the treatments giving at least 92-96% control. At the highest application rate of cypermethrin, no larvae were found on any plots during the post-treatment sampling. Significant differences ($P > 0.1$) could not be detected between any of the other cypermethrin treatments. Obviously lower rates of application of this insecticide would be required to assess the value of using the grass grub sex attractant in conjunction with it.

Pasture Pests

Grass grub control was achieved even with two applications of cypermethrin applied during the early flight period. While a few reasonable male flights were recorded before the first insecticide application on 20 October, obviously very little mating took place, and there would probably be little value in applying insecticides before this time on the trial site used.

It is also interesting that prill applications of cypermethrin gave effective control (92%) at a total rate of 1 kg/ha. From observations made during the flights very few male beetles were actually attracted onto the prills, and more dead females than males were noticed on all the treated plots. Dead females collected from some treated plots in the major flight period were young and unfed. About 30% of these females had mated but all of them contained a full egg complement.

CONCLUSIONS

The reductions in grass grub numbers obtained in these trials with synthetic pyrethroids against adults compare very favourably with results reported for the control of third instar larvae in the autumn (MacLean *et al* 1970). The pyrethroids are ideal insecticides in that they have rapid contact activity against grass grub adults and yet have a low mammalian toxicity. The main disadvantage with these materials at present is their cost, and at the rates used in the above trials they would probably be uneconomic for a farmer to use. Further work is required on the use of lower application rates. Furthermore, the correct timing of applications of such expensive materials will be essential to achieve economic grass grub control. This type of control method may be useful for hill country farms where no grass grub control method can be recommended at present.

There was no interruption to the normal management of the dairy farm during the 6-week period of the trials, as the paddocks to be treated were grazed heavily before the trials commenced, and were then shut up for use as silage.

The encouraging results obtained in these trials indicate the potential of such an approach and have demonstrated quite clearly that adult beetles can be effectively controlled with either foliar sprays or prill formulations of insecticides with rapid knock-down activity. Now that these principles have been established, albeit under somewhat abnormal flight conditions, a new avenue has been opened in the search for effective grass grub control measures.

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Pasture Pests

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