TIMING OF CYPERMETHRIN APPLICATIONS AGAINST GRASS GRUB ADULTS

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Summary

A spray programme of three applications of cypermethrin (0.10 kg/ha) at 6-day intervals was applied against grass grub (*Costelytra zealandica*) adults. The timing of the initial spray was varied at 2-day intervals from 12 days before to 12 days after the first spray of the ideal programme, which coincided with the start of mating activity. It was found that there was a period of at least 1 week, from about 4 days before to 3 days after the ideal, within which the level of control of subsequent larval populations was relatively insensitive to the timing of the spray programme.

INTRODUCTION

Three successive foliar spray applications of the synthetic pyrethroids cypermethrin and permethrin during the adult grass grub flight season have given good control of subsequent larval populations, with the lowest effective rate per application of cypermethrin in the range 0.05 to 0.10 kg/ha (Henzell and Lauren 1977a; Pottinger *et al* 1977, 1979; Lauren *et al* 1978). Cypermethrin applied at 0.10 kg/ha maintains reasonable contact activity on pasture for about 6 days (Lauren *et al* 1979b). Lauren *et al* (1978) defined the ideal spray programme for grass grub control with cypermethrin (0.10 kg/ha) or the equally effective, cost-equivalent rate of permethrin (0.20 kg/ha) as three applications at 6-day intervals, commencing just before the cumulative percentage catch in adult sex attractant traps reaches 10%. The starting date for the ideal programme should be estimated from several prior years' flight data so that the cumulative percentage catch was always less than 10% on that date. The 18 days of toxic pasture cover afforded by this programme includes the period within which most mating occurs.

The degree of accuracy required in timing a pyrethroid spray programme against grass grub adults will depend on the effects of deviation from the ideal on the level of control. Lauren *et al* (1978) found that delays of 5 and 8 days after the ideal in commencing a 3-spray programme of 0.10 kg/ha of cypermethrin at 6-day intervals reduced the level of control to 77-85% compared to 90-95% for treatments commencing at, or 2 - 4 days before, the ideal. This paper reports further work on the effects of varying the timing of this spray programme around the ideal.

METHODS

Three sprays of cypermethrin (0.10 kg/ha) were applied at 6-day intervals to ryegrass (*Lolium perenne*) - white clover (*Trifolium repens*) - bromus mollis (*Bromus mollis*) pasture at Rukuhia, with the date of the initial spray varied at 2-day intervals from 12 days before to 12 days after

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the **ideal**, giving 13 treatments. Sex attractant trapping carried out at the trial site in the 1977 flight season as part of previous work (Pottinger *et al* 1979) revealed that the cumulative percentage catch reached 10% on October 22. Hence the timing of the treatments was set by commencing the **ideal** spray programme on October 21 1978. Applications were made to dry pasture with a small plot precision sprayer at 200 kPa in 300 litres/ha. It was necessary to delay only one spray application because of unsuitable weather, viz., a 1-day delay for the final spray of the treatment commencing 10 days after the **ideal**.

Plot size was 6 m square with 1 - 2 m buffers between the plots. Each treatment and the two controls were replicated twice. Pre-treatment grass grub populations were assessed in August 1978 by taking 10 - 16, 10 cm diameter soil cores per plot to ensure that all plots used contained a reasonable population (more than 50/m²) and to allow the plots to be blocked according to initial numbers for treatment allocation.

The trial site was grazed with sheep to a height of 3 - 5 cm prior to the commencement of the first treatment and then closed to grazing for 7 weeks. Plots which received treatments commencing on or after October 17 (4 days before the **ideal**) were mown at a height of 5 cm immediately before the first spray to ensure that later treatments did not commence on longer pasture than earlier treatments. The buffer zones were not mown. There were two unsprayed controls to test whether mowing during the flight season affected grass grub numbers:

1. Not mown.
2. Mown at a height of 5 cm on October 25.

Grass grub flight was monitored with five sex attractant traps as described by Henzell *et al* (1979). Soil sampling was carried out at 4 to 6-day intervals during the flight season by taking sufficient randomly located 15cm spade squares from the untreated buffer zones to collect at least 50 individuals, in order to monitor grass grub development in the soil and the proportion of females mated (determined by dissection).

The trial site was laxly grazed during the summer to enhance grass grub survival (East 1979). Post-treatment grass grub populations were assessed at the second and third instar larval stages in March 1979 by taking 50, 10 cm diameter soil cores from the inner 5 m square area of each plot.

RESULTS AND DISCUSSION

The flight pattern revealed by the sex attractant traps in 1978 (Fig. 1) differed from that recorded at the same site in the previous year. Whereas in 1977 the cumulative percentage of the total catch first exceeded 10% on October 22, in 1978 this did not occur until October 29, reflecting cool evenings unfavourable for flight in the early part of the latter flight season. Once weather conditions became favourable for flight in 1978, the cumulative percentage catch rose from 10% to 80% in 10 days, considerably less than the typical interval of 14 - 18 days (Henzell *et al* 1979). As a result the cumulative catch reached 80% in 1978 on a similar date (November 8) to the previous year (November 10), despite the initial delay. The initial suppression of flight resulted in the **ideal** spray programme commencing when the cumulative catch was less than 1% rather than just below 10%. Nevertheless the **ideal** programme commenced at about the same time as mating activity (Fig. 1), which apparently was not influenced by the initial delay of flight.

These results highlight the importance of determining the timing of the **ideal** spray programme from several seasons' flight data to allow for year to year variations in the flight pattern, rather than from only one previous season's data as in this study. For example, if the flight pattern in

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Fig. 1: Grass grub flight and mating activity on the trial site in 1978. Arrows indicate application times for the ideal spray programme.

1977 (which was used as the basis for estimating the ideal starting date) had been similar to that in 1978 the ideal programme would not have commenced until more than 50% of the females had mated (Fig. 1). It appears to be essential to maintain residual insecticidal activity throughout the mating period to achieve effective control (Lauren *et al* 1978). While the relationship between flight and mating activity will not be revealed fully until several years' data on both are available from several sites, an ideal programme timed on the basis of several prior years' flight data appears to cover the mating period consistently (Lauren *et al* 1978, 1979a).

There was a highly significant relationship between the percentage reduction of the grass grub populations and the timing of the spray programme (Fig. 2). The post-treatment populations in the two controls differed by less than 20% and averaged 140 /m². This average was used as the baseline for computing percentage reductions. The similarity of the two control populations is in agreement with other evidence that pasture defoliation during the adult flight season has little influence on grass grub populations (East 1979). The reduction in grass grub numbers was greatest for the ideal programme (87%), exceeded 80% for treatments applied within the range 4 days before to 2 days after the ideal and fell away to low levels for treatments applied more than 6 days before or 4 days after the ideal. These results follow a similar trend to that observed by Lauren *et al* (1978) (Fig. 2).

The information in Fig. 2 suggests that while the ideal timing will give the best result there is a period of at least 1 week, from 4 days before to 3 days after the ideal, within which a 3-spray programme can be started for a similar level of control of grass grub populations. It also appears that under the conditions of this trial, in which the percentage of females mated increased from zero to about 80% in less than 2 weeks (Fig. 1), a 2-spray programme commencing at the same time may not have been

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Fig. 2: Relationship between percentage reduction of grass grub populations and variation in timing of initial spray around the ideal. Line drawn by eye for data of Lauren *et al* (1978); for this study $y = 85.73 - 0.958x - 0.347x^2$ ($P < 0.01$).

markedly inferior to the 3-spray ideal programme. This is borne out by the 80% reduction achieved by the treatment which started 6 days before the ideal. Significant mating activity did not commence until about the time of the second spray of this treatment, which coincided with the first spray of the ideal programme (Fig. 1).

Two sprays will require a greater timing accuracy than three and will be more susceptible to errors induced by such factors as the effects of local topography on grass grub adult activity (Henzell *et al* 1979). In addition under extreme weather conditions on a flat site it can take up to 3 weeks from the commencement of mating before most of the females have mated (e.g., Henzell and Lauren 1977b). Three applications of cypermethrin will therefore generally be preferable. The development of improved formulations or chemicals with a greater biological field life (Henzell and Lauren 1978; Lauren *et al* 1979b) will extend the period within which 3-spray programmes can be applied with maximum effect or alternatively enable fewer applications to give reliable control, as shown by Lauren *et al* (1979a).

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REFERENCES

- East, R., 1979. Effects of grazing management on grass grub populations. *Proc. 2nd Aust. Conf. Grassland Invert. Ecology* (in press).
- Henzell, R. F. and Lauren, D. R., 1977a. Control of grass grub adults with synthetic pyrethroids. *Proc. 30th N.Z. Weed and Pest Control Conf.*: 211-6.
- Henzell, R. F. and Lauren, D. R., 1977b. Grass grub control through sex attractant and insecticide combinations. *Proc. 29th Ruakura Farmers' Conf.*: 20-3.
- Henzell, R. F. and Lauren, D. R., 1978. Contact activity of synthetic pyrethroids against adult grass grub, *Costelytra zealandica* (White). *Pestic. Sci.* 9 (in press).
- Henzell, R. F., Lauren, D. R. and Cox, N. R., 1979. Monitoring grass grub flight with sex attractant traps. *Proc. 2nd Aust. Conf. Grassland Invert. Ecology* (in press).
- Lauren, D. R., Henzell, R. F. and Yortt, M. L., 1978. The importance of application time when synthetic pyrethroids are used to control adult grass grub. *Proc. 31st N.Z. Weed and Pest Control Conf.*: 154-9.
- Lauren, D. R., Henzell, R. F., Smith, B. N. and Graham, D. P. F., 1979a. Alternative formulations and chemicals for the control of adult grass grub with foliar sprays of synthetic pyrethroids. *Proc. 32nd N.Z. Weed and Pest Control Conf.*
- Lauren, D. R., Henzell, R. F. and du Toit, G. D. G., 1979b. Insecticides for the control of adult grass grub *Costelytra zealandica* (White). I. Chemical and biological field life of various synthetic pyrethroid formulations. *NZ J. agric. Res.* (in press).
- Pottinger, R. P., East, R., Welsh, R. D., Stratton, A. E. and Maxwell, B. C., 1977. Evaluation of cypermethrin for control of adult grass grub. *Proc. 30th N.Z. Weed and Pest Control Conf.*: 217-21.
- Pottinger, R. P., Welsh, R. D., East, R. and Stratton, A. E. 1979. Control of grass grub adults with cypermethrin. *Proc. 2nd Aust. Conf. Grassland Invert. Ecology* (in press).