COMPARISON OF TWO SPRAY DATE PREDICTION TECHNIQUES FOR CONTROL OF GRASS GRUB BEETLES

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SUMMARY

Two techniques based on sex attractant trapping have been used to predict the starting dates for foliar spray programmes against grass grub (*Costelytra zealandica*) adults on five different sites. The treatments involved three applications of cypermethrin (0.1 kg/ha) at 6-day intervals. In general, treatments applied on the predicted dates gave insecticidal activity over most of the beetle mating and flight periods. The predicted dates based on 10 beetles/trap were 3-9 days earlier than the dates based on information averaged over previous years. Control from both predictive methods was similar, and suggested that treatments should be applied early in the flight season for best effect.

INTRODUCTION

The potential of using fast acting contact insecticides against adult grass grub has been closely studied in recent years. The importance of timing the spray programme correctly and the degree of precision required have been established (Lauren *et al* 1978; East *et al* 1979). A programme of three successive sprays of synthetic pyrethroid insecticide applied at 6-day intervals can give up to 95% reduction in subsequent grass grub populations if applied to coincide with the major emergence and mating period. Optimum timing of the spray programmes for these earlier trials was determined using sex attractant trap catches. The starting dates were estimated from several prior years' flight data so that the cumulative catch was always less than 10% on that date. More recently, Henzell and Lauren (1981) have established that the spray programme should start at least as early as the 2% cumulative flight date in the year of treatment, and have developed two predictive methods for determining the starting date.

This paper describes a trial in which the relative success of these two predictive methods to give a satisfactory starting spray date for a pyrethroid spray programme has been determined. The predicted spray dates (and actual spray dates when delays occurred due to weather and other factors) have been related to the beetle flight data obtained and the rate of development of the grass grub population in the soil over the treatment period.

METHODS

Methods of predicting first spray date.

For the purpose of this trial, the predictive methods outlined by Henzell and Lauren (1981) were used. The 'Trigger Point' (Trigger) method requires the first spray to be applied the day after an average of 10 beetles/trap is caught from a set of 5 sex attractant traps placed near the treatment area. The 'Ideal Mating Period' (IMP) method is based on previous years' trapping results. The span in days from the earliest 5% cumulative flight date to the latest 60% cumulative flight date inclusive is obtained, and the first spray date is adjusted to allow the 18 days of insecticidal activity from the three-spray programme to be centralised over this period.

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Insecticide applications and trial layout.

Cypermethrin was applied at 0.1 kg/ha with the conventional vehicle mounted boom described by Lauren *et al* (1980). The boom was mounted on the front of the vehicle with the nozzles at 550 mm above ground level. The wind speed, relative humidity and temperature were measured on each spray date, as well as the length and greenweight of herbage and the quantity of insecticide deposited. Three sprays were applied at 6-day intervals to each treated area. The initial spray date was chosen as described by the predictive methods. Subsequent spray dates for the IMP treatments were set, and delays in one spray did not affect the next. Delays in the first spray date for Trigger treatments delayed the complete programme, but thereafter, spray dates were fixed.

Trial areas were set up on five sites that are part of the grass grub beetle flight monitoring project (Henzell *et al* 1979; Henzell and Lauren 1981). Flights had been measured for three years at sites A, B and C and for two years at sites D and E. Listed in order of predicted IMP spray dates, they are: A, on a dairy farm near Te Awamutu; B, on a dairy farm at Piarere, 44 km south of Hamilton; C, on a sheep farm in hill country west of Ngaruawahia; D, on a sheep farm at Tirohanga; E, on a sheep and cattle farm near Tihoi. At each site, the trial area was divided into three plots, 16-28 m wide and 40-60 m long. Within each plot, 5 x 5 m subplots were located at least 3 m from the edge of the plots and at least 2 m apart. In the pre-treatment sampling in August 1980, at least 16 soil cores (10 cm dia) were taken from each subplot, to give, in each plot, a set of six subplots with an equivalent population range. The three plots at each site were then randomly allocated to a Trigger spray treatment, an IMP spray treatment and an untreated control.

The trial areas were grazed to a height of 3-7 cm prior to the first spray date, and then allowed to grow until at least 12 days after the final spray date when they returned into the general farm management programme. When the first spray dates for the two predictive methods were more than a few days apart, the area treated first was fenced off to allow continued grazing of the rest of the trial area until it was due to be sprayed. The pasture length on the final spray dates ranged from 4-8 cm at sites D and E to 15 cm at site A.

Soil sampling for grass grub was carried out at 3 to 7-day intervals during the flight season to collect 50 individuals (or by taking 200 cores) in order to monitor grass grub development in the soil. The proportion of females mated was determined by dissection.

Post-treatment grass grub populations were assessed in April 1981 by taking 24 soil cores (10 cm dia.) (48 from site C) from each subplot.

RESULTS AND DISCUSSION

The results are shown in Table 1. All treatments reduced the subsequent grass grub populations, although the degree of control was disappointing. The Trigger treatments started 3-9 days earlier than the IMP treatments and there was a tendency for them to give better control than the IMP. At three of the sites the Trigger treatments started before the 1% cumulative flight date. These factors suggest that it is important to have the first spray applied very early in the flight period, and perhaps earlier than was formerly appreciated.

Delays to the spray programmes caused by weather were not a significant factor; six out of the thirty sprays were delayed because of wet weather, but only one of these delays was greater than one day. On two out of five trial sites, a misunderstanding caused the Trigger spray programme to be commenced after the required average catch of 10 beetles/trap. At site C (applied after 50 beetles/trap), this error could have worked against the method, since the correct spray date would have covered a greater range of cumulative flight, from 1.9 — 88%, and still covered from 0.50 + % mating. However, at site D (applied after 20 beetles/trap), it is likely that the error worked in favour of the method, since a spray programme commenced on the predicted date of October 28 would have covered only from 0.3 — 4.9% cumulative flight and from 0 — 13% mating. On site D, which has generally more protracted flights, this limited cover would be expected to be insufficient.

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TABLE 1: Details of the trial of two treatment date prediction methods applied to five sites in 1980.

Site: Method	Period of insecticidal activity	% Cumulative flight covered	% Female mating covered	Control ¹ (%)
A Trigger	4.10-21.10	3.5-36	0-10	70
IMP	13.10-30.10	17.0-70	0-76	73
B Trigger	12.10-29.10 ²	0.9-57	0-85	63
IMP	16.10-2.11	2.6-80	4-85 +	48
C Trigger	23.10-9.11 ³	10.4-91	0-50 +	54
IMP	26.10-13.11 ⁴	19.5-97	20-50 +	40
D Trigger	3.11-20.11 ⁵	0.9-47	0-67	67
IMP	10.11-26.11 ⁶	2.0-53	0-76 +	43
E Trigger	6.11-23.11	0.9-55	0-57	51
IMP	11.11-30.11 ⁷	6.6-62	0-71 +	44

1. % population reduction in treated plots compared to untreated plots.
2. 1st and 2nd sprays delayed 1 day by wet weather.
3. Programme began 2 days late because of farmer error in estimating Trigger catch.
4. 3rd spray delayed 1 day by wet weather.
5. Programme began 6 days late because of farmer error, 2nd spray delayed 1 day by wet weather.
6. 1st spray delayed 1 day by wet weather.
7. 3rd spray delayed 2 days by wet weather.
- + Egg clusters present in the soil.

It is interesting to note the good control obtained with the Trigger method on site A, where the spray programme commenced on October 4, 9 days before the IMP programme. In addition, trials on this same site in 1978 (Lauren *et al* 1979) had achieved optimum control with spray programmes commencing on October 18. In the present case, the Trigger programme covered from 3.5 — 36% of the cumulative flight but only 0 — 10% of mating. Male flight activity at this site was much earlier in relation to mating activity than at the other sites. At the four other sites, 10% of the females had been mated after only 5 — 15% of the male flight had occurred. Thus at site A, it is possible that a sizeable proportion of the male population was destroyed before any females emerged, and with the relatively large plot size used at this site (28 x 60 m) compared to the smaller 9 x 9 m and 6 x 6 m plots used for earlier timing trials (Lauren *et al* 1978; East *et al* 1979) subsequent migration of males onto the plot from outside the treated area was insignificant. This suggestion was unable to be confirmed by the soil sampling data which did not appear to indicate that the relative rate of male versus female development before and during the flight period at site A was substantially different from that at the other four sites.

The generally low levels of control obtained from all treatments were surprising, especially as the timing of most applications coincided with the major mating periods, and to a lesser extent, the main male flight periods. The probable explanation is that the rate of chemical used was too low. While 0.1 kg/ha of cypermethrin has been found to be suitable for small plot applications with precision spraying equipment, it appears that a higher rate is required when using a conventional vehicle mounted boom. Measurement of the chemical deposited on the foliage from each spray showed that on 25 out of 30 occasions, the deposit was less than 60% of that theoretically expected, and in 14 of these, it was less than 40%. These low recoveries are in line with the low efficiency of conventional spray booms for applications to pasture reported by Lauren *et al* (1980). Sprays were generally applied in the morning immediately after the dew had dried, in order to avoid too much interference by wind. The mean temperature, relative

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humidity and wind speed over the 30 spray days were 17°C (range 10 - 24,) 81% (range 65-100) and 2.5 m/sec (range 0-4.4) respectively. Multiple regression analysis showed that changes in temperature, wind speed and herbage greenweight explain 64% of the variability in the amount of insecticide deposited. As wind speed increases the deposit decreases, while an increase in greenweight increases the chances of a high deposit.

Further tests will be required to finalise the best type of prediction method to use for insecticide treatments against grass grub beetles. In using vehicle mounted booms the rate of chemical should be increased to up to double that used in this trial (or its equivalent of an alternative pyrethroid) in order to remove the doubt of chemical efficacy. While this higher rate would make applications of the currently available synthetic pyrethroids uneconomical, the information gained about timing should be invaluable for future extensions of the work to, for example, the use of short-lived soil applied adulticides.

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