THE REQUIREMENTS OF AN INSECTICIDE TREATMENT FOR CONTROL OF GRASS GRUB ADULTS

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Summary

The probable requirements of an insecticide treatment for effective control of grass grub (*Costelytra zealandica*) by application against the adult stage are indicated. Dow 179 was the most promising of 17 low toxicity materials tested in the laboratory, but did not give an effective result when applied as ultra-low volume spray in a field trial in 1967, possibly because treatments were commenced too late. The behaviour of female beetles between copulation and oviposition is considered to be of critical importance.

ATTEMPTS to achieve control of grass grub (*Costelytra zealandica*) by applying relatively transient insecticides against the adult stage rather than the larvae have so far met with only limited success (Fenemore, 1966).

The objective is, of course, to suppress the ensuing larval population; there is no advantage in eliminating adults after oviposition has taken place.

To achieve this objective, several factors must be adequately defined, and their requirements fulfilled.

The main ones are:

- (1) Time application must commence.
- (2) Duration of residual activity required.
- (3) Provision of an insecticide of high contact activity.
- (4) Best form of insecticide deposit.

Some information has been obtained on these aspects over the past two years and the main findings are summarized below:

TIME OF APPLICATION AND DURATION OF RESIDUAL ACTIVITY

These two points may be considered together, as both are dependent on defining (a) the period over which first emergence of grass grub adults takes place, and (b) the period during which eggs are laid.

This pattern of primary emergence and oviposition has been determined on two different sites in two seasons (1966 and 1967) by (a) hand collecting emerging adults from small caged plots, and (b) regularly sampling for stages in the soil on the same sites. The results are shown diagrammatically in Fig. 1. It will be noted that the date of peak emergence was considerably earlier at Maitai in 1967 than at Tapawera in 1966, but

the period over which most of the emergence took place was similar (although the beginning of emergence was missed in the first season). Peak numbers of eggs in the soil occurred at rather different times in relation to adult emergence in each case. This may be related to differences in weather pattern between the two years and to possible site differences.

It is clear in each case, however, that the peak of egg laying did not commence until well after the peak of first adult emergence. Assuming that most females are mated on the first evening of emergence (as may

(a) Tapawera, Nelson, 1966

(b) Maitai, 1967

Fig. 1: Primary emergence and oviposition.

well be the case), this delay is accounted for by the known obligatory pre-oviposition period of at least 7 to 10 days.

Two possible timings for insecticide application may be considered. This could be at time A in Fig. 1 (b) — *i.e.*, after most beetles have made their first emergence but before any eggs are laid, or time B, at the beginning of the period of adult emergence. If timing A were to prove adequate, a much shorter period of residual activity would be required than for timing B. (2 weeks compared with 4 weeks for Maitai 1967, Fig. 1 (b)). From a field trial conducted in 1967, it seems that commencement of insecticide treatment at time B will be necessary. This point is discussed further later.

INSECTICIDE OF HIGH CONTACT ACTIVITY

Seventeen potential insecticides, selected on the basis of reasonably low mammalian toxicity and residue safety, were tested in 1967 by a simple procedure of one hour's exposure of adult beetles to treated filter papers. Of these, Dow 179 ("Dursban") was outstanding in activity, with two Bayer experimental compounds 77488 and 5900 almost equally effective.

FORM OF INSECTICIDE DEPOSIT

To have chance of success, the insecticidal deposit on the pasture surface must be effective on contact with grass grub adults and must persist for as long as possible.

Comparison between Dow 179 applied as dilute spray, ULV (ultra-low-volume) spray, 1% dust, and 2% granules, showed that immediate contact activity was very high with any formulation, but that resistance to weathering was much better for spray application than for granules or dust, as might be expected.

ULV spraying also has several other advantages from work in the U.S.A. It can result in greater deposit per unit area than dilute spraying, for the same quantity of toxicant applied per acre. Residual action may be enhanced, and large areas can be treated rapidly and economically.

ULV therefore has several points to commend it as the application method of choice against grass grub adults. It was the method used in a field trial conducted in 1967.

A treatment was included with diazinon, because, although not as effective as Dow 179 on laboratory evaluation, it is commercially available.

FIELD TRIAL 1967

The treatments employed in this trial were as given in Table 1.

TABLE 1: 1967 FIELD TRIAL

<i>Insecticide</i>	<i>Rate of Application lb a.i./acre</i>	<i>Applications</i>
Dow 179	1	1
Dow 179	$\frac{1}{2}$	2 at 10-day intervals
Dow 179	$\frac{1}{2}$	3 at 10-day intervals
Dow 179	$\frac{1}{4}$	3 at 10-day intervals
diazinon	1	1

Plots were 15 × 11 yd with similar distances between plots to minimize drift effects from the fine spray droplets used (about 80 microns).

Dates of application were later than intended, owing to delay in arrival of spray equipment. Eggs were first recorded in soil samples taken three days after the first application had been made. The commencement of insecticide treatment thus corresponded closely to timing A in Fig 1(b) with second and third applications following at 10-day intervals after this.

Results of sampling for eggs and 1st instar larvae on December 5 showed that none of the treatments had effectively suppressed oviposition, compared with control plots.

DISCUSSION

As a positive result was not obtained by any treatment in the field trial described, all the conditions necessary for effective control could not have been met.

It appears unlikely that insecticidal activity of the deposit was at fault, at least for 2 × and 3 × Dow 179 applications, as bioassay of pasture clippings showed a high level of residual activity.

A more likely explanation of failure is that treatments were not commenced early enough in relation to primary emergence. Although the first eggs were not found until three days after the first application, mated females could have been present for at least a week prior to this. If mated females do not return to the pasture surface between copulation and the laying of first eggs, they would avoid exposure to an insecticide deposit applied during this period. There is even some evidence that some females are mated without emerging completely from the soil at all, and may then remain below the surface until the first eggs have been laid.

Considerably earlier treatment is therefore indicated to hit females (and males) before mating has occurred.

With an adequate programme of insecticide treatments correctly timed, there seems no theoretical reason why this approach should not eventually provide an effective means of control of grass grub. Whether it can be a practical or economic method for farm use remains to be seen, however.

REFERENCE

Fenemore, P. G., 1966: *Proc. 19th N.Z. Weed & Pest Control Conf.*: 210-4.