INSECTICIDES FOR CONTROL OF ADULT GRASS GRUB. III. PRELIMINARY TESTS WITH SOIL INSECTICIDES

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Summary

Soil applications of isazophos, lindane and RE 27644 were found to kill grass grub (*Costelytra zealandica*) adults effectively, in two laboratory bioassays. Best results were obtained with isazophos emulsifiable concentrate (EC) and granules (G) and lindane EC. Total mortality of test insects was achieved at rates comparable to a field application of 0.5 kg/ha.

INTRODUCTION

The merits of controlling grass grub by killing the adult stage have been widely recognised. Fenemore (1964) gave serious consideration to this method and in subsequent work (Fenemore and Perrott 1970) numerous insecticides were investigated for this purpose. However, none of these chemicals were effective in field tests.

The discovery of an attractant for male grass grub beetles (Henzell and Lowe 1970; Osborne and Hoyt 1970), added impetus to research into adult control and when the synthetic pyrethroids came into use as agricultural insecticides around 1974, there was renewed interest in this method. Most attempts at adult control have been concerned with foliar sprays directed at beetles above the soil surface during their mating activities, but the alternative of using soil insecticides was recognised by Fenemore (1966) and others.

The idea of using soil applied adulticides is based on the fact that beetles spend a considerable time in the top layers of the soil, especially prior to emergence while waiting for the onset of atmospheric conditions suitable for mating and also while burrowing to or from oviposition sites. Because of this, less reliance is placed on the deep distribution of insecticide than is necessary in the case of larvae. It should also be noted that insecticide contact time would possibly be longer when the beetle is in the treated ground than when it is on the treated pasture herbage. However, the problem of insecticide deactivation by the soil must always be considered, and bioassays to determine soil-active insecticides should precede field trials.

METHOD

Two trials were conducted in the insecticides laboratory at Ruakura where the temperature range during the trials was 20 - 27°C. The insecticides and formulations tested, and their rates of application, are given in Tables 1 (trial 1) and 2 (trial 2).

The insecticides (14 mg a.i.; granules, or the EC in 2 ml of water) were added to Horotiu silt loam soil (20 g), and this treated soil diluted by sequential batch additions of untreated soil with thorough mixing to give

Pasture Pests

the required rates. The soil had a moisture content of 32%. Each mix was stored in a plastic container (170x170x190 mm). In the case of trial 2 only, the filled containers were left for 24 hours in a well ventilated open corridor and the soil occasionally stirred to allow evaporation of any solvents in the formulations used. After this time, the containers were sealed and returned to the laboratory. The moisture content had fallen to 29% and was maintained at between 27 - 29% for the duration of the trial.

The bioassays were conducted on the day of soil treatment for trial 1 and at 2, 8 and 16 days after soil treatment for trial 2. From each container five replicate subsamples of soil (*ca* 85 g) were packed firmly into petri dish bases (86 mm diameter; 11 mm deep). Ten newly collected grass grub beetles, collected and stored overnight as described by du Toit (1978), were placed on each dish of soil which was then covered with another, inverted petri dish; the latter being weighted down with a glass sheet to prevent the beetles from escaping. All beetles buried themselves within 10 minutes. Affected beetles subsequently re-emerged, and the numbers remaining on top of the soil at the time intervals shown in the tables were recorded individually for each replicate.

After 24 h exposure to treated soil, all beetles were removed and placed onto untreated soil in covered petri dishes. The numbers of beetles above the soil were again recorded at the times given in the tables.

RESULTS AND DISCUSSION

The one organochlorine and four organophosphorous insecticides used in trial 1 had all shown high activity in earlier topical application tests. From the results of trial 1, presented in Table 1, it is apparent that only RE 27644, isazophos and lindane were active in the soil. It was noted that the more active chemicals had been applied as EC formulations while the less active ones had been applied as granules. To establish whether the method used was biased against granules, trial 2 was designed to evaluate both the EC and granule formulations of lindane and isazophos, the two most active insecticides from trial 1.

Table 1. Percentage beetles affected at various times after exposure to treated soil. Trial 1.

Insecticide*	Percentage of beetles affected at times after				
	Placement on treated soil			Relocation on untreated soil	
	2h	17h	24h	2h	24h
Hoe 6417 G	0	2	2	2	4
fosthietan	0	0	2	8	16
RE 27644 EC	0	70	88	92	92
isazophos EC	60	90	90	100	100
lindane EC	94	94	94	100	100
untreated	0	0	0	0	0

* Insecticides were applied to the soil at 14 mg/kg. This is the concentration expected if the total insecticide applied to soil at 2 kg/ha over the surface area of a petri dish was evenly distributed in 85 g of soil.

In trial 2, beetles were exposed to insecticide treated soil 2, 8 and 16 days after treatment. A comparison of results from these three times showed that insecticidal potency had not diminished noticeably 16 days after treatment, therefore only results from the last exposure are presented in Table 2.

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Table 2. Percentage beetles affected at various times after exposure to soil treated 16 days previously. Trial 2.

Insecticide	Rate (mg/kg of soil)	Percentage of beetles affected at times after						
		Placement on treated soil				Relocation on untreated soil		
		2h	4h	8h	24h	2h	4h	24h
isazophos G	1.75	2	2	2	18	24	24	22
	3.5	0	2	30	100	100	100	100
	7.0	2	18	100	100	100	100	100
	14.0*	6	88	90	90	100	100	100
isazophos EC	1.75	2	6	6	36	40	36	38
	3.5	0	0	48	100	100	100	100
	7.0	60	100	100	100	100	100	100
	14.0*	98	100	100	100	100	100	100
lindane G	1.75	0	2	0	10	14	14	24
	3.5	0	0	4	26	41	35	33
	7.0	0	10	90	96	96	87	83
	14.0*	8	90	100	100	100	100	100
lindane EC	1.75	0	0	42	84	84	70	52
	3.5	2	48	98	100	100	98	94
	7.0	0	26	100	100	100	100	100
	14.0*	26	98	98	98	100	100	100
untreated	—	0	0	0	0	6	6	6

* See Table 1 for explanation.

Isazophos, both as granules and EC, gave total mortality of the test insects within 24 hours at rates above and including 3.5 mg/kg of soil (3.5 mg/kg is equivalent to 0.5 kg/ha applied over the surface area of the petri dish.) Similar results were obtained with lindane EC, however lindane granules gave marked mortality only at or above 7 mg/kg of soil and appeared to be slower acting than either lindane EC or both isazophos formulations. Generally, the quickest acting treatment appeared to be isazophos EC where all test insects were affected after only four hours, on soil treated at 7 mg/kg. The above results demonstrate that soil insecticides with considerable potency against grass grub adults in the soil are available. With such insecticides, the strict treatment time accuracy reported to be involved with foliar application of synthetic pyrethroids (Lauren *et al* 1979; East *et al* 1979) could be avoided.

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Pasture Pests

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