EVALUATION OF TERBUFOS FOR GRASS GRUB CONTROL

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SUMMARY

Topical application tests, soil bioassays and field trials were conducted to determine the effectiveness of terbufos for grass grub (*Costelytra zealandica*) larval control. Laboratory tests indicated terbufos to have similar activity and biological persistence to fensulfothion. Field derived bioassay tests and field evaluation trials indicated persistence and activity to be superior to diazinon but inferior to fensulfothion.

INTRODUCTION

With presently available organophosphate insecticides control of grass grub larvae in pasture can be variable, 30-96% control (East *et al* 1981). Insecticides are also expensive, varying between \$60 and \$120/ha at current recommended broadcast application rates (East 1984). Costs can be reduced by direct drilling into pasture at half the broadcast application rate; however, control generally declines by about 20% (East *et al* 1981).

There is a continued need to search for insecticides which are more cost effective than those currently available. Terbufos, an organophosphate insecticide, has been shown to be effective in controlling a range of soil insects, including black beetle (Watson and Webber 1975) and soldier fly (Saunders 1975) in New Zealand. It is registered for use as a soil insecticide in several countries including the United States. At the time this trial series was conducted, there were no known published results determining its efficacy against New Zealand grass grub.

This paper reports a limited series of laboratory and field trials designed to evaluate and compare terbufos against standard insecticides for grass grub larval control.

METHODS

Initial laboratory assessments (2) used an Arnold microapplicator to apply topically an insecticidal drop to the dorsum of field collected, third instar grass grub. The drop size was 0.79 μ l with technical materials terbufos (88% ai) and fensulfothion (76.5% ai) being diluted in acetone. Rates of 1.0, 10.0 and 100 μ g ai/insect were used in the initial test and 0.08, 0.1, 0.2, 0.4, 0.6 and 1.0 μ g ai/insect in a subsequent test. After insecticide application, the 28 larvae/treatment were held individually for 24 h before placing on untreated soil. After 5 days, the grubs were extracted from the soil and their normal ability to bury was tested.

Following the topical application tests, a soil bioassay test was conducted in pots in a screenhouse. Granular insecticides, fensulfothion and terbufos, were mixed into a Taupo sandy loam soil. The treated soil was placed in 5 replicate pots (170 x 170 x 190 mm). After 24 h 4-10 2nd or 3rd instar grass grub larvae, depending upon test date, were added to each pot. Following a 2 week contact period, the larvae were extracted and assessed for their normal ability to bury. Subsequent tests were commenced 2, 4, 6, 10 and 12 weeks after the initial insecticide mixing in early February. The soil moisture was maintained at approximately 68% (weight of water divided by oven dry weight of soil x 100) by watering at the completion of each test.

Field trials were sited near Matamata on a Peria soil (easy rolling phase) and near Atiamuri on an Oruanui loamy sand. Granule formulations of terbufos (Counter 20 G), fensulfothion (Dasanit 5 G) and diazinon (Dyzol 20 G) were broadcast by hand shaker onto 5 x 5 m pasture plots. Four replicates were arranged in a randomised block design.

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In the Matamata trial, fensulfothion and terbufos treatments were applied on February 27 1984, while the diazinon was applied 8 days later when rain fell. All insecticides were applied to the Atiamuri trial on March 1 1984.

Insect populations in the trials were assessed by hand sorting 20, 10 cm diameter soil cores from each plot, 10-12 weeks after treatment.

In addition, bioassay tests were conducted using soil collected from the Matamata trial. Eight 5 cm diameter, 2 cm deep cores were collected from each plot (bulked within plots) at 14, 29 and 43 days after the trial commenced. After foliage removal, the cores were crumbled before placing each treatment in four replicate pots (7.5 cm diameter and 9.0 cm deep). Ten 3rd instar grass grub larvae were added to each pot, and after a 2 week contact period, the larvae were assessed for their normal ability to bury. The tests were conducted in a screenhouse.

STATISTICAL ANALYSIS

To compare the insecticides in topical application tests, the rate ($\mu\text{g ai/insect}$) which affected 50% of the grubs was calculated by logit analysis after $\log_e$ transformation. In the bioassay tests, the day at which mortality declined to 50% was estimated by logit analysis. Insect counts from field trials were transformed ($\log_e x + 1$) before analysis of variance tests.

RESULTS

Topical application tests indicated fensulfothion and terbufos have similar activity with LD_{50} levels of 0.09 (95% CI 0.06-0.12) and 0.09 (95% CI 0.06-0.13) $\mu\text{g ai/insect}$ respectively.

Fig. 1: The biological persistence of granular fensulfothion and terbufos insecticides as determined by laboratory soil bioassay tests on grass grub larvae.

The laboratory prepared soil bioassay showed fensulfothion and terbufos to have similar activity against grass grub larvae (Fig. 1). Bioassay tests conducted with the field collected soil showed (following the logit analysis) terbufos (2 kg ai/ha) to have an active period 1.8 times that of diazinon and 0.8 times that of fensulfothion (extrapolation). Terbufos at 1.0 kg ai/ha and diazinon at 2.0 kg ai/ha had a similar period of activity. Graphic results are presented in Fig. 2.

Fig. 2: Grass grub larvae affected by granular insecticide formulations following field application as determined by bioassay tests.

Grass grub larval counts from the Matamata field trial following terbufos application at 1.0 and 0.5 kg ai/ha and diazinon at 2.0 kg ai/ha were not significantly different from the untreated (Table 1). Terbufos at 2.0 kg ai/ha gave a significant ($P < 0.01$) level of control, 48%. Fensulfothion at 2.0 kg ai/ha gave a significantly higher ($P < 0.01$) level of control, 75%, than the equivalent terbufos rate.

TABLE 1: Comparison of terbufos with standard insecticides for grass grub control in two field trials, 10-12 weeks after treatment.

Insecticide	kg ai/ha	No. $\log_e x + 1$ insects/20, 10 cm dia soil cores		
		Matamata trial Grass grub	Atiamuri trial Grass grub	Porina
untreated	—	2.7	4.0	1.8
terbufos	2.0	2.1 (48)*	1.8 (90)	0.2 (96)
terbufos	1.0	2.6 (10)	2.2 (85)	0.5 (87)
terbufos	0.5	2.9 (-24)	3.1 (60)	0.7 (65)
diazinon	2.0	2.6 (10)	2.6 (77)	0.2 (96)
fensulfothion	2.0	1.5 (75)	1.3 (95)	0.3 (90)
LSD	$P < 0.05$	0.25	0.26	0.36

* percent control in brackets

In the Atiamuri trial, all insecticides gave significant ($P < 0.01$) and generally high level of grass grub control. In both this and the Matamata trial grass grub density after terbufos application was linearly proportional to the rate applied $r = -0.8^{**}$ and $r = -0.7^{**}$ respectively.

All insecticides gave significant ($P < 0.01$) control of porina which were also present in the Atiamuri trial. At equivalent rates (2.0 kg ai/ha) all insecticides were equally effective. Lower rates of terbufos gave lower control (Table 1).

DISCUSSION AND CONCLUSIONS

The topical application tests indicated terbufos to have high activity against grass grub larvae. The biological persistence of terbufos, as shown by laboratory and field soil bioassay tests, was similar to fensulfothion. It was more persistent than diazinon. Kain (1972) indicated biopersistence was needed for reliable grass grub control.

The effectiveness of all insecticides including terbufos was relatively greater on the yellow-brown pumice soils, Taupo sandy loam (laboratory bioassay) and the Oruanui loamy sand (Atiamuri field trial) than on the Peria soil (yellow-brown loam). This agrees with finding by Kain and Atkinson (1968) who also found organophosphate insecticides to be more effective on pumice derived soils than on Waikato soils. Additional trials over a range of soil types would be needed to establish positively any such effect for terbufos. Stewart (1984) reported terbufos to give some control of grass grub in trials in Southland.

These initial trials indicate, providing other factors such as cost, toxicity and stock-withholding period are acceptable, further field evaluations against grass grub larvae and porina caterpillar are justified.

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