INSECTICIDE SCREENING TRIALS AGAINST BLACK BEETLE

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Summary

In a pot experiment with a mineral soil, CGA 12223 and terbufos gave significantly better control of black beetle (*Heteronychus arator*) adults than the insecticides currently recommended for black beetle control in maize. In a pasture field plot trial against second and third instar black beetle larvae, fensulfothion and CGA 12223 gave the best level of control, followed by ethoprophos, triazophos and terbufos.

INTRODUCTION

Black beetle (*Heteronychus arator*) has been an increasing problem in both pastures and maize (*Zea mays*) in the northern North Island, where maize areas have also increased in recent years. Maize crops sown at the usual time (October) are most susceptible to black beetle attack in the first four weeks after sowing, during which time there appear to be continual black beetle flights into the crop. After this live beetle numbers drop off markedly due to natural senescence, and the more mature plants are better able to withstand attack. Although it is probably possible to reduce black beetle damage in greenfeed maize by delaying sowing until mid-November, this is not practical in maize grown for cob production. It is therefore desirable to obtain protection from black beetle damage over the period from sowing until late November.

This paper reports the results of a pot experiment designed to screen insecticides for protecting seedling maize against attack by black beetle adults, and of a small plot field trial of insecticides against black beetle larvae in pasture.

METHODS

Trial 1

Insecticide screening against adult beetles was conducted in a glasshouse in pots 15 x 15 cm surface area and 12 cm soil depth. The pots contained maize seedlings growing in a Horotiu sandy loam soil (3.6% organic matter) which had been given a basal nutrient dressing. Four maize seeds (hybrid XL 306) were sown per pot. Insecticide treatments were applied at time of sowing in half of the pots, while the remainder were treated two weeks later, when all pots were seeded with black beetle adults. The insecticides were sprinkled on to the pot surfaces, lightly worked in and given 50 ml water. Pots were maintained at a moisture adequate for plant growth by watering to a constant weight during the trial. One male and four female beetles were seeded into each pot, this ratio reflecting that occurring in the field in November when beetles were collected for the trial. All insecticides used were granular formulations and each treatment was replicated five times in a randomised design. The treatments are given in Table 1.

Proc. 28th N.Z. Weed and Pest Control Conf.

TABLE 1: EFFECT OF CHEMICALS AGAINST ADULT BLACK BEETLE (maize pot trial)

Treatment (% Granular)	Rate kg/ha	% beetles dead or affected		treatment effect	% plants damaged or destroyed
		0 weeks*	2 weeks*		
terbufos (5)	2.0	90	100	94 aAB	5 fD
CGA 12223 (5)	2.0	95	95	96 aA	25 eCD
phorate (10)	1.0	85	65	75 bBC	41 cdeBC
chlorfenvinphos/ diazinon (10/10)	0.5/1.5	85	60	73 bBC	44 bcdeBC
diazinon (10)	1.5	90	45	67 bC	36 deBC
fensulfothion (5)	1.1	70	50	60 bC	59 abcAB
fensulfothion (5)	2.2	60	50	56 bC	38 deBC
parathion (10)	1.5	50	65	58 bC	54 bcdBC
fonofos (10)	1.0	65	45	55 bC	50 bcdBC
carbofuran (10)	1.0	10	40	25 cD	45 bcdeBC
fenamiphos (10)	1.5	15	5	10 dD	58 abcAB
chlorpyrifos (5)	1.5	15	0	7 dD	55 bcdABC
triazophos (2)	1.5	10	0	6 dD	61 abAB
untreated	—	5		5 dD	76 aA
Main effects: time 0				58 aA	35 cB
time 2				47 bB	53 bA
untreated				5 cC	76 aA

* Time between insecticide application and seeding beetles; results rounded to nearest 5.

The pots were destructively harvested three days after seeding with beetles, and beetle survival and plant damage were assessed. Beetles were considered unaffected if they dug beneath loose soil 10 to 15 minutes after removal from pots on to fresh soil.

Trial 2

Plots 0.5 x 0.5 m surrounded by fibrolite board sunk to a depth of 18 cm were constructed in established pasture at Otakanini near Helensville. Plots were pretreated with diazinon granules (2 kg/ha) three weeks prior to the commencement of the trial in an attempt to eliminate the resident black beetle population. Insecticide treatments were all applied as granules, and are given in Table 2. There were five replications in a randomised block design. Each plot was seeded with 14 black beetle larvae (12 third instar, 2 second instar) on January 9. Larvae were discarded and replaced if they did not bury themselves beneath the turf immediately after seeding into plots. Insecticides were broadcast by hand and watered into the plots on January 10. Plots were destructively harvested after one month and beetle survival was assessed. By this time some individuals had matured to pupal and teneral adult stages although dispersal flights had not occurred.

Grass Grub and Black Beetle

TABLE 2: EFFECT OF CHEMICALS AGAINST BLACK BEETLE LARVAE (Pasture Plot Trial)

Treatment (% Granular)	Rate kg/ha	% Mortality (Abbotts)*
fensulfothion (5)	1.1, 2.2	82 aA
CGA 12223 (5)	1.5, 2.5	73 abAB
ethoprophos (10)	1.1, 2.2	53 abcABC
triazophos (2)	1.7, 2.8	53 abcABC
terbufos (5)	1.5, 2.5	47 abcdABC
diazinon (10)	1.5, 1.9	35 bcdeABC
chlorfenvinphos/diazinon (10/10)	0.1/1.9, 0.5/1.5	27 cdeBC
leptophos (5)	2.0, 4.0	20 cdeC
DS 15647 (10)	2.0, 4.0	12 deC
fonofos (10)	2.5	17 **
untreated	—	0 eC

$$* \text{ Abbott's mortality} = \frac{(P-C)}{(100-C)} \times 100$$

P = % observed treatment mortality
C = % untreated mortality

** Tested at one rate only.
There were no significant interactions.

RESULTS

Trial 1

The results of trial 1 appear in Table 1. The percentage of beetles affected by insecticide treatments are presented for the 0 and 2 week intervals between insecticide application and seeding in beetles. These are combined to give the treatment effect by which chemicals are compared. The treatments fall into three groups:

(a) Terbufos and CGA 12223 gave high initial and residual activity against black beetle. The overall level of activity was significantly higher than that of all remaining chemicals (5% level).

(b) Phorate, chlorfenvinphos/diazinon, diazinon, fensulfothion, parathion and fonofos were significantly better than control (1% level). This group includes chemicals currently in use against black beetle adults in maize.

(c) Carbofuran, fenamiphos, chlorpyrifos and triazophos were not significantly different from control (1% level).

The main effects of the two times of insecticide application were significantly different from each other, and from control (1% level).

In the analysis of plant damage, there was a significant reduction in the number of plants attacked (1% level) in groups (a) and (b) above over that of control, with the exception of fensulfothion at the low rate. Plant damage in group (a) was significantly less than in the other treatments (5% level). A comparison of the rankings of individual treatments showed that the number of plants attacked was correlated to the number of beetles unaffected ($t = 4.15$, significant at 0.1% level). The main effects of the times of chemical application on plant damage were significantly different from each other and from control (5% level).

Trial 2

The results of this trial appear in Table 2. There were no significant differences in larval mortality between the rates of each insecticide and these were combined in the results, giving ten replications per treatment.

Grass Grub and Black Beetle

Fensulfothion and CGA 12223 gave a level of mortality significantly greater than control (1% level). Ethoprophos, triazophos and terbufos were significantly different from control at the 5% level.

DISCUSSION

The results presented here are from screening trials only, and indicate those chemicals which show some degree of activity against black beetle. Of the new chemicals tested, CGA 12223 compared favourably with those insecticides currently used to control black beetle in both pasture and maize. This chemical has also shown promise for control of grass grub (McPhail 1974).

Although the level of insecticidal control achieved is affected by soil and climatic conditions, the situation in maize has often been further complicated by the presence of a complex of pests including greasy cutworm (*Agrotis ypsilon*), soldier fly (*Inopus rubriceps*) stem weevil (*Hyperodes bonariensis*), white fringed weevil (*Graphognathus leucoloma*), and wire worm (*Elateridae*) (Given 1973), which has led to the use of materials not necessarily effective against black beetle. For example, carbofuran, although effective against soldier fly (Dixon and Grimmer 1973) and stem weevil (Mackay and Rowe 1974) in maize, is shown to be ineffective against black beetle in trial 1 of this study. In contrast, phorate has been shown to give significant reductions in numbers of soldier fly (Dixon 1974), stem weevil (Dixon pers. comm.) and black beetle in maize.

ACKNOWLEDGEMENTS

To chemical companies concerned for provision of insecticide materials, Mr C. B. Dyson for biometric analyses, and Mr A. B. Davidson, Ruawaro, with whose co-operation live material was obtained for use in the trials.

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