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CONTROL OF BLACK BEETLE IN MAIZE USING BAITS

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SUMMARY

Baits of cracked maize (12 pieces/kernel) at 10-40 kg/ha and carrying isazophos (0.63 — 5% by weight), were broadcast onto maize ground at planting to control adult black beetle (*Heteronychus arator*). There was a significant effect of bait rate on the number of dead beetles recovered on the surface of plots, but there was no effect of concentration of insecticide. Bait treatments gave comparable control to standard granular treatments, but at lower rates of insecticide per hectare. In a further trial row treatments of the baits were inferior to broadcast treatments.

INTRODUCTION

Currently recommended controls of black beetle in maize are granular insecticides of phorate or isazophos, as furrow or band treatments at planting (Watson *et al* 1978). Limitations to the effectiveness of these treatments result from:

- reduction of pesticide activity in some soils between planting and emergence, after which most beetles become attracted onto rows;
- frequent occurrence of damaged plants before the effective reduction of beetle numbers;
- an inability to protect crops against high beetle densities.

Control of black beetle using post-emergence sprays of isazophos were effective (Watson *et al* 1978, 1980), although the second and third limitations still applied. Seed treatments using organochlorine insecticides for control of *Heteronychus* spp in cereal crops have been recommended (Taylor 1951; Le Pelley and Goddard 1952; Graham *et al* 1959; Wilson 1972), but currently available and effective organophosphate alternatives are phytotoxic (Watson *et al* 1978).

Baits give the prospect of pre-plant or pre-emergence reduction of beetle numbers. Baits consisting of cracked maize (6-8 pieces/seed) and carrying lindane powder have been recommended for control of black beetle adults in maize and vegetable crops in Australia (Wallace 1948; Gellatley and Braithwaite 1962; Jenkins 1965). Wallace (1948) claimed that the baits were highly attractive to beetles even when scattered among young maize plants, but recommended the application of baits as a pre-plant treatment and preferably harrowed into the soil.

Pot trials conducted at Ruakura indicated a potential for isazophos baits to reduce black beetle numbers at lower rates of insecticide per hectare than for granules (Watson and Wrenn, unpublished data). Misgivings regarding field use of grain based baits carrying organophosphorus pesticides concerned the possibility of bird deaths. In spring 1980, an opportunity was provided to test the potential of these baits for control of black beetle in field maize crops.

METHODS

Two trials were conducted on separate farms at Otamarakau, Bay of Plenty, on Ohinepanea loamy sand soil. The ground had been cultivated during September from pasture which had deteriorated as a result of black beetle attack. The treatments were applied immediately after planting of the crops by contractor.

In the first trial three rates of baits (10, 20, 40 kg/ha) carrying four concentrations of isazophos (0.63, 1.25, 2.5 and 5.0% by weight) were broadcast onto plots on 3 October 1980. A granular application of isazophos (2.0 kg/ha) was also broadcast by

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hand shaker. Plots in the adjacent crop, which was treated with phorate (1.5 kg/ha) as a row treatment were monitored subsequently, along with the trial plots. After application of baits the plots were lightly raked, although many bait particles remained at the surface.

The baits consisted of maize chips retained between 5 mm and 2 mm sieves. They were dyed green with food colouring during the application of insecticide. The 10 kg/ha bait rate resulted in approximately 58 pieces of treated maize/m², with 12 pieces per seed weight.

Plots consisted of four rows (75 cm row spacing) by 10 m long with 1 m separating blocks. There were five replicates in randomised blocks. An estimate of beetle numbers present at planting was made from fifty 10 cm diameter soil cores taken in each buffer. Numbers of dead beetles appearing on the surface of each plot were counted and removed 3, 6, 11, 18, 28 and 35 days after treatment. Plant numbers from the inner two rows (each 6.55 m in length) were assessed on 21 October and 7 November and any visible damage to plants recorded. On 7 November, 10 plants from each plot were sampled, using the 10 cm diameter corer, and examined for presence of insects and plant damage beneath the soil surface.

The second trial site contained fewer black beetles. Plot width was increased to 8 rows. The treatments in Table 2 were applied on 10 October. Broadcasted bait treatments were applied as above. Row treatments of the baits and granules were applied in a shallow furrow above the seed before covering with soil by rake. Dead beetle numbers were assessed 11, 18 and 24 days after treatment.

Yields were assessed from the trials on 24 April 1981, by harvesting cobs from the inner rows used for plant counts.

RESULTS AND DISCUSSION

The trials were analysed on a log transformation of the accumulated counts of dead beetles on each plot. Back transformed numbers of dead beetles recovered in trial 1 are given in Table 1. The total numbers recovered (2.6/m²) compared with the pre-plant estimate of 4.6/m² from soil sampling. Sampling from beneath plants on 7 November (5 dead beetles in 650 samples) indicated that a low proportion of beetles died beneath the soil surface. Few live beetles remained on 7 November (6 in 650 samples).

There was a significant ($P < 0.01$) positive effect of bait density on the numbers of dead beetles recovered (Table 1). Regression of the beetle mortality with bait rate indicated that increased efficacy from bait rates greater than 40 kg/ha is likely to be small.

TABLE 1: Accumulated numbers of dead beetles following treatment with baits (Trial 1) (Mean No. dead beetles/plot)

Insecticide concentration on baits (% by wt.)	Bait rate (kg/ha)			Insecticide concentration means	Other treatments	Mean No. dead beetles
	10	20	40			
0.63			84	84	untreated	15
1.25	67	74	107	81	isazophos 10G broadcast	74
2.5	55	81	90	74	phorate 20G row	93
5.0	50	85	107	77		
Bait rate means	50	80	101		SED = 1.3, F**	
Insecticide rate kg/ha	Bait rate kg/ha		Mean No. dead beetles			
0.125	(10)		67			
0.25	(10,20,40)		70			
0.5	(10,20,40)		76			
1.0	(20,40)		87			
2.0	(40)		107			

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There was no significant effect of concentration of insecticide on the bait ($P > 0.05$). Thus, in the trial overall, increase in control at higher rates of insecticide per hectare was a reflection of increasing bait rates (Table 1).

The 20 and 40 kg/ha bait treatments, applying insecticide rates as low as 0.25 kg/ha, were equivalent to the maize planted with phorate, and slightly better than the broadcast granules of isazophos.

In trial 2, the broadcast bait treatments were superior to both the banded bait and banded granular treatments ($P < 0.01$) (Table 2). The 40 kg/ha broadcast bait treatment

TABLE 2: Control of black beetle using baits broadcast and banded on the rows (Trial 2).

Treatment	Bait rate (kg/ha)	Insecticide rate (kg/ha)	Mean No. dead beetles/plot
1.25% bait broadcast	40	0.5	59
1.25% bait broadcast	20	0.25	47
isazophos 10G row	-	2.0	29
isazophos 10G row	-	1.0	25
2.5% bait row	10	0.25	21
1.24% bait row	10	0.13	19
1.25% bait row	20	0.25	19
untreated	-	-	10
LSD ($P < 0.05$)			12
LSD ($P < 0.01$)			16

gave higher counts of dead beetles than the 20 kg/ha broadcast treatment ($P < 0.05$).

When comparing the time taken for dead beetles to appear on the surface in trial 1, 50% of the beetles were recovered within 4 and 8 days of application on the baited and phorate treatments respectively. By the end of the second week, coinciding with full crop emergence, the proportions of dead beetles had risen to 85% and 70% respectively. The daily pattern of mortality for each trial is represented in Fig. 1. The broadcast bait treatments had similar mortality profiles, but with more beetles killed at the higher bait rates. The broadcast granules of isazophos in trial 1 had a similar profile to the broadcast baits. The banded baits and banded granular treatments in trial 2, however, were more similar to the banded phorate in trial 1. The method of application apparently affected the rate at which beetles succumbed to insecticide.

Insecticidal activity of the baits appeared to decline to sub-lethal levels after the third week when mortalities were comparable to the untreated plots (Fig. 1). The apparent earlier mortality peaks in the second trial may have resulted from increased beetle activity in warmer conditions at the later sowing date.

Good protection of the crops resulted from bait treatments. There was no differences in crop damage (plant numbers or yields) on Trial 1. This was because of the extent of beetle movement across plots, and the large reduction in beetle numbers, before seedling emergence. With the larger plots in trial 2, there was a 3.4% reduction in plant numbers on untreated plots during the seedling stage.

No bird deaths were recorded. LD 50 values for rats are 40-60 mg/kg for isazophos, and 89-130 mg/kg for methiocarb, which is used as a bird repellent (Meister 1979). Methiocarb has low avian toxicity (5 mg/kg for small wild birds 0.4 kg in weight, 18 mg/kg for "domestic" birds 1 kg in weight), but birds develop an aversion for the chemical before lethal doses are consumed. Avian toxicity and the possibility of aversion by birds for isazophos could not be established.

CONCLUSIONS

Because of the extent of movement across plots, especially before seedling emergence, the bait treatments reflected the ability to intercept beetles as well as their potency (hence the bait rate effect). Since there was no effect of concentration of insecticide on baits, potential exists for effective and more rapid control of black beetle adults, using lower pesticide rates. The method requires evaluation in larger scale trials.

FIG. 1: Mean daily beetle mortality within assessment periods from treatment.

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