BAITS FOR CONTROL OF GREASY CUTWORM LARVAE. I. LABORATORY SCREENING

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SUMMARY

Mortality of greasy cutworm (*Agrotis ipsilon*) larvae was assessed 24 and 48 h after each was given a large flake of moistened bran treated with insecticide at various concentrations. Eight insecticides were screened and the LC_{50} s of five were compared in baits using vegetable oil as a diluent. Two synthetic pyrethroids, deltamethrin and fenvalerate, were very toxic but may be repellent. Chlorpyrifos was more potent than carbaryl, endosulfan and diazinon. Cost considerations justify field testing only chlorpyrifos and carbaryl. Kibbled wheat was as effective as bran in stimulating feeding on the poisoned bait but is more expensive.

INTRODUCTION

Greasy cutworm has become a serious pest of poroporo (*Solanum aviculare*) transplants in Taranaki and of sweetcorn (*Zea mays*) seedlings in Gisborne since the use of DDT was restricted. The larvae chew through the stems of poroporo transplants and corn seedlings.

Control of cutworm larvae was achieved by the application of poisoned baits in the pre-DDT era (Hough and Mason 1951) and more recently with baits containing modern insecticides (Sechriest and Sherrod 1977). Martin (1980) reported on the palatability of the non-toxic components of baits for cutworm, including the carriers, diluents and stickers for the toxicant. This paper summarises the laboratory screening of toxicants for bran- or kibbled wheat-based baits.

METHODS

The cutworm larvae used in these tests were reared on dock leaves by a method based on Allan (1973). The day before the test, even sized 3rd and 4th instar larvae, were selected and placed singly without food in 110 ml plastic pots. Any larvae about to moult (i.e. those with a small head compared to the body size) were rejected. Just before the tests, healthy larvae in pots were randomly allocated to the treatments.

Approximately 1 mg (dry weight) moistened bran, i.e. one or two flakes, containing insecticide was placed in each plastic pot. Mortality was assessed after 24 h in initial screening and, in all later experiments after 48 h. The presence of uneaten bran and moulted larvae were recorded.

For the initial screening of toxicants, baits were prepared by mixing 10 g of bran with 4 ml of aqueous solutions of insecticides (Table 1) at a range of concentrations. The added liquid was standardized in this way because the palatability of bran to cutworm larvae is affected by its moisture content (Martin 1980). The added moisture stimulated fungal decomposition of the bran baits which were therefore used on the day of manufacture. Each insecticide was usually tested twice and 15 or 20 larvae used at each concentration of insecticide in each test. The same number of larvae were given moistened untreated bran and acted as a control.

After initial screening, tests were conducted to establish the LC_{50} (concentration of insecticide causing 50% mortality in 48 h) of the more promising insecticides. Twenty larvae were used at each concentration and in the control, and each experiment was repeated three times so that a total of 60 larvae were used for each insecticide concentration and the control. Both water and vegetable oil ('Sunfield') were used as a

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diluent. The baits with vegetable oil were prepared by mixing 80 g of bran with 4 ml insecticide dissolved in oil. To keep the moisture levels in the final bait similar at all insecticide dosages, 1 ml of water was added to 2.5 g of the oil-bran bait just before use. From this mixture flakes weighing approximately 1 mg were selected for presentation to the larvae.

TABLE 1: Insecticides and product formulations screened for use in cutworm baits.

carbaryl	(Septan 80% WP)	endosulfan	(Thiodan 35% EC)
chlorpyrifos	(Lorsban 40% EC)	fenvalerate	(Sumicidin 10% EC)
deltamethrin	(Decis 2.5% EC)	maldison	(Malathion 25% EC)
diazinon	(Dyzol 80% EC)	methiocarb	(Mesurol 75% WP)

Kibbled wheat baits were prepared in a similar manner to the oil-bran baits but only 2 ml of oil + insecticide were required for mixing with 80 g of coarse kibbled wheat (330 particles/g). Before use, 1 ml of water was added to 2.5 g of each bait. The toxicity of these baits was compared with bran baits with the same insecticide dosages utilising three insecticides at each of three concentrations. Twenty larvae were used per concentration and the experiment repeated three times.

Oil-bran baits containing diazinon at a series of concentrations were prepared on 31 May 1979 and tested at intervals over 12 months to examine the keeping properties of oil-bran baits stored in screw topped jars. The oil-bran baits were compared with freshly made water based baits. Twenty larvae were used at each dosage.

Data were examined graphically and where appropriate by probit analysis and analysis of variance. When mortality of larvae in the control treatment reached 50% the results were discarded and the experiment repeated.

TABLE 2: Toxicity to cutworm larvae of insecticides in bran baits with water or vegetable oil as diluent, mortality assessed after 48 h. LC_{50} (expressed as % weight of insecticide in dry bait); 95% confidence limits in brackets.

Insecticide	Experiment (diluent)		
	1 (water)	2 (oil)	3 (oil)
carbaryl	0.22 (0.18-0.26)	0.34 (0.26-0.45)	0.20 (0.17-0.25)
chlorpyrifos	0.079 (0.066-0.095)	0.055 (0.046-0.066)	-
diazinon	0.55 (0.43-0.72)	0.44 (0.36-0.54)	-
deltamethrin	-	-	0.000056 (0.000045-0.000073)
endosulfan	-	-	0.25 (0.21-0.31)

RESULTS

Of the eight insecticides initially screened, maldison and methiocarb were rejected because their toxicity to cutworm was low compared with other insecticides of similar cost. Fenvalerate was rejected because its toxicity was lower than deltamethrin, the

other pyrethroid screened. Other promising insecticides were carbaryl, chlorpyrifos, diazinon and endosulfan. The LC_{50} s of these four insecticides and deltamethrin were determined (Table 2). Carbaryl was used as a standard in these experiments. Chlorpyrifos and deltamethrin were significantly more toxic than carbaryl, deltamethrin being the most toxic chemical tested. Diazinon and endosulfan had equivalent activity to the standard.

TABLE 3: Percentage mortality of cutworm larvae after 48 h exposure to approximately 1 mg of bran or piece of kibbled wheat treated with insecticide. Sixty larvae were used per concentration of insecticide.

Carrier	Insecticide and percentage by weight in bait									
	control	carbaryl			chlorpyrifos			endosulfan		
		0.25	0.5	1.0	0.06	0.13	0.25	0.25	0.5	1.0
bran*	2	67	85	97	70	98	100	70	90	97
kibbled*										
wheat	3	83	93	98	85	98	97	90	93	97

* no significant difference was found between baits with the two carriers

There was no significant difference between baits using bran or kibbled wheat as carrier when they were compared at the same dosages of carbaryl, chlorpyrifos and endosulfan (Table 3).

The stored diazinon baits made with oil as diluent remained as toxic as freshly made baits for at least one year (Table 4).

TABLE 4: Percentage mortality of cutworm larvae after 48 h exposure to approximately 1 mg of bran-diazinon-oil baits stored for 12 months compared with freshly made bran-diazinon-water baits. 20 larvae were used per concentration of insecticide.

diluent	percentage of diazinon in bait				
	0.05	0.1	0.5	1.0	5
water	20	45	75	98	100
oil	15	35	95	100	100

An LC_{90} value would be more useful for determining dosages for field trials but the wide variation of the data prevented calculation of this figure. The inconsistencies in the data were due partly to the variable health of the insects and the difficulty of giving each larva the same quantity of bran bait. It was not practical to moisten pre-weighed treated flakes or to weigh moistened bran.

Mortality recorded after 48 h was more reliable and consistent than at 24 h because at 24 h there were live larvae exhibiting abnormal behaviour which died 48 h after treatment. Therefore 48 h mortality data was used whenever available.

DISCUSSION

The object of the laboratory screening of insecticides for cutworm toxicity was to select suitable candidates and dosages for field trials. There are two main criteria of suitability - effectiveness and cost. Carbaryl and chlorpyrifos appear to be similarly cost-effective. Deltamethrin was the most potent insecticide tested but it is claimed to repel insects (Anon undated), which is an undesirable property in a bait. This possible repellancy to cutworm needs to be tested before field trials are conducted.

Both bran and kibbled wheat were equally effective as a carrier in the bait. Bran is cheaper but the denser kibbled wheat particles may allow better distribution in the field especially in windy conditions.

The use of vegetable oil as a diluent in bait formulation simplifies manufacturing procedures. It also allows growers to make their own bait because the oil/insecticide formulation* can be sprayed on to the bran in a concrete mixer. In addition, the good storage properties of the oil/bran baits allow them to be made at the user's convenience and stored until required.

Methiocarb baits (2% ai) are used for slug and snail control. Laboratory tests suggest that this concentration of methiocarb may control cutworm. This would be a useful additional benefit if the bait is already being used in a crop as a molluscicide.

CONCLUSION

As a result of these laboratory studies, two insecticides, carbaryl and chlorpyrifos, are proposed for field testing in bait form.

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*Full protective clothing must be worn because the oil may aid the penetration of the insecticide through the skin.