EVALUATION OF THREE MOLLUSCICIDE BAITS AGAINST SLUGS IN VEGETABLES

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The most common method of control of terrestrial gastropods is the application of baits containing a molluscicidal compound, an attractant, and a mould inhibitor. Most commercial products consist of an extruded cereal-based bait containing 2 to 8% of either methiocarb or metaldehyde. Baits formulated with either of these two compounds have not proven to be consistent in the control of slugs (Godan 1983). Currently much effort is being expended worldwide in the search for alternative molluscicidal compounds and formulations.

Thiodicarb, a carbamate widely used as an insecticide, has been shown to have molluscicidal properties (Crowell 1977). A molluscicidal bait containing thiodicarb has recently been developed and registered in Europe. Initial field trials have indicated good activity against slugs in field and horticultural crops, with a long period of activity (Gauliard and Laverriere 1989).

This paper reports on the evaluation of thiodicarb baits against two common slug species, *Deroceras reticulatum* and *D. panormitanum*, under New Zealand conditions. An experimental cereal-based extruded bait containing 4% thiodicarb, supplied by Rhône-Poulenc New Zealand Ltd, was compared with the commercial extruded products; Blitzem Slug and Snail Bait (2.7% metaldehyde) and Mesurol Snail and Slug Bait (2% methiocarb).

Three field trials were conducted in cold frames:

- Trial 1: Main crop winter cabbage (variety 'Winter Cross') on Bruntwood clay loam.
- Trial 2: Main crop winter cauliflower (variety 'Phenomenal') on Horotiu sandy loam.
- Trial 3: Main crop lettuce (variety 'Triumph') on Bruntwood clay loam.

One day after planting seedling transplants, enclosures 90 cm x 45 cm x 25 cm high were sunk into the soil to a depth of about 10 cm to enclose 10 seedlings. The enclosures consisted of galvanised sheet iron, with a barrier to slug escape fixed to the upper rim. Two 10 cm diameter x 10 cm deep holes, lined with a PVC sleeve and supplied with a raised cover, were placed in each enclosure between the seedlings rows to provide a refuge for the slugs released into the enclosures. In Trial 1, twelve *D. reticulatum* (equivalent to 28.7/m²) and four *D. panormitanum* (equivalent to 9.6/m²) were introduced to each enclosure. For Trials 2 and 3, twelve *D. reticulatum* and six *D. panormitanum* (equivalent to 14.5/m²) were introduced. The slug developmental stages used were in approximate proportion to those present in natural field populations: weight range, *D. reticulatum* 180-740 mg; *D. panormitanum* 160-470 mg.

Thiodicarb in Trials 1 and 2 was applied as broadcast applications at 150, 300, 600 and 900 g ai/ha (i.e. 5, 10, 20 and 30 bait particles/m²). In Trial 3 thiodicarb was applied at 300 g ai/ha. Methiocarb and metaldehyde were applied at 200 and 810 g ai/ha respectively (20 and 21 bait particles/m²). The three trials consisted of treatments replicated four times in a randomised block design.

The number of healthy, moribund, and dead slugs were recorded at 1, 4, 8, and 12 days post treatment. Slug damage to individual seedling plants was scored on a scale of 0-10 (0 = no damage; 10 = total loss) at each assessment date.

On all sampling dates in all trials the proportion of slugs dead was significantly higher for bait treated plots compared to unbaited plots (Table 1). The thiodicarb bait formulation was highly acceptable and toxic to both slug species although *D. panormitanum* was more susceptible than *D. reticulatum*. This was evident in the higher level and rapidity of mortality in the former species.

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TABLE 1: Mortality of two species of slugs, *Deroceras reticulatum* (*D.r*) and *D. panormitanum* (*D.p*) 12 days after application of molluscicide baits to seedling vegetables.

Treatment	Rate		Proportion of slugs dead on final assessment					
	g ai/ha	kg bait/ha	Trial 1		Trial 2		Trial 3	
			Cabbage		Cauliflower		Lettuce	
			<i>D.r</i>	<i>D.p</i>	<i>D.r</i>	<i>D.p</i>	<i>D.r</i>	<i>D.p</i>
unbaited	0	0	0.02	0.00	0.02	0.12	0.19	0.21
thiodicarb	150	3.75	0.62	1.00	0.50	0.88	—	—
thiodicarb	300	7.5	0.71	1.00	0.64	0.88	0.73	0.96
thiodicarb	600	15.0	0.71	1.00	0.64	0.88	—	—
thiodicarb	900	22.5	0.71	1.00	0.71	0.96	—	—
methiocarb	200	10.0	0.77	0.81	0.73	0.91	0.75	0.96
metaldehyde	810	30.0	0.62	0.81	0.40	0.54	—	—
Max SED			0.09	0.14	0.09	0.12	0.08	0.09

At day 1 a high proportion of slugs on the thiodicarb treated plots exhibited symptoms of carbamate poisoning. Loss of muscular tone was evidently rapid as many slugs were immobilised very close to the site of their feeding on the baits. Subsequently, numbers of slugs alive but exhibiting symptoms of thiodicarb poisoning declined, reflecting mortality of some affected slugs and recovery of others. A high proportion of slugs poisoned by thiodicarb were in a moribund condition for the first 8-15 hours after the onset of toxicity, but subsequently some regained locomotor (and some feeding) activity.

In Trials 1 and 2 there was no rate effect for the thiodicarb bait against *D. panormitanum*. However, thiodicarb at 150 g ai/ha was slightly less effective than the 300-900 g ai/ha rate against *D. reticulatum* (Trial 2), and consequently only the 300 g ai/ha rate was used in Trial 3.

The differences between the three bait formulations were small. In Trials 1 and 3 the proportion of slugs killed did not differ significantly between baits formulated with thiodicarb, methiocarb or metaldehyde. However in Trial 2 metaldehyde baits gave lower slug mortality for both species of slug.

Under the caging conditions used the molluscicide baits did not entirely prevent feeding damage to the crops, despite their effect on slug mortality. In Trials 1 and 2 there was a significant reduction in feeding damage compared to the unbaited plots, but the seedling plants were still severely damaged (Table 2). In Trial 3 although both baited treatments had lower damage scores there was no significant difference between baited and unbaited treatments in the damage to lettuce seedlings (Table 2).

At 300 g ai/ha the experimental formulation of thiodicarb gave comparable control to the two commercial molluscicide formulations of methiocarb and metaldehyde.

TABLE 2: Slug damage to seedling vegetables 12 days after application of molluscicide baits.

Treatment	Rate		Mean damage score (scale 0-10)		
	g ai/ha	kg bait/ha	Trial 1	Trial 2	Trial 3
			Cabbage	Cauliflower	Lettuce
unbaited	0	0	4.72	4.98	9.85
thiodicarb	300	75	2.80	3.60	6.15
methiocarb	200	10	2.30	4.02	8.50
metaldehyde	810	30	2.28	3.72	—
SED			0.48	0.30	1.86

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