Slugs and Snails

CONTROL OF SLUG DAMAGE IN OVERSOWN PASTURE LEGUMES

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Summary

Control of slug damage to oversown legume seedlings was examined in a series of experiments during 1976 and 1977. Two box experiments showed that, in the presence of slugs, seeds coated with methiocarb molluscicide had higher survival rates at six weeks after sowing than untreated seeds. Such seed treatment appeared to have little effect on seedling development even at high levels of active ingredient. An oversowing trial in hill country indicated little benefit from commercial seed coating, with and without methiocarb, in autumn but better survival from both treatments in spring.

INTRODUCTION

Slugs have been classed as major economic pests during the establishment of cereals in temperate climates (Runham and Hunter 1970). They are also reputed to cause many failures during pasture establishment (Anon 1967) but little is published on this particular aspect. Losses of legume seedlings after aerial oversowing in New Zealand's moist hill country areas have been attributed to slugs as well as to management and climatic factors (Suckling 1949; Madden 1952; Charlton 1978a).

Recent studies on legume oversowing (Charlton 1977, 1978a) have led to more detailed examination of slugs as a factor in seedling survival (Charlton 1978b, 1978c). A series of experiments involving legume species oversown into hill country pasture *in situ* and also into turfs in net-covered boxes, was carried out during 1976 and 1977 with a view to control of slug damage during the seedling establishment phase.

METHOD

For two experiments turfs were removed from close-grazed swards at Ballantrae, Grasslands Division's hill country research area near Woodville, during Winter 1976. Component species were mainly browntop (*Agrostis* spp), white clover (*Trifolium repens*), flatweeds and small quantities of other grasses and legumes. Each turf was trimmed to 10 cm and fitted into a 35 x 50 x 20, cm deep box section. Legume seeds were oversown into the turfs at 4 cm spacing using a small grid to enable relocation of seedlings. Each sub-plot contained 12 scarified seeds. Legumes used were red clover (*T. pratense*) 'Grasslands Turoa', white clover 'Grasslands Huia', subterranean clover (*T. subterraneum*) 'Woogenellup' and lotus (*Lotus pedunculatus*) 'Grasslands Maku'. Slugs were introduced where required at the rate of 20/box approximating to 100/m², a moderate level of population according to published estimates (Crawford-Sidebotham 1970). An equal mixture of the two common species *Agriolimax reticulatus* (field slug) and *Arion hortensis* (garden slug) was used. Seedling counts were made at weekly intervals, the herbage being trimmed to 3 cm at each count.

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The first turf experiment examined survival of oversown legumes with and without slugs introduced and with seeds untreated and coated with methiocarb (75% a.i. coated with 40% gum arabic). The second experiment compared survival from seeds, also coated by the author, with dolomite-Gafsa phosphate containing 0, 7.5, 20 and 75% methiocarb. A third experiment examined effects of methiocarb coating at the concentrations used in the second experiment, on legume seed germination in trays in a glasshouse without slugs.

Lastly a field experiment at Ballantrae compared untreated seeds and 'Prillcote' coated seeds with and without methiocarb, of red and white clovers sown into hill country pasture in April and repeated in September 1977. Additional treatments were sowing with and without an experimental formulation of methiocarb prills as an alternative control method. A split-plot design was used with legumes as sub-plots, treatments being replicated four times as in the previous experiments. Each sub-plot was composed of 20 seeds and spaced at 5 cm intervals and sown using a wire grid as in the box experiments. Main treatments were applied to areas of 1.5 x 1 m so that sub-plots (18 x 24 cm) had buffer zones to minimise effects of neighbouring treatments.

RESULTS

Turf experiments

Few seedlings survived from untreated seeds in the presence of slugs, only 7% remaining at 6 weeks after sowing. Coating of seeds with methiocarb gave much higher levels of survival when slugs were present (37%) suggesting a potential slug control method. Although molluscicide had been applied to remove any slugs from control treatments, immature slugs reappeared within 2-3 weeks, presumably hatched from eggs. Within these treatments the numbers of surviving seedlings were reduced to around 45%.

In the second experiment seedlings survived better under all levels of methiocarb coating than with dolomite-Gafsa phosphate alone (Table 1). After 6 weeks seedling numbers were highest in the 75% methiocarb coating treatment, the 7.5% and 20% treatments being similar to each other in effect. Legume species did not differ significantly from each other in this experiment.

TABLE 1: Survival of legume seedlings under different methiocarb-coating treatments in presence of slugs (% of viable seeds sown). Figures presented are actual means but analysis was carried out on transformed data.

% methiocarb in seed coat	Weeks after sowing	
	3	6
0	1 d	1 c
7.5	24 c	13 b
20	36 b	23 b
75	56 a	32 a

Effect of methiocarb coating on growth of legume seeds

In the third experiment, carried out in the absence of slugs, there was no effect of methiocarb concentration in the coating, average germination being 70%. Legume species did not differ significantly from each other. Some seedlings from methiocarb-treated seeds were chlorotic and a few were deformed but all those affected survived.

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TABLE 2: Establishment of untreated, coated and methiocarb-coated seeds oversown at Ballantrae in Autumn and Spring 1977 (% of viable seed sown).

Seed treatment	Legume	Autumn		Spring	
		3 weeks	6 weeks	3 weeks	6 weeks
Untreated	red clover	37 a	35 a	11 b	9 b
	white clover	56 a	45 a	6 b	2 c
'Prillcote'	red clover	46 a	48 a	26 a	23 a
	white clover	49 a	43 a	19 a	8 b
'Prillcote' + methiocarb	red clover	41 a	38 a	36 a	27 a
	white clover	45 a	39 a	21 a	14 b
	MEAN	46	41	20	14

Field experiment

Seedling survival from autumn sowing was almost three times better than from spring-sowing (Table 2). There appeared to be no benefit from either coating treatment in autumn but both coating treatments gave significantly better establishment in the spring oversow. Red clover survived better than white clover during spring. Methiocarb prills had no effect on any of the treatments.

DISCUSSION

Slug damage symptoms observed in the experiments were as recorded in seedlings of other crops (Runham and Hunter 1970) with germinating seeds hollowed out and young seedlings eaten at radicle and cotyledons. Better survival of red clover in the field experiment during spring conflicts with data from the box experiments (Charlton 1978b) but may be associated with choice of herbage available to slugs.

The results of this series of experiments indicated that coating of seeds could be beneficial during spring when seedling survival is usually low in moist hill country (Suckling 1949), possibly due to peak slug populations at this time of year (recorded in unpublished data in Wairarapa by B. E. Burridge, pers comm). Previous attempts at slug control by coating of cereal seeds with copper compounds and metaldehyde have failed (Gould 1962) but the development of carbamates and other molluscicides (Symonds 1975) warrants further examination of this method. Methiocarb is already marketed as a prill in Britain for slug and snail control in glasshouse crops (Anon 1976). Although it is more effective than metaldehyde in killing slugs (Crawford-Sidebotham 1970; Proude 1970), methiocarb seems unable to effect long-term control of slugs, as shown by the control treatments in the first experiment. This suggests that the search for a more persistent formulation or even a new molluscicide is necessary. Earlier work (Charlton 1978b) has shown that seedlings are easily killed by slugs up to the true-leaf stage of development. Thereafter growth is rapid enough to prevent seedlings being killed by slugs although damage still occurs. The chemical treatment required would render seeds and seedlings, up to the true-leaf stage, unattractive to slugs and other invertebrates without being phytotoxic or harmful to rhizobia.

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The box experiments have shown slugs to be a potential pest during oversowing but the field experiment failed to prove this owing to difficulty in separating slug effects from those of other factors. The technical difficulty of location of damaged seeds and seedlings in the dense sward is also a problem.

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REFERENCES

- Anonymous, 1967. "Slugs and snails" *U.K. Min. Agric. Adv. Leaflet* 115: pp 8.
- Anonymous, 1976. "Approved products for farmers and growers 1976" *H.M.S.O.* London, pp191.
- Charlton, J. F. L., 1977. Establishment of pasture legumes in North Island hill country. 1. Buried seed populations. *N.Z. J. Exp. Ag.* 5: 211-4.
- Charlton, J. F. L., 1978a. Establishment of pasture legumes in North Island hill country. 2. Seedling establishment and plant survival. *N.Z. J. Exp. Ag.* 5: 385-90.
- Charlton, J. F. L., 1978b. Slugs as a possible cause of establishment failure in pasture legumes oversown in boxes. *N.Z. J. Exp. Ag.* 6: In press.
- Charlton, J. F. L., 1978c. Effects of slugs during establishment of oversown legumes. *Proc. 2nd Australasian Conf. of Grassland Invert. Ecol., Massey Univ.*, May 1978. In press.
- Crawford-Sidebotham, T. J., 1970. Differential susceptibility of species of slugs to metaldehyde/bran and to methiocarb baits. *Oecologia (Berl.)* 5: 303-24.
- Gould, H. J., 1962. Tests with seed dressings to control grain hollowing of winter wheat by slugs. *Pl. Path.* 11: 147-52.
- Madden, E. A., 1952. Establishment of clovers on unploughable hill country. *Sheepfmg Ann (Massey Univ.)* 15: 37-48.
- Proude, C. K., 1970. The control of slugs and snails. *Proc. 23rd N.Z. Weed and Pest Control Conf.*: 216-19.
- Runham, N. W. and Hunter, P. J., 1970. "Terrestrial slugs". Hutchinson, London, pp 184.
- Suckling, F. E. T., 1949. Improvement of hill country pastures in the Wellington Province. *Proc. N.Z. Grassld. Ass.* 11: 89-117.
- Symonds, B. V., 1975. Evaluation of potential molluscicides for the control of the field slug, *Agriolimax reticulatus* (Mull.) *Pl. Path.* 24: 1-9.