SLUG DAMAGE TO PASTURE RENOVATED BY DIRECT DRILLING

C.M. FERGUSON and B.I.P. BARRATT

Invermay Agricultural Research Centre, MAF, Private Bag, Mosgiel

SUMMARY

The effect of slugs (*Deroceras reticulatum*) at densities of 0, 5, 10, 20, 40 and 80/m² was measured in a newly direct-drilled spring-sown pasture of white clover (*Trifolium repens*) and ryegrass (*Lolium spp.*). Slugs had their greatest impact on seedling mortality within 21 days following sowing. Seedling damage and losses increased in a non-linear fashion suggesting that slug density dependent factors influence feeding behaviour. Ryegrass and clover establishment and clover yield up to 97 days after sowing were significantly reduced by slug feeding. Ryegrass yield was less adversely affected.

INTRODUCTION

Direct drilling of pasture has received increasing interest in the last decade from farmers who are attracted by potential time and fuel cost savings. However this trend away from conventional cultivation has brought with it many pest problems which were previously controlled during seed bed preparation (Edwards 1975). Pottinger (1979) and Barker and Pottinger (1980) pointed out that slug degradation can be a serious problem in the establishment of direct drilled pasture species. Direct drilling does not provide mechanical disturbance of the soil to reduce slug density significantly, but in fact enhances slug survival by providing a moist dark refuge in the form of the drill slit. Furthermore the herbicidal removal of the existing pasture before drilling reduces the available food supply for the slugs, focusing their feeding activity on the germinating seeds and seedlings.

In New Zealand no effort has been made to quantify the impact of slugs in direct drilling. This study aimed to assess the effect of slug density on seedling damage and survival, and on early pasture yield.

METHODS

The resident pasture was sprayed with dicamba 0.44 kg ai/ha (Dicamba 20% EC) and glyphosphate 2.16 kg ai/ha (Roundup 36% EC) 43 days prior to drilling. To control regrowth, the area was sprayed with paraquat 1.2 kg ai/ha (Paraquat 20% EC) 23 days prior to sowing. The trial area was rendered slug free by applying methiocarb 14 kg ai/ha (Mesurol 2% baits) 39 days before drilling. Once trapping revealed no live slugs, the baits were removed by raking and rotary mowing.

The area was drilled on 8 November 1982 using a Duncan 734 multi-seedliner triple disc drill to sow 15 kg ryegrass ("Grasslands Nui") and 4 kg white clover ("Grasslands Huia")/ha. This gave viable seed densities of approximately 650 and 550 seeds/m² for ryegrass and clover respectively. Depth of drilling ranged from 2-4 cm. Immediately following drilling the trial was laid down. A randomised block design with 1 m² plots was used to compare slug densities of 0, 5, 10, 20, 40 and 80 slugs/m², replicated ten times. A channel 3 cm wide x 2 cm deep was cut around each plot and was filled with rock salt to prevent slug movement into or out of the plots. The salt was renewed as necessary throughout the duration of the trial. The slugs seeded into the plots had been collected from a nearby lucerne paddock and ranged from 0.05 g to 0.7 g wet weight. This was representative of the naturally occurring size range at the time except for a few extremely small slugs not collected. Any slugs that died were replaced regularly by live ones. The plots were protected with bird netting.

Proc. 36th N.Z. Weed and Pest Control Conf.

Plant survival and slug damage were assessed by randomly marking 20 ryegrass and 20 clover seedlings per plot 14 days after sowing and recording damage at 3-4 day intervals until the seedlings became too large for individual recognition, some 25 days after sowing.

Plant populations were measured by counting all seedlings in each plot 21 days after sowing.

Dry matter production of the sown species was measured at 41, 66 and 97 days after sowing by cutting the herbage growing from the drill slits to a height of 2-3 cm above ground level.

RESULTS AND DISCUSSION

Seedling damage and loss

Both ryegrass and clover seedling densities were low in relation to sowing rates, and this was thought to be a result of poor germination from drilling too deeply. This affects clover more severely than ryegrass, although only about half the density of clover as compared with ryegrass seedlings are normally expected (B.M. Smallfield, pers comm).

Seedling densities 21 days after sowing are shown in Table 1. As slug densities increased, seedling densities of both clover and ryegrass decreased until about 60% of seeds and seedlings had been lost in the highest slug density treatment. The relationship between seedling and slug density was, however, not linear with seedling losses per slug decreasing from 7.6 seedlings at 5 slugs/m² to 1.0 per slug at 80 slugs/m² for clover, and from 17.2 to 2.3 for ryegrass. The non-linear relationship may be a result of density-dependent factors such as aggression, which has been known to occur at high densities (Rollo and Wellington 1979), cannibalism or reduced feeding activity.

Damage and loss of marked ryegrass and white clover seedlings 21 days after sowing are also shown in Table 1. The data have been adjusted to disregard the slight damage resulting from factors other than slug feeding, by subtracting damage and loss which occurred in the slug-free plots from that which occurred in the slug-infested plots. Losses of clover and especially ryegrass seedlings were low in comparison with those indicated by the seedling density data discussed above, suggesting that the major proportion of losses occurred during the 14 days after sowing. Charlton (1978, 1979) also found that once clover seedlings reached the 1-5 true-leaf stage, there was comparatively little slug-induced mortality.

TABLE 1: Seedling density, and damage to marked seedlings in relation to slug density, 21 days after sowing.

Slug density (n/m ²)	Seedling density (n/m ²)		Percentage of marked seedlings					
	ryegrass	clover	damaged			destroyed		
			ryegrass	clover	Prob.*	ryegrass	clover	Prob.*
0	320	129	0	0		0	0	
5	234	91	19	10	NS	3	12	<0.01
10	234	82	25	15	NS	0.6	14	<0.05
20	213	64	30	17	NS	5	18	<0.05
40	196	57	31	27	NS	7	15	NS
80	139	51	59	29	<0.01	5	22	<0.01
LSD (p=0.05)	59	29	13	14		6	12	

* Level of significance of paired t-test

Sub-lethal slug feeding damage to clover and ryegrass seedlings reached similar proportions in all the slug density treatments except the highest where 59% of ryegrass but only 29% of clover seedlings were damaged. Conversely, significantly more clover than ryegrass seedlings were destroyed at most slug densities and this probably reflects

the different growth habit of the two plant species. Monocotyledonous plants, which grow from the tiller base, are less likely to sustain serious injury from foliar damage than dicotyledonous plants. Early cotyledon damage to clover seedlings can also result in long-term effects upon growth and plant productivity (Barratt 1980).

Dry matter production

During the trial there was some regrowth of pasture between the drill lines which may have affected yields of the sown species in the second and third harvests.

The results of three harvests are shown in Table 2. Ryegrass production from the first harvest, 41 days after sowing, was significantly reduced in all slug density treatments. At the second harvest yield was only reduced in the 80 slugs/m² plots and at the third harvest 14 weeks after sowing no significant treatment effects were recorded.

Clover dry matter production was reduced similarly in all treatments at the first harvest; the two highest slug density treatments showed reduced yield after 66 days and only the highest density of slugs reduced the yield significantly in the final harvest.

These results reflect not only the more prolonged effect of sub-lethal injury to clover as compared with ryegrass plants already noted but also the greater ability of ryegrass to compensate by increased individual plant production at lower plant densities.

TABLE 2: Dry matter production (g/m²) 41, 66 and 97 days after sowing

Slug density (n/m ²)	Harvest	Ryegrass				Clover			
		41 days	66 days	97 days	Total	41 days	66 days	97 days	Total
0		12.2	52.4	37.5	102.1	0.55	2.58	0.82	3.95
5		10.2	40.9	34.6	85.7	0.35	1.20	0.80	2.35
10		9.3	44.9	38.8	93.0	0.30	0.90	0.37	1.57
20		9.2	40.6	36.7	86.5	0.24	0.97	0.37	1.58
40		9.1	43.2	36.1	88.4	0.26	0.73	0.36	1.35
80		7.4	35.4	35.0	77.8	0.20	0.77	0.14	1.11
LSD (P=0.05)		2.0	11.9	11.6	16.3	0.16	1.75	0.63	1.79

The results suggested that direct-drilled clover was at greater risk from slug damage than ryegrass because it was less able to survive slug feeding activity. Severe slug damage to direct-drilled pasture may lead to low clover content and thus a low-producing pasture deficient in nitrogen. The percentage of the total yields made up by the clover component decreased from about 4% in the slug-free treatment to 1.5% in 80 slugs/m² plots, but the greatest proportional reduction occurred at the 5 and 10 slugs/m² treatments suggesting that economic thresholds may be at the lower end of the range tested in this experiment.

ACKNOWLEDGEMENTS

We would like to thank P. Watson and N. Bree for technical assistance.

REFERENCES

- Barratt, B.I.P., 1980. Effect of simulated insect damage to white clover seedlings. *Proc. 33rd N.Z. Weed and Pest Control Conf.*: 49-51.
- Barker, G.M. and Pottinger, R.P., 1980. Slugs, biology, damage and control in nurseries, vegetables, cereals and pasture. *AgLink Farm Production and Practice FPP* 439.
- Charlton, J.F.L., 1978. Slugs as a possible cause of establishment failure in pasture legumes oversown in boxes. *N.Z. J. Exp. Agric.* 6: 313-317.

- Charlton, J.F.L., 1979. Effects of slugs during establishment of oversown legumes in box experiments. *Proc. 2nd Aust. Conf. Grassl. Invert. Ecol.* 253-255.
- Edwards, C.A., 1975. Effects of direct drilling on the soil fauna. *Outlook on Agriculture*: 243-244.
- Pottinger, R.P., 1979. The role of soil fauna and pest control in conservation tillage systems. *Proceedings of the 1979 Conservation Tillage Technical Seminar*, Christchurch, N.Z.
- Rollo, C.D. and Wellington, W.G., 1979. Intra- and Inter-specific agonistic behaviour among terrestrial slugs (Pulmonata:Stylommatophora). *Can. J. Zool.* 57: 846-855.