NEMATICIDAL PROTECTION OF RYEGRASS SEEDLINGS IN PASTURE RENOVATION TRIALS

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SUMMARY

Perennial ryegrass (*Lolium perenne* cv "Ellett") was direct drilled into pasture during autumn 1985 at six sites in the northern North Island. Low infestations of root lesion (*Pratylenchus* spp) and root knot (*Meloidogyne* sp) nematodes were found in seed roots on all sites. Seed remains contained nematodes generally regarded as saprophytic or fungal feeding species. The combined seed (1% oxamyl ai by weight of seed) and furrow (2 kg ai/ha isazophos 10 G) pesticide treatment gave effective reduction in numbers of both seed and root nematodes. Pesticide application did not affect ryegrass seedling survival, but there was a slight increase in tiller numbers during establishment on five sites.

INTRODUCTION

Pasture renovation using conservation tillage methods is widely practiced because it has important cost, time and environmental advantages over cultivation methods (Allen 1981). There are, however, many mechanical and biotic factors that influence the effectiveness and reliability of seed establishment by this method (e.g. Baker 1985). An overall understanding of potential causes of failure, as well as appropriate corrective measures, is essential if the technique is to be successfully fostered. This paper reports on nematode populations infecting ryegrass seedlings on six pasture renovation trials in the Waikato and central volcanic areas of the North Island during autumn 1985.

METHODS

At each site, three methods of pasture renovation involving different turf treatments *viz* (i) no herbicide; (ii) glyphosate (2.16 kg ai/ha) as a blanket spray 14 days before drilling and (iii) glyphosate (1.08 kg ai/ha) as a 75 mm band over the drill row at the time of planting were compared. "Ellett" ryegrass was sown directly into turf at 20 mm depth and 150 mm row spacing through a Duncan triple disc drill. On undersown treatments, seed was drilled with and without pesticide in a split plot, randomised block design with four replicates. Each sub plot was two drill widths (5.4 m) by 15 m long, with 0.6 m buffers between blocks. Pasture was hard grazed (500 kg residual DM/ha) before undersowing. The trials were drilled in mid-late March 1985. The pesticide treatment consisted of oxamyl (Vydate 24 NAC) (1% ai/wt seed) and captan (Captan 80WP) (0.3% ai/wt seed) seed dressing applied one day before drilling, isazophos (Miral 10 G) (2 kg ai/ha) as a furrow treatment with the seed, and 2% ai methiocarb (Mesurol) slug baits (5 kg/ha) broadcast at the time of drilling.

At full emergence (4 weeks after drilling) seedling establishment counts were made within the furrow in twenty 100 mm diameter soil cores (2 m total row length) per plot. Estimates were made of total numbers of viable and non-viable, non-emergent seeds. A subsample of 20 seedlings from each plot was washed, cleared and stained for examination of nematodes. Nematodes were counted on all seedling parts (shoot, mesocotyl, seed, seed roots and true seedling roots) and identified to genera under a stereomicroscope (20 x) *in situ* or under a microscope (100 x) after dissection from seedling tissue.

Statistical analyses were based on square root transformation of seedling tiller numbers, angular transformation of seedling percentages and log transformation of

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nematode counts. Means of raw data are generally presented because of the variety of transformations used.

RESULTS AND DISCUSSION

Nematodes

Over all sites, 88% of total nematodes were found in seed roots and 8% were associated with the seed, but there were differences in the distribution of nematodes on the seedlings between sites (Table 1). A greater proportion of the nematode infestation occurred in the seed, sheath and mesocotyl from Waikato soils (sites 1-3) than on the Volcanic Plateau pumice soils (sites 4-6). The nematodes isolated were largely *Aphelenchoides*, *Aphelenchus* and *Eucephalobus*, which are generally regarded as microbial feeding genera. *Aphelenchoides* do, however, include some important seed, stem and foliar parasitic species (Southey 1978). Plant roots were just beginning to appear on some seedlings at the time of sampling so that most root feeding nematodes occurred in seed roots. Infestations consisted of root lesion nematodes (*Pratylenchus* spp) and a root knot species (*Meloidogyne* sp). Greater numbers of *Meloidogyne* occurred in plants from pumice soils.

TABLE 1: Nematode populations on ryegrass seedlings 4 weeks after planting.

	Site						Mean (total nematode no's on 6 sites)
	1	2	3	4	5	6	
	Waikato			Volc. Plateau			
% of total population on:							
seed	78	8	25	1	1	0	8
mesocotyl	7	2	1	0	0	0	1
sheath	3	2	19	0	1	0	2
seed roots	11	88	52	97	98	100	88
true roots	1	0	2	1	0	0	1
total nematodes/80 seedlings	216	318	167	1993	306	217	
total <i>Pratylenchus</i>	16	149	49	1821	90	38	
total <i>Meloidogyne</i>	6	22	39	135	210	186	
% seedlings with nematodes (no-pesticide treatments)	35	27	18	70	24	11	31

Infestations per plant varied widely, although on average only 31% of the seedlings contained nematodes. Pesticide reduced nematode infestations by 85% ($P < 0.001$, Table 2). Similar reductions occurred in the seed and root populations, and in *Pratylenchus* and *Meloidogyne*. The greater nematode infestation per seedling occurring on the blanket herbicide treatment, compared with band and no herbicide treatments, apparent from log transformed data (Table 3), may be related to the comparative absence of alternative plant hosts, or to the larger seedling size on the blanket herbicide treatment. The raw data and back transformed means however, differ drastically because of the different nematode populations at each site. At sites 2 and 4 with the highest populations, the blanket treatment had lower nematode numbers than the other two treatments although the site by treatment interaction was not significant when the log transformed data was analysed. There were no significant interactions between herbicide treatment and pesticide.

Seedling responses

Total seeds per sample core varied widely due to uneven seed distribution by the drill. There were no significant herbicide or herbicide x pesticide effects on seed counts/2 m row length. Total seed counts for pesticide and non pesticide treatments are given in Table 2, with germination and emergence expressed as percentage of total seeds recovered. Germination at sites 5 and 6 was adversely affected by dry soil conditions.

TABLE 2: Pesticide effects on nematode infestations per 20 ryegrass seedlings and seeds per 2 m row 4 weeks after drilling.

Observation	Treat- ment	Site						Mean	Significance of pesticide effect
		1	2	3	4	5	6		
Total nematodes	(U)	16	27	11	142	23	15	39	***
% reduction	(T)	89	88	83	83	89	81	85	
Nematodes in seed roots	(U)	2	24	6	138	23	15	35	***
% reduction	(T)	79	87	84	83	89	81	84	
Infested seedlings /2 m row	(U)	60	39	9	114	29	12	44	***
% reduction	(T)	86	82	78	71	85	76	80	
Total seeds	(U)	178	149	59	174	127	142	138	ns
	(T)	168	176	62	144	117	127	132	
% not germinated	(U)	0.8	0.3	4.2	1.7	0.9	16.3	4.0	*
	(T)	1.7	1.2	4.0	3.0	1.4	15.1	4.4	
% viable, not emerged	(U)	3.0	2.6	6.7	3.4	—	3.1	3.8	***
	(T)	7.6	7.2	10.5	10.9	—	9.3	9.1	
% emerged	(U)	96	97	89	95	99	81	93	***
	(T)	91	92	86	86	99	76	88	

U = without pesticide, T = with pesticide

TABLE 3: Effect of herbicide treatment on nematode infestations and ryegrass seedling tiller numbers (means of the 6 sites).

	Herbicide treatment			% Increase on blanket vs nil	Significance
	nil	band	blanket		
Total nematodes/20 seedlings	5.9 (24)	5.5 (23)	9.5 (21)	—	LSR 1.54
Nematodes in seed roots/20 seedlings	5.5 (22)	5.3 (22)	8.5 (17)	—	LSR 1.68
No. nematode infested seedlings/2 m row	13.2 (24)	12.7 (24)	21.3 (33)	—	SED 4.11
Total nematodes/2 m row	19.9 (174)	16.6 (160)	38.1 (141)	—	LSR 1.90
No. tillers/seedling after 4-5 weeks (sites 1,2,3,5)	1.1	1.9	2.7	145	SED 0.09
7-9 weeks (sites 1-6)	1.3	3.5	6.4	392	SED 0.19
12-14 weeks (sites 1,2,4,5,6)	1.8	5.7	11.7	550	SED 0.34

Raw nematode data given in parentheses; LSR = least significant ratio; SED's are average values since analysis was of transformed data.

High germination counts, similar to sites 1-4, were recorded on site 5, two weeks after the original counts were taken and these are used in Table 2. There was significantly more non-germinated seed in pesticide treatments ($P < 0.05$), but sites were not affected consistently, and the proportion of total seeds affected was very small.

A small proportion of germinated seeds had not emerged at the time of sampling. There were 2.5 times as many viable, non-emergent seedlings on the pesticide, compared with non-pesticide treatments ($P < 0.001$). This effect was attributed to isazophos and has been confirmed in pot trials in which oxamyl and isazophos treatments were applied

separately (Barker unpublished). A germination delaying rather than phytotoxic seedling mortality effect has also been observed for isazophos in maize (Watson 1981).

Counts of tillers per seedling were taken on 2-4 occasions (depending on site) between emergence and five months after sowing. The greatest effect was a suppression of tillering in the no herbicide treatment compared with the blanket application ($P < 0.001$), with the band treatment intermediate between the two (Table 3).

There was an increase in seedling size (tiller number) with pesticide use on all sampling occasions except at site 2, with the effects reaching significant levels only on site 3 ($P < 0.01$) and site 4 ($P < 0.05$, Table 4). Site 3 had low nematode counts per seedling, but also had the highest population of grass grub (*Costelytra zealandica*). Grass grub was the main insect monitored on the trials and these tended to become concentrated in drill rows after seedling emergence. Site 4 had the highest nematode counts of the six sites, and no grass grub. There was no assessment of ectoparasitic root feeding nematodes, which have also been implicated in establishment and persistence problems in ryegrass (Spaull 1985; Spaull *et al* 1985).

TABLE 4: Effect of pesticide on ryegrass seedling size (tillers/seedling) up to 22 weeks from drilling.

Site	Number of assessments	Mean % pesticide effect	Range %	
			Min	Max
1	4	12.0	5	15
2	4	-7.0	-9	-4
3	2	27.5	17	38
4	2	18.5	12	25
5	3	7.7	4	11
6	2	10.5	10	11

SE of the pesticide effect is approximately 8.5%

CONCLUSIONS

The combined seed and furrow pesticide treatment provided a consistent reduction in nematode infestations of around 85% in undersown ryegrass seedlings. There was a slight increase in seedling growth (tiller numbers) from the pesticide treatment, but the level of response did not relate well to nematode infestations in seedling roots. Nematode infestations in oversown ryegrass at the levels reported seem to be of minor agronomic importance.

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