EFFECT OF PLANT SPECIES ON THE DEVELOPMENT AND VERTICAL MIGRATION OF LARVAE OF GASTROINTESTINAL NEMATODES WHICH PARASITISE SHEEP

J.H. Niezen[1], W.A.G. Charleston[2], J. Hodgson[3], C.M. Miller[1] and H.A. Robertson[1]

[1]AgResearch Grasslands, Flock House Agricultural Centre, Private Bag 1900, Bulls, New Zealand

[2]Department of Veterinary Pathology and Public Health, Private Bag 11-222, Massey University, Palmerston North, New Zealand.

[3]Department of Plant Science, Private Bag 11-222, Massey University, Palmerston North, New Zealand

ABSTRACT

The development and migration of gastrointestinal nematode larvae on a range of herbage species were compared following a series of standardised contaminations with sheep faeces over two years. In 1992/93, greatest numbers of larvae were recovered from browntop (*Agrostis capillaris* cv Grasslands Muster), cocksfoot (*Dactylis glomerata* cv Grasslands Kara), ryegrass (*Lolium perenne* cv Grasslands Nui) and Yorkshire fog (*Holcus lanatus* cv Massey Basyn) while the lowest numbers were recovered from white clover (*Trifolium repens* cv Grasslands Huia) with the other herbages intermediate. In 1993/94, highest numbers were recovered from Yorkshire fog and ryegrass, lowest numbers from white clover, chicory (*Chicorium intybus* cv Grasslands Puna) and lucerne (*Medicago sativa* cv Grasslands Otaio) and intermediate from the other herbages. The proportions of total larvae recovered in the 0-2.5 cm stratum, an inverse measure of larval migration, were lowest in white clover, ryegrass, tall fescue (*Festuca arundinacea* cv Au Triumph) and browntop, highest for Yorkshire fog and intermediate for the other grasses.

KEYWORDS

gastrointestinal nematodes, internal parasites, larvae, development, migration, pasture species

INTRODUCTION

Levels of gastrointestinal nematode parasitism in lambs and cattle can differ with the type of pasture grazed (Ciordia *et al*., 1962; Scales *et al.*, 1995). The results suggest that differences in levels of parasitism in animals grazing different herbage species result from differences in larval dynamics. Plant species effects on sward microclimate may affect larval development and may also modify the number of organisms which colonise or consume faeces, or consume gastrointestinal nematode eggs or larvae. Differences in leaf and stem surface morphology may affect vertical migration of larvae (Silangwa and Todd, 1964). This work was carried out to compare development, survival and migration of nematode larvae on herbage species of differing morphology and in different seasons.

MATERIALS AND METHODS

A series of 4 contaminations per year of a range of herbage species with sheep faeces containing known numbers of gastrointestinal nematode eggs were carried out in 1992/93 and 1993/94. Four replicate plots (each 3 x 2 m) of monospecific swards (see Table 1) were established in a randomised block design on prepared seed-beds in October 1991, and were cut intermittently to 4 cm until faecal deposition began. Plots were then subdivided into 30 x 30 cm sub-plots and each sub-plot was contaminated with approximately 30,000 (1992/93) or 50,000 (1993/94) *Trichostrongylus colubriformis* and/or *Ostertagia circumcincta* eggs in faeces derived from donor lambs which were given a single dose of either 15,000 *T. colubriformis* or *O. circumcincta* infective larvae. The faeces were mixed before sub-samples were placed in the centre of each sub-plot. The contaminations were undertaken in late spring, early summer, mid-late summer and autumn.

For each herbage species, six sub-plots per replicate were cut at each of 2, 4, 6, 8, 11 and 14 weeks after contamination. Remaining faeces were removed before cutting. Herbage was cut by grasping it in small handfuls and cutting as close as possible to ground level. It was then cut into 4 vertical strata, 0-2.5 cm, 2.5-5 cm, 5-7.5 cm and 7.5+ cm above the soil surface, which were placed in labelled receptacles. Larvae were recovered from the herbage by a modified Baermann procedure. Ensheathed, third stage larvae were identified as either *Trichostrongylus* spp. or *Ostertagia* spp. based on size and morphological characteristics.

STATISTICAL ANALYSIS

Due to high variation in the numbers of larvae recovered in different contaminations, herbages were compared by rank analysis. Herbages were ranked from lowest to highest according to the numbers of third stage larvae recovered and comparisons of least squares means of rank values made with respect to the numbers of larvae measured at each cut by analysis of variance. A similar ranking analysis was undertaken for the maximum numbers of larvae recovered after contamination.

"Larval migration" was defined as the inverse of the proportion of larvae on the herbage which were recovered from the bottom stratum of herbage, and was also ranked for analysis.

RESULTS AND DISCUSSION

Numbers of Larvae Recovered. In both years there was a highly significant herbage effect on the total numbers of larvae recovered (Table 1) and results were in general consistent within years (Niezen, 1997). In 1992/93, the greatest numbers were recovered from browntop, cocksfoot, ryegrass and Yorkshire fog, and the lowest from white clover, with the other herbages intermediate. In 1993/94, highest numbers were recovered from Yorkshire fog and ryegrass, with lowest numbers from white clover, chicory and lucerne. The ranking values for the two nematode species were generally consistent across herbage species in both years (Table 1).

There was a significant herbage effect on vertical migration of larvae for both species of nematode except for *Ostertagia* in 1992/93 (Table 2). The greatest proportion of larvae were in the bottom stratum for Yorkshire fog and the lowest for white clover. This pattern was similar in both seasons for both species of nematode.

The results indicate that the developmental success of the parasites (numbers of eggs which developed into third stage larvae) and subsequent migration onto the sward canopy differed between herbages. These effects appear to reflect the influence of differences in sward microclimate and in plant morphology and surface characteristics. Greater understanding of the mechanisms involved should allow the definition of plant characteristics which limit the rates of parasitism in grazing lambs.

REFERENCES

Ciordia, H., W.E. Bizzell, P.M. Baird, H.C. McCampbell, H.H. Vegors and O.E. Sell. 1962. The influence of pasture type and supplemental grain feeding on numbers of gastrointestinal nematodes in beef yearlings. Am. J. Vet. Res. **23**: 1001-1005.

Scales, G.H., T.L. Knight and D.J. Saville. 1995. Effect of herbage species and feeding level on internal parasites and production performance of grazing lambs. N.Z. J. Agr. Res. **38**: 237-247.

Silangwa, S.M. and A.C. Todd. 1964. Vertical migration of trichstrongylid larvae on grasses. J. Parasitology **50**: 278-285.

Table 1
Ranking values of total numbers of *Ostertagia* spp. and *Trichostrongylus* spp. third stage larvae recovered from swards contaminated with faeces containing a known number of eggs. Ranking value of 1 = lowest number of larvae recovered, 9 = highest.

Herbage	1992/93			1993/94			Combined for both years
	Ostertagia	*Trichostrongylus*	Combined	*Ostertagia*	*Trichostrongylus*	Combined	
Browntop	5.65	5.41	5.56	4.56	3.75	4.00	4.78
Cocksfoot	5.45	5.13	5.43	6.06	4.48	4.81	5.12
Chicory	ND[1]	ND	ND	2.65	4.09	3.47	ND
Tall fescue	4.55	4.43	4.38	5.64	4.56	4.96	4.67
Lucerne	4.10	4.68	4.42	4.33	4.22	3.81	4.12
Prairie grass	4.44	4.55	4.42	4.92	5.59	4.83	4.63
Ryegrass	5.34	5.25	5.48	5.67	5.29	5.63	5.56
Ryegrass/white clover	ND	ND	ND	5.16	4.91	4.45	ND
White clover	4.38	4.09	4.01	4.08	3.48	3.42	3.72
Yorkshire fog	4.99	5.45	5.43	6.28	6.06	6.08	5.76
Pooled SE	0.253	0.277	0.291	0.295	0.312	0.303	0.276
Herbage effect (P<)	0.0001	0.0001	0.0001	0.009	0.02	0.009	0.0001

[1] ND - not determined.

Table 2
Ranking values for the proportion of the total *Ostertagia* and *Trichostrongylus* third stage larvae recovered from the bottom stratum (0-2.5 cm of experimental swards). Ranking value of 1 = lowest proportion; 9 = highest.

Herbage species	1992/93			1993/94			
	Ostertagia	*Trichostrongylus*	Combined	*Ostertagia*	*Trichostrongylus*	Combined	Combined for both years
Browntop	4.5	4.5	4.3	3.5	4.2	3.9	4.1
Cocksfoot	5.7	5.4	5.5	4.5	4.0	3.8	4.6
Tall fescue	3.8	4.2	4.3	4.8	4.9	4.9	4.6
Lucerne	4.2	4.2	4.6	3.4	ND	ND	4.3
Prairie grass	4.7	4.9	4.6	6.4	ND	ND	5.3
Ryegrass	4.4	4.0	4.0	5.3	3.9	4.1	4.1
Ryegrass/white clover	ND[1]	ND	ND	5.3	ND	ND	ND
White clover	3.8	3.3	3.3	4.9	3.2	4.1	3.7
Yorkshire fog	4.8	5.5	5.5	6.4	5.6	6.1	5.8
Pooled SE	0.27	0.26	0.28	0.27	0.23	0.27	0.27
Herbage effect (P<)	0.14	0.0008	0.002	0.0003	0.0001	0.005	0.0001
Contamination effect (P<)	0.99	0.99	0.99	0.97	0.03	0.02	0.11

[1] ND - not determined.