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Short Communication

Establishment rate of sheep gastrointestinal nematodes in farmed red deer (*Cervus elaphus*)

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ABSTRACT

To investigate the establishment of sheep gastrointestinal nematodes (GIN) in red deer, five red deer and five sheep aged 5–6 months were challenged with a mixed burden of sheep GIN at a rate of 327L3/kg bodyweight. The LSmean (SE) establishment rates (%) for *Haemonchus contortus*, *Teladorsagia circumcincta*, *Cooperia curticei*, *Trichostrongylus* spp. and *Oesophagostomum* + *Chabertia* spp. were 18.6 (0.03), 35.5 (0.04), 30.7 (0.04), 74.9 (0.05), 19.9 (0.06), respectively in sheep and 10.5 (0.03), 1.0 (0.04), 0.1 (0.04), 1.0 (0.05), 4.8 (0.06) respectively, in deer. Establishment rates were significantly different ($p < 0.05$) between hosts for all genera. No *Trichostrongylus colubriformis* or *Trichostrongylus vitrinus* were seen in any deer but were present in all sheep. *Trichostrongylus axei* were seen in both hosts but there were relatively more which established in sheep than in deer ($p < 0.01$). No *Chabertia ovina* were seen in any deer but were present in four of five sheep in low numbers. The only species of *Oesophagostomum* seen in either host was *Oesophagostomum venulosum*. These results suggest that the sheep GIN most likely to infect red deer grazing the same pastures are *H. contortus*, *T. axei* and *O. venulosum*.

1. Introduction

As in other livestock production systems, parasites are an important clinical and economic problem in farmed deer (Audigé et al., 1998; Wilson, 2002). Whilst most focus has historically been on clinical disease caused by *Dictyocaulus* spp., gastrointestinal nematodes (GIN) may also be an issue for red deer (Audigé et al., 1998; Mason, 1977; Watson and Charleston, 1985). To help limit parasitism in deer there has been a move by deer farmers to use integrated management systems, particularly cross-grazing with other ruminants to restrict the number of deer-specific parasite larvae on pasture. However, very few studies have investigated the potential for cross-infection of GIN between deer and other ruminants. It is known that deer can be infected with some GIN of sheep including *Trichostrongylus axei*, *Haemonchus contortus*, *Oesophagostomum venulosum*, *Teladorsagia circumcincta*, *Trichostrongylus vitrinus*, *Nematodirus* and *Chabertia ovina* (McKenna, 2009). However, it is not clear how readily deer are infected with sheep nematodes. The aim of the present study was to determine the establishment rate of sheep GIN in young deer compared with sheep of the same age to help understand the potential risks associated with cross-grazing and susceptibility of deer to sheep GIN.

2. Materials and methods

Five male red deer calves (*Cervus elaphus*) and five Romney-cross ewe lambs (*Ovis aries*) raised on pasture which were born mid-November to early December 2011

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Table 1
Mean establishment rate of a mixed challenge of nematodes to young sheep ($n = 5$) and deer ($n = 5$). The proportion in the larval challenge dose is also given.

Animal	LW (kg)	Larval dose (%)				
		14.3 *H. contortus*	28.7 *T. circumcincta*	10.8 *C. curticei*	14.3 *Trichostrongylus* spp.	31.7 *Oesophagostomum* + *Chabertia* spp.
Establishment rate (%)[b] deer						
117	64	13	2	0	2	7
118	60	9	1	0	1	1
120	60	6	0	0	1	6
122	58	12	1	0	1	8
123	63	13	3	2	1	5
Arithmetic mean	61	10.7	1.4	0.4	1	5.3
LS mean[c] (SE)[d]		10.51 (0.025)	1.02 (0.041)	0.07 (0.039)	1.01 (0.049)	4.81 (0.064)
Establishment rate (%)[b] sheep						
409	21	18	28	27	63	23
416	27	11	24	27	58	23
417	23	23	51	43	78	37
418	34	21	34	15[a]	90[a]	2
420	19	20	41	39	80	24
Arithmetic mean	24.8	18.8	35.8	31.1	73.9	21.8
LS mean[c] (SE)[d]		18.6 (0.025)	35.53 (0.041)	30.72 (0.039)	74.85 (0.049)	19.94 (0.064)
P[e]		0.0118	<0.0001	<0.0001	<0.0001	0.0284

[a] Based on 10% aliquot for the small intestine.
[b] Number of worms counted/number of infective larvae administered.
[c] Least square means.
[d] Standard errors.
[e] Probability of significant differences between deer and sheep.

(aged 5–6 months), were housed in different sheds. The deer were treated with abamectin (0.2 mg/kg; Combat AbaCare LV®, Virbac New Zealand Ltd.) together with oxfendazole (9.06 mg/kg; Bomatak C®, Bayer New Zealand Ltd.), and lambs were treated with abamectin (0.2 mg/kg, Combat AbaCare LV®) together with a dual combination of oxfendazole (4.53 mg/kg) plus levamisole HCl (8 mg/kg; Scanda®, MSD Animal Health, NZ Ltd.), and monepantel (2.5 mg/kg; Zolvix®, Novartis New Zealand Ltd.). Two weeks after treatment they were infected with a mixed culture of sheep-origin GIN including *Trichostrongylus colubriformis*, *T. vitrinus*, *T. axei*, *T. circumcincta*, *H. contortus*, *Cooperia curticei*, *Nematodirus* spp., *O. venulosum* and *C. ovina*. Each animal was given 327 infective larvae (L3)/kg liveweight administered by stomach tube, the dose is shown in Table 1.

Larvae were available as individual experimental isolates for *T. colubriformis* and *T. circumcincta* with the remainder collected from naturally infected sheep. The infective dose given to deer was within the range nominated for sheep in WAAVP guidelines for evaluating anthelmintic efficacy in ruminants (Wood et al., 1995). Larvae were less than 5 months of age at the time of infection.

Faecal egg counts were estimated using a modified McMaster technique where each egg counted represented 50 eggs/g (Stafford et al., 1994). Four weeks after infection all animals were euthanized. After slaughter the abomasa, small intestines and large intestines were removed and frozen at −20 °C until processing for worm counts. Individual organs were thawed, and then worm counts were undertaken on 5% aliquots of abomasal and small intestinal washings, and 10% aliquots of large intestinal washings. Prior to counting, all aliquots were sieved over a 37.5 μm mesh. All available males up to a maximum of 50 per animal, for each genus, were examined and identified to species. These proportions were used to calculate the worm burdens of each species within a genus for each animal.

When the species in the original dose were known, the establishment rate was estimated by comparing the worm burden with the infective dose. These establishment rates were compared after ArcSin transformation and analysed with a linear model that included the fixed effect animal species (sheep vs. deer) and a random residual error. To enable a comparison between sheep and deer for *T. axei* and *O. venulosum* the number of worms counted was divided by the total number of infective larvae given of *Trichostrongylus* spp. and the *Oesophagostomum/Chabertia* group and this proportion was then compared as for the other species. To provide an estimate of establishment rate for these two species, the number of worms of each species counted in the sheep was extrapolated to estimate the proportion in the infective dose and this was used to estimate the establishment rates for those species. The experiment was approved by the Massey University Animal Ethics Committee.

3. Results

On the day of challenge all animals had zero faecal egg counts and on Day 28 all animals shed eggs with the mean for sheep of 4750 eggs/g (range 1200–4950) and for deer 350 eggs/g (range 50–800). No clinical signs of parasitism were seen in any animal. Individual and mean establishment rates for both deer and sheep are shown in Table 1. For Sheep 418 the small intestinal counts from the first aliquot indicated an unusually high establishment