Gastrointestinal Nematode Populations in Stabled Ewes of Rimouski Region

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ABSTRACT

Nematode populations in stabled ewes of the Rimouski region were studied by means of fecal worm egg counts, fecal culture of larvae, and worm counts at necropsy. It was found that during the winter strongyle egg counts were low, Trichostrongylus eggs being most numerous. The strongyle egg counts increased following lambing and reached peak in June. Ostertagia spp was the principal contributor to this "spring-rise", with substantial contribution from Trichostrongylus and Haemonchus contortus. The bulk of adult worm populations in winter, however, was made up of Trichostrongylus, whereas the great majority of the populations of Ostertagia spp, H. contortus and Nematodirus spp were inhibited in development at the fourth larval stage. All the worms recovered at necropsy in spring were adults, coinciding with the "spring-rise".

RÉSUMÉ

Au moyen du comptage des oeufs dans les fèces, des coprocultures et du dénombrement des parasites, lors de la nécropsie, les auteurs ont tenté de déterminer le nombre de nématodes parasitant les brebis en stabulation, dans la région de Rimouski. Ils réalisèrent que le nombre d'oeufs de strongles était bas durant l'hiver, et que ceux de Trichostrongylus étaient les plus nombreux. Le nombre d'oeufs des strongles augmenta après l'agnelage et atteignit un point culminant en juin. Le principal responsable de cette augmentation printanière était Ostertagia spp; Trichostrongylus et Haemonchus contortus fournissaient aussi un apport substantiel. Au cours de l'hiver, Trichostrongylus représentait la majorité des parasites adultes, tandis que la plupart des nématodes Ostertagia spp, H. contortus et Nematodirus spp subissaient un arrêt dans leur développement, au quatrième stade larvaire. Au printemps, tous les parasites rencontrés lors de nécropsies étaient des adultes; cette observation coïncidait avec la montée printanière.

INTRODUCTION

It has been estimated that some 48% of the sheep population in Quebec is raised in the Rimouski region. Field veterinarians hold the view that diseases caused by gastrointestinal nematodes in Rimouski sheep account for a considerable economic loss,

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depsite empirical anthelmintic control measures. There is however no information on the species of helminths involved in the perpetuation of disease in sheep of that region.

An investigation was therefore undertaken to determine the structure of worm populations and their epidemiology in sheep of the Rimouski region. The present is a report of the findings in breeding ewes stabled for the winter period.

MATERIALS AND METHODS

Experimental Design

In September 1970, preliminary visits were made to some ten different sheep properties in Rimouski in order to gather further information on farm histories, husbandry practices and parasitic problems. It was learned from the owners that parasitic diseases had been a common problem on the majority of properties, chiefly during early spring and summer. The general practice had been to administer anthelmintic drenches once in the spring to all sheep, immediately before turning the animals out onto pasture in June. In many properties a second drench was given in the fall (November) before turning sheep into stables for the winter period.

It was then decided to select two adjacent breeding properties on which to carry out observations using 110 experimental adult ewes which were predominantly Leicester, Cheviot, Dorset crosses. Ninety of these ewes were chosen at random from among 350 sheep kept on the first property. The majority of the animals chosen on this farm were bought by the owners from several other properties in the region and introduced into his flock in the summer of 1970. Twenty animals were similarly chosen from a flock of 80 sheep kept on the second property for at least the past two years. All the experimental animals were identified by a neck collar number and allowed to run for the entire duration of the experiment with other sheep on their respective properties. The ewes were bred in October-November and they were stabled in December for the winter months. In the pens the animals were fed hay and concentrates. Reinfections are believed to be minimal in these unheated pens. Virtually all the ewes lambed between February and May, the majority of ewes having lambed in March. Single lambs were run with each dam.

A small trial was carried out to determine if the expected "spring-rise" in fecal egg counts could be prevented by thiabendazole[1] drench (80 mg/Kg). Twelve experimental ewes which had lambed within the same week in March were chosen at random for this trial. Four of these ewes were treated once three weeks before lambing, the next four three weeks after lambing, and the other four were treated twice, three weeks before and after lambing.

Technical Procedures

Faeces were collected per rectum from all individual sheep and the egg counts carried out using a modified McMaster method (12). Nematode eggs were recorded as *Strongyloides papillosus, Nematodirus* and Strongyle. From October 1970 to March 1971, samplings were done fortnightly, and from March until the termination of the experiment in June, samplings were done weekly.

The method of Roberts and O'Sullivan (17) was used for fecal cultures. Composite cultures were done on faeces of all ewes fortnightly throughout the experiment excepting February. For the necropsy animals, individual cultures were made on the three or four samplings preceding slaughter. The species proportions were derived by identifying the first 100 or 50 larvae.

A group of nine untreated ewes chosen at random from the two properties combined were killed in December 1970, and another group of six untreated ewes similarly chosen were killed in June 1971. These dates were selected because they appeared to coincide with the expected turn-over of worm populations during the winter and spring (1). The worm counts of the abomasum, small intestine and large intestine were done separately using the dilution and peptic digestion methods described by Ayalew and Gibbs (1).

[1]Merck Sharp & Dohme of Canada Limited, Montréal, Québec.

RESULTS

The infection levels and the species involved on the two properties were essentially similar. Therefore the 110 experimental animals are considered as a single flock and the results are entered as such.

STRONGYLE EGG COUNTS

The mean strongyle egg count (e.p.g.) of the untreated flock and of the treated ewes with thiabendazole is presented in Fig. 1. In the winter, both in the treated and untreated ewes the egg counts were low ranging between 40 and 100 e.p.g. In all the treated ewes the counts decreased equally one to two weeks following the first treatment of each group, and the e.p.g. was virtually nil in all groups throughout the rest of the experiment. A condensed form of the egg counts of the three treated groups combined is shown in Fig. 1. The egg count in the untreated flock, however, had commenced to increase in mid-March and by mid-June it had reached a peak of over 1000 e.p.g. The individual egg counts, not included here, varied between 0-250 e.p.g. during the winter, but several weeks following lambing, the majority of ewes were passing more eggs with individual counts ranging 500-6000 e.p.g.

Differentiation of larvae from fecal cultures and direct egg identification showed that individual sheep were infected with at least four nematode genera at any one time. Using the larval proportions of the fecal cultures, the egg count of the different strongyle species was assessed for the flock. The estimates for the nematodes most frequently encountered are shown in Fig. 1. During the winter *Trichostrongylus* and *Ostertagia* eggs were very low and there were virtually no *Haemonchus* eggs. From mid-March until June, however, the egg counts for *Ostertagia* followed by those for *Trichostrongylus* and *Haemonchus contortus*, had increased. There was no well defined seasonal pattern in the egg counts of *Cooperia, Bunostomum, Oesophagostomum, Strongyloides papillosus, Nematodirus, Chabertia ovina, Trichuris ovis* and *Capillaria* which were encountered only sporadically, and the egg counts are not included in the results.

NECROPSY WORM COUNTS

The following nematodes were recovered at necropsy: *Ostertagia* spp (predominantly *O. circumcincta*), *Trichostrongylus axei, Haemonchus contortus, Trichostrongylus* spp, *Nematodirus* spp (predominantly *N. spathiger*), *Cooperia* spp, *Bunostomum trigonocephalum, Strongyloides papillosus, Capillaria* spp, *Oesophagostomum columbianum, Chabertia ovina* and *Trichuris ovis*. The worm counts of the important parasites are shown in Table I. The other genera were seen sporadically.

Ostertagia spp was most numerous at all times. *Ostertagia* were recovered from all animals killed, and the worm counts in individual sheep varied between 40 and 10,-454 in December, and between 360 and 1,820 in June. In excess of 87% of the worm population in December were, however, inhibited in development at the fourth larval stage, whereas virtually all worms recovered in June were adults.

The incidence of *H. contortus* was irregular. Although worms were recovered from the majority of ewes killed in December, only in three out of nine animals were substantial numbers seen. As in the case of *Ostertagia*, all *Haemonchus* recovered in December consisted of inhibited larvae. In June all the worms recovered were adults. Whereas the mean worm count in June was similar in magnitude to that of December, in the former only two out of six animals harboured this species.

The most numerous adult worms recovered in ewes killed in December were those of *T. axei*. This species was present in all animals but one. There was no well defined pattern of the adult/immature proportions. In the majority of ewes in December the worms recovered were adults while in one animal inhibited larvae only were recovered. In June, however all the worms were adults, but the mean worm count was much lower than that of ewes killed in December.

Trichostrongylus spp were recovered from only four ewes out of nine in December and the mean count of the adult worms was comparable to that of *T. axei*. In June all the ewes were infected with this species with a mean count slightly higher than that in December. No inhibited larvae were seen on either occasion.

Substantial numbers of *Nematodirus* spp were recovered in only four out of nine ewes in December when in excess of 70% of the worm populations was inhibited larvae. In June, two out of the six ewes harboured this species and all the worms were adults.

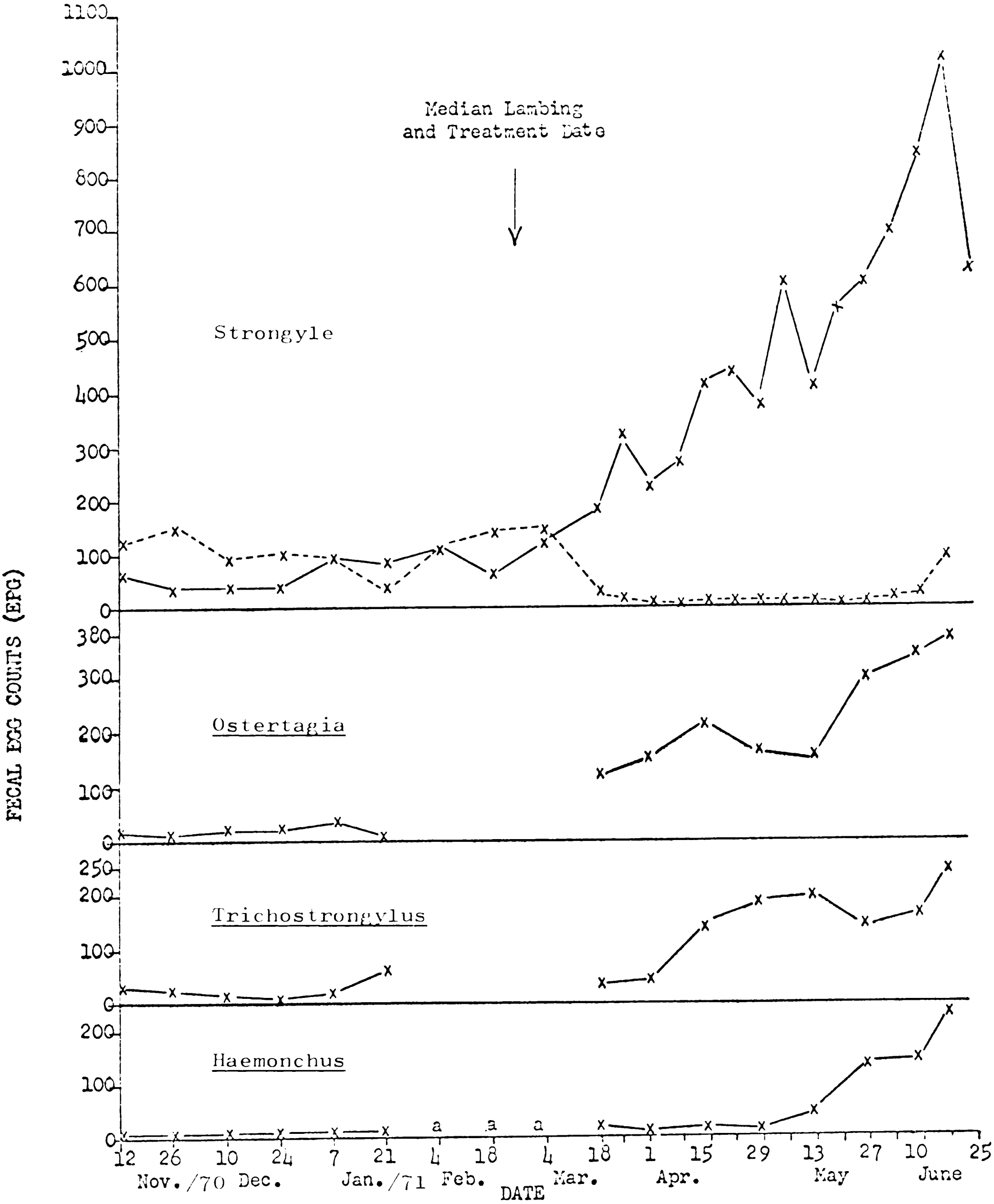

Fig. 1. Mean worm egg counts of untreated (x—x) and treated (x---x) ewes. Egg counts of Ostertagia, Trichostrongylus **and** Haemonchus **were assessed from larval proportions of cultures of the strongyle eggs from all untreated ewes. These species are not indicated for the treated ewes, since the strongyle egg counts of these ewes were virtually nil after treatment.**
[a]No cultures made.

DISCUSSION

The sudden rise in strongyle egg counts in the spring represents the so-called "spring-rise", which is similar to that observed in sheep of other countries (1, 2, 3, 5, 7, 13, 14, 15, 21) and in sheep of the Montreal area (1, 7, 15). Although the majority of the untreated ewes had "spring-rise" following lambing, inspection of the individual egg counts showed that the onset, duration and magnitude of the peak counts varied greatly. Treatment with thiabendazole three weeks before or after lambing had virtually eliminated the "spring-rise", a finding similar to that of other workers including Procter and Gibbs (15) and O'Sullivan and Donald (14).

The present results are in accord with previous findings (1) that low winter egg counts and high spring counts in stabled ewes are essentially attributable to massive larval inhibition and to subsequent maturation of the dormant larvae, respectively. Thus the important species including *Ostertagia* spp, *H. contortus* and *Nematodirus* spp were inhibited in development in the winter but have all matured in the spring. It may be noted that *Trichostrongylus* eggs were more numerous during the time of "spring-rise" than during the winter, despite the fact that the adult worm counts were higher in December than in June. The contribution of this species to the "spring-rise" might therefore be due to "increased fecundity" of the existing adult worms (1, 3, 14).

It is clear that the incidence of nematode species in Rimouski sheep is essentially identical to that reported for sheep of Eastern Canada (6, 20) and particularly of the Montreal area (1). Also, like the situation for the Montreal area (1), most nematodes in Rimouski were characterized by larval inhibition and subsequent maturation. There are, however, interesting differences between the Montreal and Rimouski regions as regards the seasonal occurrence of the turn-over of worm populations. The present results have revealed that *Ostertagia* spp was the most predominant parasite. It was also the major (40%) contributor to the "spring-rise", followed by *Trichostrongylus* (25%) and *H. contortus* (23%). This is in contrast with the findings of the Montreal area (1) where *H. contortus* was the principal donor (80%) to the spring-rise, while *Ostertagia* and *Trichostrongylus* contributed very little. It will be noted, however, that workers in other countries (2, 3, 4, 13, 18) have

TABLE I. Number of Worms Found at Necropsy of Ewes

Animal No.	H. contortus		Ostertagia spp		T. axei		Tricho-strongylus spp adults	Nematodirus spp	
	Total	$\%L_4$	Total	$\%L_4$	Total	$\%L_4$		Total	$\%L_4$
December									
1	600	100	40	100	0	—	0	0	—
8	460	100	2148	100	1300	39	168	720	100
29	10	100	112	9	33	0	0	160	100
31	0	—	1732	95	3560	0	240	0	—
36	3510	100	10454	100	1000	100	0	0	—
38	15	100	64	100	536	51	0	0	—
74	10	100	300	96	540	12	0	0	—
75	30	100	690	88	760	0	400	320	75
109	0	—	40	100	210	0	4160	640	50
Mean	515	100	1740	87	882	25	552	204	80
June									
19	0	—	1360	0	265	0	320	160	7
35	3380	0	800	0	0	—	1440	0	—
60	0	—	1820	0	92	0	1120	0	—
66	160	0	200	5	224	0	160	0	—
101	0	—	360	0	6	0	1280	960	0
102	0	—	1460	0	120	0	320	0	—
Mean	505	0	1000	1	117	0	790	186	3

also reported results similar to the present findings.

The events leading to the dominance of *Ostertagia* and *Trichostrongylus* in the Rimouski area and of *H. contortus* in the Montreal area are not determined. It is reasonable to suspect, however, that this discrepancy between the Montreal and Rimouski regions may be related chiefly to differences in size of populations of infective larvae available to sheep during the grazing period preceding the stabling time. Rimouski is located some 350 miles east of Montreal in the lower St. Lawrence River region. The daily mean temperatures in the Rimouski area are known to be generally lower than those of the Montreal region by 10°F for any given grazing season. Ayalew and Gibbs (1) estimate that in the Montreal area temperature conditions favorable for optimum translation of *Haemonchus* infective larvae are met during mid-July to mid-August. The period permitting optimum development of the free-living stages of this species in Rimouski may be much shorter indeed. As a result appreciable build-up of *Haemonchus contortus* infective larvae on pasture in Rimouski may well be impeded, although the temperature conditions appear to be most favorable for translation of *Ostertagia* and *Trichostrongylus* infective larvae (5). It is therefore conceivable that by the end of the grazing season, sheep in Rimouski might have acquired greater levels of *Ostertagia* and *Trichostrongylus* infections than *Haemonchus*. That temperature conditions are important in determining the sequences and levels of nematode infections is also well documented elsewhere (9, 10, 11, 16). Recently Smith and Archibald (19) have also concluded that temperature conditions are responsible for the low incidence of *H. contortus* in the Maritimes, the climate of which is more relevant to that of Rimouski than it is to that of the Montreal area.

The present findings clearly support the view that the importance of nematode species and their epidemiology must be appreciated under local environment and conditions of husbandry (5, 8). Whereas in the Montreal area the "spring-rise" has been shown to be an important source of hazardous *Haemonchus* infections in lambs in the summer (1), the epidemiology of the "spring-rise" in Rimouski could well revolve principally around *Ostertagia* and *Trichostrongylus*.

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REFERENCES

1. **AYALEW, L. and H. C. GIBBS.** Seasonal fluctuations of nematode populations in breeding ewes and lambs. Can. J. comp. Med. **37:** 79-89. 1973.
2. **BRUNSDON, R. V.** The seasonal variations in the nematode egg counts of sheep: A comparison of the spring rise phenomenon in breeding and unbred ewes. N.Z. vet. J. **12:** 75-80. 1964.
3. **CONNAN, R. M.** Studies on the worm populations in the alimentary tract of breeding ewes. J. Helminth. **42:** 9-28. 1968.
4. **CROFTON, H. D.** Nematode parasite populations in sheep on lowland farms. I. Worm egg counts in ewes. Parasitology **44:** 465-477. 1954.
5. **CROFTON, H. D.** Nematode parasite populations in sheep and on pasture. Technical Communication N°35, Commonwealth Bureau of Helminthology, 104 pp. 1963.
6. **FALLIS, A. M.** A study on the helminth parasites of lambs in Ontario. Trans. R. Can. Inst. **22:** 81-128. 1938.
7. **GIBBS, H. C.** Some factors involved in the "spring-rise" phenomenon in sheep. **In** The Reaction of the Host to Parasitism. E. J. L. Soulsby, Ed. pp. 160-173. Marburg/Lahn: N. G. Elwert. 1967.
8. **GIBSON, T. E.** The ecology of the infective larvae of **Trichostrongylus colubriformis. In** Biology of Parasites. E. J. L. Soulsby, Ed. pp. 1-13. New York: Academic Press. 1966.
9. **GORDON, H. McL.** The epidemiology of parasitic diseases, with special reference to studies with nematode parasites of sheep. Aust. vet. J. **24:** 17-45. 1948.
10. **GORDON, H. McL.** Some aspects of parasitic gastroenteritis of sheep. Aust. vet. J. **26:** 14-28. 1950.
11. **GORDON, H. McL.** The epidemiology of helminthosis in sheep in winter rainfall regions of Australia. I. — Preliminary Observations. Aust. vet. J. **29:** 337-348. 1953.
12. **GORDON, H. McL. and H. V. WHITLOCK.** A new technique for counting nematode eggs in sheep feces. J. Coun. sci. Industr. Res., Aust. **12:** 50-52. 1939.
13. **MORGAN, D. O., I. W. PARNELL and C. RAYSKI.** The seasonal variations in the worm burden of Scottish hill sheep. J. Helminth. **25:** 177-212. 1951.
14. **O'SULLIVAN, B. M. and A. D. DONALD.** A field study of nematode parasite populations in the lactating ewe. Parasitology **61: 301-315. 1970.**
15. **PROCTOR, B. G. and H. C. GIBBS.** Studies on the spring rise phenomenon in ovine helminthiasis. I. Spring rise in stabled sheep. Can. J. comp. Med. **32:** 359-365. 1968.
16. **PULLAR, E. M.** The epidemiology of helminthosis in sheep in winter rainfall regions of Australia. Aust. vet. J. **29:** 357-364. 1953.
17. **ROBERTS, F. H. and P. J. O'SULLIVAN.** Methods for egg counts and larval cultures for Strongyles infesting the gastro-intestinal tract of cattle. Aust. J. agric. Res. **1:** 99-102. 1950.
18. **SALISBURY, J. R. and J. H. ARUNDEL.** The relationship between lactation and post-parturient rise in fecal nematode egg counts of ewes. Aust. vet. J. **46:** 267-271. 1970.
19. **SMITH, H. J. and R. McG. ARCHIBALD.** The overwinter survival of ovine gastrointestinal parasites in the Maritime Provinces. Can. vet. J. **6:** 257-267. 1965.
20. **SWALES, W. E.** The helminth parasites and parasitic diseases of sheep in Canada. I. A survey and some preliminary studies on existing problems. Can. J. Res. **18:** 29-48. 1940.
21. **TAYLOR, E. L.** Seasonal fluctuation in the number of eggs of Trichostrongylid worms in the feces of ewes. J. Parasit. **21:** 175-179. 1935.