Ann Rech Vét (1990) 21, 259-266

Original article

Epidemiology of gastrointestinal helminths of sheep in the Rabat area of Morocco

VS Pandey [1*], H Ouhelli [1], A Dakkar [1], J Cabaret [2**]

[1] *Institut Agronomique et Vétérinaire Hassan II, PO Box 6202, Rabat – Instituts, Rabat, Morocco;*
[2] *INRA, Station de Pathologie Aviaire et Parasitologie, Unité d'Écologie des Parasites, 37380 Monnaie, France*

(Received 19 November 1989; accepted 10 May 1990)

Summary — The epidemiology of gastrointestinal helminths of sheep on permanent pastures in Morocco was studied by monthly examination of faeces of ewes for helminth eggs and by use of batches of 3 tracer lambs each month from December 1979 to November 1980. The main helminth genera encountered were *Teladorsagia, Haemonchus, Trichostrongylus* and *Moniezia*, with *Nematodirus, Cooperia, Oesophagostomum* and *Trichuris* occasionally recorded. The faecal egg counts of ewes showed 2 peaks; the first in March due to the acquisition of larvae during the rainy season and periparturient rise, the second in October probably due to maturation of inhibited larvae. The worm burdens of tracer lambs showed that there was a gradual accumulation of nematodes from December, reaching a peak in May; an absence of infection in July and August during the dry period, and a second peak in November. Infection by *Moniezia* was higher during the dry season.

helminth / sheep / Morocco / epidemiology

Résumé — Epidémiologie des helminthes gastro-intestinaux des ovins dans la région de Rabat (Maroc). *L'épidémiologie des helminthes gastro-intestinaux des ovins élevés sur des pâtures permanentes au Maroc a été étudiée de décembre 1979 à novembre 1980. Des examens de matières fécales des brebis, ainsi que les autopsies de 3 agneaux traceurs, ont été réalisés mensuellement. Les principaux genres d'helminthes rencontrés sont :* Teladorsagia, Haemonchus, Trichostrongylus *et* Moniezia, *plus occasionnellement* Nematodirus, Cooperia, Oesophagostomum *et* Trichuris *sont recensés. L'excrétion d'œufs dans les matières fécales des brebis présente 2 maxima. Le premier, en mars, est lié à l'ingestion de larves infestantes durant la saison des pluies et également à la montée peri-parturiente. Le second, en octobre, semble lié à la maturation des larves ingérées durant l'été puis inhibées transitoirement dans leur développement. L'examen des agneaux traceurs montre que la charge parasitaire augmente progressivement depuis décembre pour atteindre un maximum en mai. Elle est suivie par l'absence d'infestation durant l'été sec en juillet et août. Enfin, un deuxième maximum apparaît en novembre. L'infestation par* Moniezia *est plus forte durant la période sèche.*

helminthe / ovin / Maroc / epidémiologie

* Present address : Paraclinical Veterinary Studies, Faculty of Veterinary Science, University of Zimbabwe, PO Box MP 167, Mount Pleasant, Harare, Zimbabwe
** Correspondence and reprints

INTRODUCTION

One of the major constraints to sheep production in Morocco, like many other countries, is infection with gastro-intestinal helminths. However, very little information is available on their epidemiology, the knowledge of which is an essential prerequisite for effective prophylactic measures to be taken. A previous study has demonstrated that the gastrointestinal strongyles and protostrongylids have a significant effect on the performance of sheep and that anthelmintic treatment is beneficial (Pandey *et al*, 1981, 1984). The risk of infection appears to be related to the climatic conditions in Morocco (Ouhelli *et al*, 1981).

The aim of the present work was to study the epidemiology of gastro-intestinal helminths of sheep on permanent pastures by using worm-free tracer lambs and monitoring the faecal excretion of eggs by ewes.

MATERIALS AND METHODS

Farm

The study was conducted on a farm with 1 000 ha of natural pasture, located 30 km southeast of Rabat and 20 km west of the Atlantic ocean (33° 65' N, 6° 80'E). The climate of the region is of a sub-humid Mediterranean type with an annual rainfall of 500 mm. The cold rainy season extends from mid-October to mid-May, followed by the hot dry period. The hottest month of the year is usually August with a mean maximum temperature of 28.5°C, and the coldest month is January with a mean minimum temperature of 7.5°C. The meteorological data for the period of study were obtained from Rabat.

Permanent ewes

Six flocks of 150 ewes per flock no particular breed were grazed on the permanent pastures throughout the year. Each flock was tended by a separate shepherd in a similar manner. The various pasture areas and their order of utilisation by different flocks were not defined. Prior to the start of this experiment ewe faecal samples were examined from all the flocks and results were found to be similar. Lambing occurred from mid-December to mid-February, but the vast majority of ewes lambed in January.

Twenty-five ewes from one of the flocks were identified by means of tags. Faecal samples from each ewe rectum were collected every month.

Tracer lambs

The 36 tracer animals were castrated 6–12-month-old Timhadit lambs with type BB haemoglobin. They were vaccinated against enterotoxaemia, and were acquired from a commercial farm where they had been raised on pasture. On arrival they had relatively low worm egg counts. As these animals were also infected with protostrongylids, they were dosed with fenbendazole at the rate of 15 mg/kg body weight (Dakkak *et al*, 1979). They were then housed indoors under worm-free conditions for at least one month. Between December 1979 and November 1980 batches of 3 lambs were introduced each month to the farm where they grazed for one month with the same flock from which faecal samples ewe were collected. At the end of this period they were housed indoors for one month and then slaughtered.

Parasitological techniques

Faecal egg counts from ewes were estimated by the McMaster method (Whitlock, 1948). After slaughter of the tracer lambs, the digestive tract was separated into the abomasum, small and large intestine. The contents and washings were collected separately from each part. The nematode burdens from the abomasum and small intestine were estimated by examining aliquot samples (1/5th–1/10th). The nematodes from the large intestine were collected from the total of contents and washings. Digestion of abomasal or intestinal mucosa was not performed.

Tapeworm scoleces and proglottids were collected from the total intestine samples. The number of scoleces was counted and proglottids were weighed as wet mass. The parasites were identified at the genus level. In this area, the following species have previously been recorded : *Teladorsagia circumcincta, T trifurcata, Haemonchus contortus, Trichostrongylus colubriformis, T vitrinus, T axei, O venulosum.*

Statistical procedures

Most of the procedures were classical and have not been reported. Discriminant analysis by Stat-Itcf package (1988) was performed on the most frequent parasites. The aim was to assess similarities between months for the most frequent nematodes found in tracer lambs.

RESULTS

The meteorological data are presented in figure 1. Of 25 ear-tagged ewes, 18 lambed between mid-December and January.

Ewe faecal egg count

The mean faecal egg counts of nematodes from ewes are shown in figure 2. The egg counts showed a gradual increase from December, reaching a peak in March followed by a decline. A second peak occurred in October.

Worm burden of tracer lambs

The mean monthly worm burden of tracer lambs is shown in table I for abomasum nematodes, table II for intestine nematodes and table III for *Moniezia. Teladorsagia, Haemonchus, Trichostrongylus* and *Moniezia* were consistently present; *Nematodirus, Cooperia, Oesophagostomum* and *Trichuris* were observed irregularly and in low numbers. The tracer lambs did not acquire roundworm infections in July and August. In September, only one of the 3 tracers was found to be positive for parasites. During the remaining 9 months of the

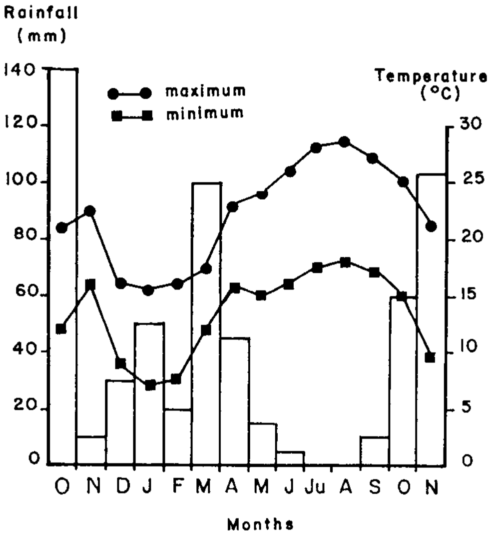

Fig 1. Maximum and minimum monthly mean temperature and monthly rainfall in Rabat.

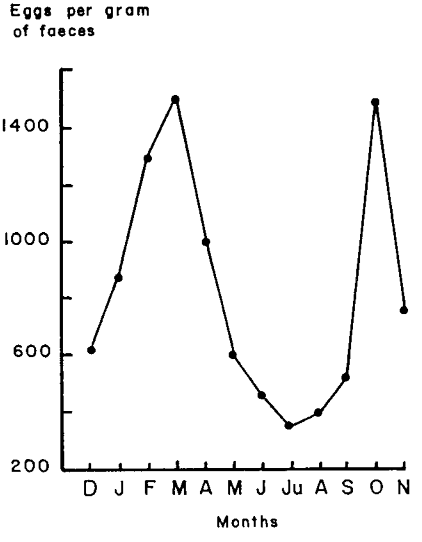

Fig 2. Ewe faecal egg counts.

Table I. Worm burdens in abomasum of lambs put out to graze at monthly intervals.

Months	Teladorsagia	Trichostrongylus	Haemonchus
		Mean worm No (range)	
December	233 (63–565)	276 (30–535)	186 (80–340)
January	490 (85–820)	145 (120–180)	78 (30–160)
February	340 (165–500)	387 (200–700)	237 (150–280)
March	557 (330–850)	167 (35–345)	190 (100–365)
April	158 (30–375)	168 (0–505)	100 (0–250)
May	683 (475–825)	445 (0–700)	1033 (700–1200)
June	48 (20–100)	5 (0–15)	238 (15–350)
July	0 0	0 0	0 0
August	0 0	0 0	0 0
September	8 (0–25)	0 0	0 0
October	100 (25–225)	25 (0–75)	42 (0–75)
November	2400 (1300–2950)	442 (150–775)	283 (0–150)

year, all the tracer lambs became infected. Throughout the study, the nematode burdens of the abomasum were higher than those of the small intestine. The worm burdens of the large intestine were very low. On average 84.5% of nematodes were localised in the abomasum, 14.7% in the small intestine and 0.8% in the large intestine.

Discriminant analysis was performed on the 36 tracer lambs for the most frequent nematodes, *Teladorsagia, Trichostrongylus, Haemonchus,* in the abomasum, and *Trichostrongylus* in the intestine. Most of the variability (95% of inertia) was found to be on axes 1 and 2 (fig 3). Axis 1 (56% of total inertia) showed that infection with *Teladorsagia* was in opposition to that of *Haemonchus.* Two months differed markedly from the others : May (heavy infection with *Haemonchus*) and November (heavy infection with *Teladorsagia* and other nematodes). From January to April, little varia-

Table II. Nematode burdens in intestine of lambs put out to graze at monthly intervals.

Months	Trichostrongylus	Nematodirus	Cooperia	Oesophagostomum	Trichuris
	Mean worm No (range)				
December	148 (10–430)	1 (0–3)	0 –	58 (29–146)	3 (1–6)
January	141 (90–200)	0 –	0 –	0 –	0 –
February	252 (145–385)	0 –	5 (0–15)	6 (5–7)	5 (4–6)
March	383 (130–665)	0 –	0 –	2 (1–5)	2 (1–4)
April	118 (120–235)	0 –	0 –	0 –	2 (0–4)
May	83 (0–125)	0 –	0 –	0 –	0 –
June	17 (0–50)	8 (0–25)	8 (0–25)	1 (0–3)	0 –
July	0 –	0 –	0 –	0 –	0 –
August	0 –	0 –	0 –	0 –	0 –
September	8 (0–25)	0 –	0 –	0 –	0 –
October	158 (25–450)	0 –	0 –	0 –	1 (0–1)
November	283 (100–575)	0 –	0 –	4 (1–6)	2 (1–3)

tion in helminth fauna was observed; a similar stability was demonstrated from June to October. The worm burden was nil in July and August for the selected helminths and the positions in figure 3 have been slightly separated for the sake of readability.

DISCUSSION

The helminth spectrum found in the present study was similar to that reported previously for sheep in Morocco (Pandey *et al*, 1980; Ouhelli *et al*, 1981; Cabaret, 1983a). The major difference between the fauna of the Rabat area and that of the Middle Atlas of Morocco is that concerning the absence of *Haemonchus* and the presence of *Marshallagia* in the latter area (Cabaret, 1984). The low burdens in the large intestine were similar to those reported in the Middle Atlas of Morocco (Cabaret, 1983a). *Chabertia* was not recorded in the present work, but this might be related to the longer life-cycle of this nematode.

Table III. *Monezia* burdens in small intestine of lambs put out to graze at monthly intervals.

Months	*No of scoleces*	*Wet weight (g)*
December	2	20
January	1	5
February	0	0
March	0.3	2
April	1.3	7
May	1.3	7
June	6.5	26
July	0	0
August	3.7	27
September	3.3	30
October	2.6	6
November	3.7	18

The use of tracer lambs put out to graze at monthly intervals and then slaughtered after being kept one month indoors is not the best technique for demonstrating the presence of *Chabertia.*

Climatic factors, mainly temperature and rainfall, are considered to be the limiting factors for the development and survival of infective larvae of gastrointestinal nematodes (Levine, 1963) which in their turn influence the acquisition of infection. In the present study rainfall appeared to be the main controlling factor. With the onset of rains in autumn the parasitic burdens gradually increased, reaching a peak in late winter/early spring. The lack of rain after June would explain the absence of nematode infection in tracer lambs grazing during July, August and September (tables I, II). Conversely, temperature may play a role in the peak observed in Haemonchus in May and that of Teladorsagia in November (fig 3).

The egg count of the ewes (fig 2) showed a seasonal pattern. The gradual increase from December with a peak in March is considered to be due to acquisition of infective larvae during the rainy season, as evident from the worm burdens of tracer lambs and the periparturient rise in faecal egg counts. The second peak in ewe egg count occurred at the end of the dry season in October, following a period when climatic conditions were unfavourable for development and survival of infective larvae on pasture. Indeed, the tracer lamb results demonstrated that the infection from pastures could not be acquired during the summer. The infection acquired during the rainy season would have less-

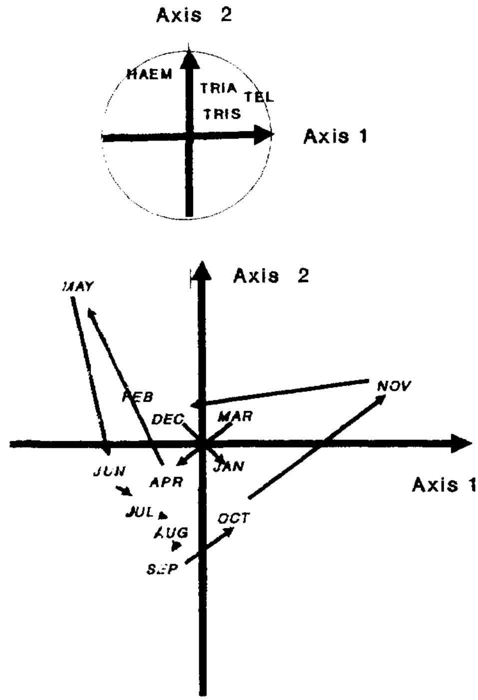

Fig 3. The monthly evolution of helminth fauna in tracer lambs: discriminant analysis. The months of study are abbreviated to the first 3 letters. The groups of nematodes studied were as follows : *Teladorsagia* (coded as TEL), *Haemonchus* (HAEM), *Trichostrongylus* of abomasum (TRIA), Trichostrongylus of the small intestine (TRIS).

ened in intensity by September–October (Cabaret, 1983b) and consequently to be expected that the females would lay fewer eggs. The only plausible explanation for the rise in egg counts in October would be the maturation of inhibited larvae. The study undertaken in the middle Atlas of Morocco where digestive tracts were subjected to a digestion procedure showed the presence of a large number of inhibited fourth-stage larvae of nematodes in adult ewes during the summer months and a high number of adult worms in September (Pandey *et al*, 1980; Cabaret, 1984). As digestive mucosa was not digested in the present work, it cannot be ascertained with certainty whether there was any arrested development of larvae ingested by tracer lambs during the latter part of spring and early summer. Such maturation of inhibited larvae at the end of the dry season/early autumn is very similar to that reported during spring in temperate regions (Blitz and Gibbs, 1971; Reid and Armour, 1972; Gibbs, 1982). The practical implication of this rise in ewe egg count is that there would be a large number of infective larvae available on the pasture at the onset of the autumn rains. This is reflected in the worm burden of the tracer lambs which rose to a high peak in November.

To control this rise in egg counts in October, an anthelmintic with activity against inhibited larvae should be administered during the dry season. Such treatment would have a retarding effect on the build-up of infection during the rainy period. Further treatments would be required during the rainy season to reduce worm burdens. The advantage of anthelmintic treatment of sheep in summer (June), during the early rainy season (November) and middle rainy season (January) on the productivity of sheep has been demonstrated by Pandey *et al* (1984).

Apart from February and July, infection by *Moniezia* was present throughout the year (table III). In general, the infection was higher from June to December and low during the rest of the year. The present results are similar to those of a study from Chad, where Graber and Service (1974) found higher *Moniezia* burdens during the dry season. However, in the mountainous region of Morocco, higher burdens are observed during the period February–April (Ouhelli and Dakkak, 1979).

REFERENCES

Blitz NM, Gibbs MC (1971) An observation on the maturation of arrested Haemonchus contortus larvae in sheep. *Can J Comp Med* 35, 178-180

Cabaret J (1983a) The nematode parasites of large intestine of sheep in the Middle Atlas (Morocco). *Folia Parasitol (Praha)* 30, 117-121

Cabaret J (1983b) Caractéristiques des populations *d'Ostertagia* spp chez les ovins naturellement infectés du Moyen Atlas (Maroc). *Ann Parasitol Hum Comp (Paris)* 58, 377-382

Cabaret J (1984) Seasonal changes in the abomasal nematodes of naturally infected ewes in Moulay-Bouazza (Morocco). *Vet Parasitol* 15, 47-56

Dakkak A, Cabaret J, Ouhelli H (1979) Efficacité comparée du fenbendazole et du tétramisole sur les helminthoses ovines du Maroc. I. Protostrongylides et *Dictyocaulus filaria*. *Recl Med Vet Ec Alford* 155, 703-711

Gibbs HC (1982) Mechanisms of survival of nematode parasites with emphasis on hypobiosis. *Vet Parasitol* 11, 25-48

Graber M, Service J (1974) Le teniasis des bovins et des ovins de la République du Tchad. *Rev Elev Méd Vét Pays Trop* 17, 491-521

Levine ND (1963) Weather, climate and bionomics of ruminant nematode larvae. *Adv Vet Sci* 8, 215-261

Ouhelli H, Dakkak A (1979) Des particularités épidémiologiques de la Monieziose ovine au Maroc. *Rev Méd Vét* 130, 1653-1658

Ouhelli H, Benzaouia T, Pandey VS, Dakkak A (1981) Étude épidémiologique de certaines parasitoses du mouton au Maroc atlantique par utilisation de la méthode des «animaux traceurs». *Rev Elev Méd Vét Pays Trop* 34, 319-324

Pandey VS, Cabaret J, Ouhelli H, Dakkak A (1980) Étude des nématodes parasites du tube digestif des ovins adultes dans deux régions du Maroc. *Bull Off Int Epizoot* 92, 1345-1349

Pandey VS, Cabaret J, Dakkak A (1981) Effect of treating ewes with fendendazole during pregnancy and lactation in a Mediterranean climate. *Vet Rec* 109, 15

Pandey VS, Cabaret J, Fikri A (1984) The effect of strategic anthelmintic treatment on the breeding performance and survival of ewes naturally infected with gastrointestinal strongyles and protostrongylids. *Ann Rech Vet* 15, 491-496

Reid JFS, Armour J (1972) Seasonal fluctuations and inhibited development of gastrointestinal nematodes of sheep. *Res Vet Sci* 13, 225-229

Stat-Itcf (1988) *Manuel d'utilisation.* Institut Technique des Céréales et des Fourrages, Service des Etudes Statistiques, Paris, pp 238

Whitlock HV (1948) Some modifications of the McMaster helminth egg-counting technique and apparatus. *J Counc Sci Ind Res Aust* 21, 177-180