



HAL
open science

**A STUDY OF OVINE GASTRO-INTESTINAL STRONGYLOSIS
IN A SHEEP FLOCK ON PERMANENT PASTURE II.
POPULATION DYNAMICS OF PARASITES ON THE PASTURE
IN 1977 AND AN EPIDEMIOLOGICAL INTERPRETATION**

L. Gruner, H. Mauleon, J. Hubert, C. Sauvé

► **To cite this version:**

L. Gruner, H. Mauleon, J. Hubert, C. Sauvé. A STUDY OF OVINE GASTRO-INTESTINAL STRONGYLOSIS IN A SHEEP FLOCK ON PERMANENT PASTURE II. POPULATION DYNAMICS OF PARASITES ON THE PASTURE IN 1977 AND AN EPIDEMIOLOGICAL INTERPRETATION. *Annales de Recherches Vétérinaires*, 1980, 11 (2), pp.133-140. <hal-00901257>

HAL Id: hal-00901257

<https://hal.science/hal-00901257v1>

Submitted on 11 May 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



HAL Authorization

A STUDY OF OVINE GASTRO-INTESTINAL STRONGYLOSIS IN A SHEEP FLOCK ON PERMANENT PASTURE II. POPULATION DYNAMICS OF PARASITES ON THE PASTURE IN 1977 AND AN EPIDEMIOLOGICAL INTERPRETATION

L. GRUNER¹, H. MAULÉON¹, J. HUBERT² and C. SAUVÉ²

I.N.R.A., Centre de Recherches de Tours, Station de Pathologie Aviaire et de Parasitologie,
¹Unité d'Ecologie Parasitaire, ²Unité de Physiologie des Nématodes Parasites,
Nouzilly, 37380 Monnaie, France

Résumé

ETUDE DES STRONGYLOSES GASTRO-INTESTINALES DANS UN TROUPEAU OVIN SUR PRAIRIE PERMANENTE. II. DYNAMIQUE DES POPULATIONS DE PARASITES SUR LE PÂTURAGE EN 1977 ET INTERPRÉTATION ÉPIDÉMIOLOGIQUE. — L'excrétion des œufs par les animaux ainsi que les populations larvaires présentes sur les pâturages sont étudiées en 1977 et comparées aux résultats des bilans parasitaires d'agneaux régulièrement autopsiés publiés dans une première note. La pâturage est contaminé presque toute l'année, par les brebis en premier lieu, puis par les agneaux dès le second mois de présence, avec un maximum d'été. Une vague précoce de larves d'*Ostertagia* et d'*Haemonchus* sur le pâturage est responsable du parasitisme très élevé des agneaux par *O. circumcincta*. Le climat peu favorable de l'été a limité le développement des œufs, et deux vagues secondaires de larves fin août et en septembre entraîneront des pics de *H. contortus* et *Trichostrongylus* en fin d'été chez les agneaux. *Nematodirus* est resté à un niveau plus faible que de coutume. Par comparaison au gain de poids d'agneaux traités régulièrement, il apparaît une nette diminution de la croissance des agneaux non traités dès l'ingestion d'un nombre élevé de larves infestantes, début juillet puis fin août-début septembre. Ces premiers résultats, limités à l'année 1977, montrent la nécessité de poursuivre les observations plusieurs années consécutives, pour mieux déterminer l'influence de la contamination de l'année précédente.

A general study of gastro-intestinal parasitism in sheep comprising observations on the animals and observations on the pasture was commenced in two flocks in 1976 and 1977 respectively. Although this epidemiological study is in its early stages, that is at its analytical phase, it seemed interesting to report the results obtained in 1977 for the flock which was farmed according to the most widespread method used in this region, that is

to say on permanent or semi-permanent pasture all year round.

Having describing the location of the farm and the method of farming used in our initial publication (Hubert *et al.*, 1979), we then described the incidence of animal parasitism that year. Untreated lambs enabled us to follow the natural growth of the population of helminth worms studied. These animals harboured an average of 26 000 worms in July,

and 23 000 in August, predominantly *Ostertagia circumcincta*. In September, *Haemonchus contortus* and *Trichostrongylus colubriformis* were particularly numerous (6-7 000 worms): *Nematodirus* sp. (*N. filicollis* and *N. spathiger*) also increased at this time, totalling nearly 900 worms. This high level of parasitism was responsible for the halving of the rate of growth of these control lambs compared to other lambs receiving treatment every four weeks. High blood levels of pepsinogen were found before peak parasite infestation in the abomasum, underlining the usefulness of such measurements in estimating the mean level of infestation of flock.

In this second part, observations relevant to the parasitic elements present on the pasture will be presented and discussed. These elements are strongyloid eggs dropped by the animals, and an estimation of this excretion throughout the year has thus been attempted. According to the environmental conditions, principally climatic, these eggs give rise to infective larvae hence the paddocks were regularly sampled to determine the size of the larval population. Finally, an overview of the population dynamics of the parasites on pasture and also within the animals should enhance our understanding of the epidemiology of these diseases in the flock studied here, not withstanding the fact that only the results for 1977 are presented.

Materials and Methods

1. Pastureland

As described previously, sheep from several flocks were herded into pastures near the farm buildings during the winter months of January and February (Hubert *et al.*, 1979), and the flock studied stayed 300 days on pasture, from March 1st to the end of November. The lambing period is from March 10 to April 20; weaning occurs on July 15th, and lambs are sold from the beginning of August to mid-November. The pasture is divided in four paddocks comprising 12 hectares of old grass meadow. The ground sloped slightly with a somewhat irregular contour. The land was bordered by a stream while water drained off across the enclosures stagnating here and there in marshy zones.

The poor drainage brought about widespread variations in the vegetation and encouraged the presence of carex in areas which varied in size according to the season. This had the effect of reducing the area which could be grazed. An analysis of the flora published previously confirmed the low quality of this grassland. One should note that a fifth enclosure ploughed and planted in the spring of this year was used as grazing land by the end of the summer.

2. Estimation of the number of strongyloid eggs excreted on the pasture

During the course of the grazing season, the number of eggs deposited with the faeces on a given area of land is a function of the number of ewes and lambs present, the length of stay on the area of land, the level of internal parasitism and the amount of faecal matter eliminated per day.

At the beginning of the experiment, these were 120 ewes and 140 lambs of which 60 received no strongyloids. Every four weeks, 5

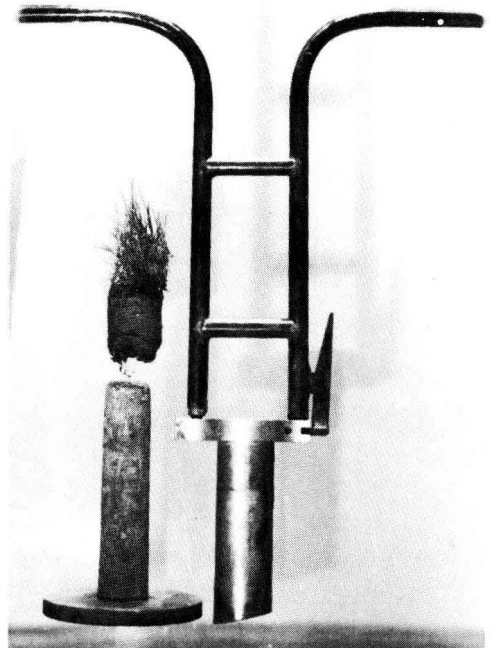


Fig. 1. — Soil probe for extracting soil cylinders from pasture.

of the latter group were removed and slaughtered to estimate the level of internal parasitism. The first slaughtering date was May 11, lambs were 50 days old. The excretion of eggs was measured every 4 weeks by coproscopy on 20 ewes and 20 lambs (10 controls and 10 treated animals).

The quantity of faecal matter excreted per day by the ewes and the lamb is a variable rarely taken into consideration in open-air farmed flocks. Taylor (1961) calculated that lambs excreted 1.5 kg/24 h and ewes 2-3 kg/24 h. Olechowicz (1974) reviewed several results from studies on nutrition and digestibility. It was thought best to attempt to measure this variable directly using collecting apparatus perfected by Tissier *et al.* (1975). It is not easy to use this apparatus in open-air flocks as the animals, unaccustomed to wearing the apparatus, are easily scared and difficult to approach. The results that were obtained in 1976, and compared with those in the literature, led to the adoption of the following quantities: ewe, 2 000 g; 15 kg lamb, 300 g; 20 kg lamb, 500 g; 25 kg lamb, 650 g; 30 kg lamb, 800 g; 35 kg lamb, 1 000 g. Although crude, these figures allow one to estimate a greater or lesser contamination of the grazing land.

3. Sampling infective larvae

The technique most commonly used was perfected by Taylor (1939). It consists of sampling the total length of a W or N (according to Lancaster, 1970) extending across the grazing land, by cutting small clumps of grass close to the ground. While this technique satisfactorily estimates the population present on the grass at the time of sampling, its greatest drawback is that it gives results which are dependant on the movement of larvae. This is a factor that is linked to the species as well as to the climatic and edaphic conditions. For these reasons, it was thought preferable to sample the pastureland population by removing the grass and the underlying five centimetres of soil simultaneously by using a special probe developed for soil microfauna studies (Vannier, 1971) (fig. 1). Sixty cylinders, each 5 cm long and 5 cm diameter were removed every 2 weeks from each paddock in as systematic a way possible. The extraction of the nematode fauna was performed according to the Baermann collecting technique using a large plastic tank 60 cm long by 40 cm wide by 12 cm deep (fig. 2). A grid sup-

ports the soil cylinders, with a filter paper interposed such that the water stays clean. After 24 h, the water is directly collected on a 20 μ metal sieve. The number of larvae collected have been expressed per square metre. The value of this sampling method, with respect to the distribution of larvae on the pasture that it revealed, as well as the validity of the extraction method have been the object of investigations which are reported elsewhere.

4. Amount of available grass on pasture

The amount of available grass on the pasture on the day of sampling was estimated by cropping the grass in a 50 cm square at soil level, twelve such squares being designated at random in each enclosure.

5. Meteorological data

Daily rainfall was measured *in situ* while other data were obtained from a nearby (12 km distant) meteorological station.

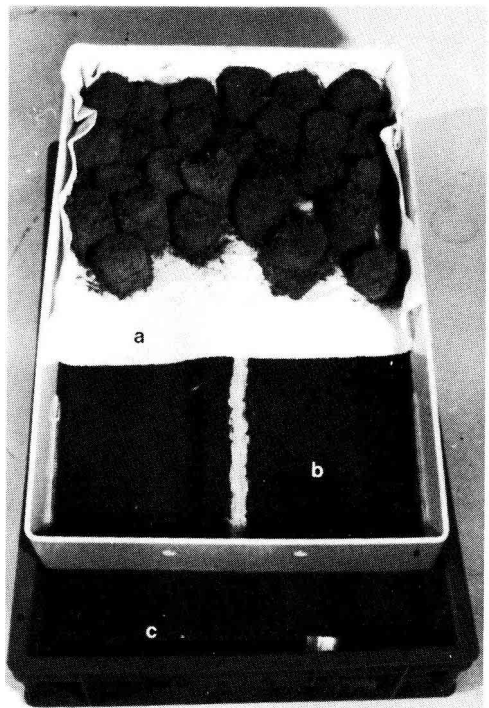


Fig. 2. — Modified Baermann for extracting nematodes present on the soil surface: a, filter paper; b, grid; c, plastic tank with water.

Results

1. Pasture contamination

This was estimated for all the gastro-intestinal strongle eggs passed with the faeces

over a two week period and expressed per square metre of pastureland. It would appear that (fig. 3) at the moment of their arrival in the enclosures, the sheep deposited around 10 000 eggs per square metre although this figure dropped to a steady 3 000 throughout

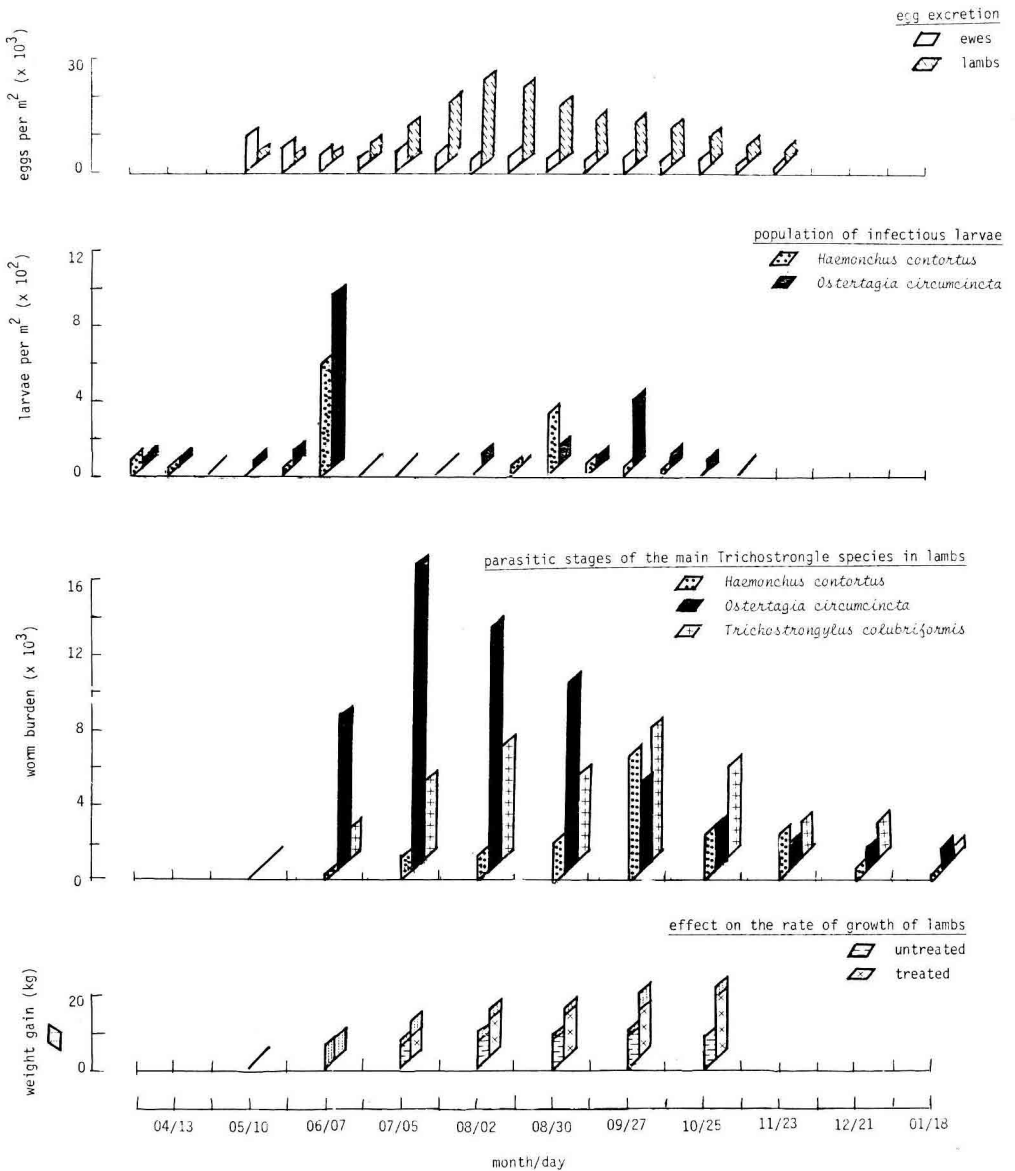


Fig. 3. — Population dynamics of the different stages of main nematode parasites during 1977 pasture season and the repercussion of strongylosis on the rate of growth of lambs.

the pasture season. This drop corresponded to the tailing off of the post parturient rise. From June onwards, the lambs became the principal source of contamination, with a maximum appearing in July. Later still, a drop in the level of contamination was observed following the sale and disposal of lambs.

The measurements that were made reflect the number of eggs discarded by the flock

throughout the pasture season. It is apparent that sampling and counting difficulties make it difficult to estimate the number of egg-stage parasites present on the pasture. While it is possible to retrieve eggs from faecal matter found in the enclosures, sophisticated techniques are needed to detect their presence on the soil surface once the faeces have disintegrated. A knowledge of the viable parasite egg population at this stage would enable one to take egg survival throughout the winter into account, and thus one could assess the importance of the preceding year's contamination.

2. Populations of infective larvae

While the number of eggs present at a given moment is directly linked to the length of stay of a host animal in an area, the population of infective larvae which eventually results depends on the ways in which environmental conditions affect the development of these eggs. The number of stage III larvae was low at the end of winter (fig. 4) and rose to a maximum at the beginning of June of 1 500 larvae per square metre. Larvae were sparse during the summer then two peaks were found at the end of August and the end of September with 439 and 414 larvae per square metre respectively. The predominant species was, throughout the year, *Ostertagia circumcincta* but clear, synchronous peaks of *Haemonchus contortus* were seen in June and at the end of August. *Nematodirus* was characterized by a small number of larvae which appeared late in the season on the pasture. Therefore, the general pattern of parasites on pasture is described by an early peak, a virtual absence during the early summer and fresh waves of parasites appearing at the end of the summer.

It was decided to express the results as infective larvae per square metre to obtain an idea of the distribution of parasites over the area occupied by sheep. It is, however, common practice to express such results as number per kg grass which allows one to assess the risk to which animals are exposed when feeding. In order to try and establish a relationship between these two notions, the quantity of grass per square metre was measured (fig. 4). The amount of grass available rose slightly in August and September but diminished in the autumn despite a smaller number of lambs being present. If one wishes to express the number of infective larvae in terms of kilogramme of dry

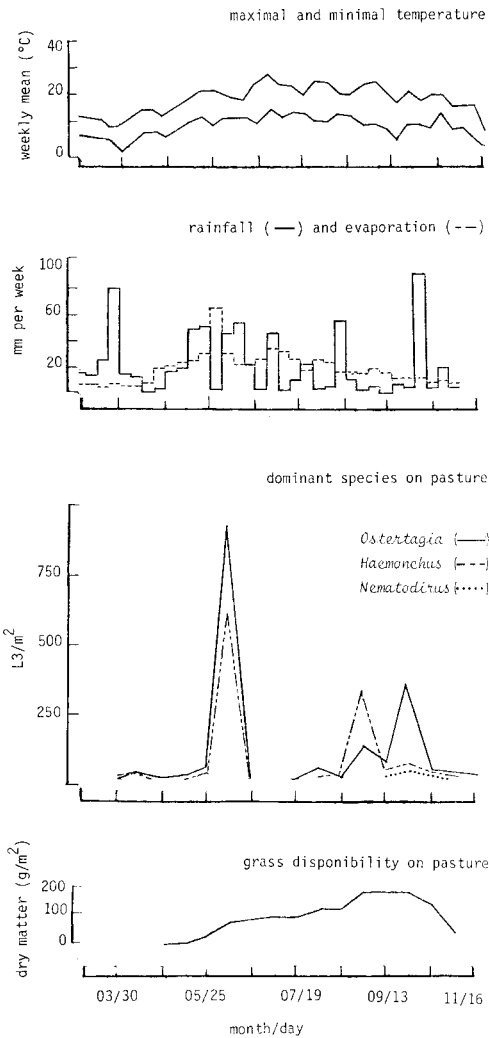


Fig. 4. — Influence of meteorological conditions upon the infective larval populations of the main species recovered, and grass disponibility on pasture.

matter, then the number found during the springtime peak should be multiplied by six, and the number found at the end of summer by five.

3. Relationship with climatic conditions

Following a mild winter with temperatures rarely dropping below zero, 1977 was characterized by a cool spring and summer, and a warm autumn. Early in the year, alternating warm and cold airstreams in Western Europe produced mild weather in February, March and May, and cold spells at the end of March, in April and during August when temperatures rarely exceeded 20 °C (fig. 4).

Regular rainfall occurred during the first three months of the year but during the succeeding three months, rainfall became more irregular. A calculation following Penman's method of evapotranspiration indicated the presence of a number of water-deficient periods.

Thus, the high May temperatures allowed eggs to develop and partly explain the early June maximum larvae. Thereafter, low temperatures and a lack of water considerably limited the number of parasites on the pastureland.

Discussion and Conclusions

The time-course of the development of gastro-intestinal strongylosis in the flock studied here may be better understood if the data on parasites present on the pasture above are compared with the data on animal parasitism reported in the first publication (Hubert *et al.*, 1979) (fig. 3). The flock was raised on permanent meadows with the object of producing grazing lambs. Animals were put out to graze from the lambing month of March and stayed there until the end of the year. Lambs that were to be sold were eliminated from the flock at the end of summer and in the autumn, while sheep and female replacement lambs were herded near the farm buildings in the winter months. As a result, the contamination of the pasture took place throughout most of the year. The sheep were the principal source at the beginning of the season but the role of the lambs became more important from the second month following entry on to grazing land. Their maximum contribution was in July-August when the

greatest number of eggs per gramme was found in the untreated lambs. The presence of larvae in the meadows before the arrival of the animals indicates that a certain number of eggs or infective larvae survived from the preceding year.

The number of larvae on the pasture rose in May to peak values of 912 larvae (*Ostertagia spp*) and 607 larvae (*H. contortus*) per square metre on the 7 June. Less than two months had passed since the expulsion of the first eggs by sheep and it is therefore probable that these larvae did not arise from these eggs alone. Given the very early appearance and the relatively low temperatures, one is led to think that these larvae arose from eggs which had survived the winter. Observations made in 1976 and 1977 on a similar flock of animals revealed the presence of a peak of larvae on the pastureland before the arrival of the animals, interpreted as a large number of *Ostertagia* and *Haemonchus* having survived the winter (Gruner *et al.*, 1978).

In Great Britain more larvae than eggs of *Ostertagia* and *Trichostrongylus* can survive during winter (Boag and Thomas, 1970; Gibson and Everett, 1967, 1972). So we must confirm the eventuality of overwintering eggs in this Central district of France.

On the other hand, the peak numbers of larvae found at the end of the summer were due to eggs deposited in the springtime. *H. contortus* was predominant on the 30 August while large numbers of *Ostertagia* and *Trichostrongylus* were recorded.

The parasite counts on untreated lambs serving as controls for the natural development of parasitism show that a large number of *Ostertagia* larvae were ingested following the maxima of 8 000 and 16 000 worms of this species found on 8 June and 6 July. Thereafter, the population diminished steadily up to the end of the year. *Trichostrongylus* worms were highest in August and September, respectively with 6 000 and 7 000 worms while *H. contortus* totaled 6 600 worms on the 28 September. These high levels of parasitism followed the maxima observed on the pasture.

Lambs treated every four weeks grew steadily except in August when a temporary slowing down was due to moniesiosis. The weight gain between two successive weighings was far less in untreated than in treated animals, for the data obtained from the 5 July, the end August and end September

weighings. These times corresponded to the periods when larval ingestion was maximal and serve to indicate the rapid onset of pathological effects.

In the autumn, the grass had ceased to grow but the untreated animals were unable to catch up despite a low level of parasitism.

We have also confirmed the usefulness of plasma pepsinogen measurements as an early indicator of pathological effects. Maximal values were observed when a large number of larvae was passing through the mucous membrane of the abomasum, that is to say, following the peaks of *Ostertagia* in July and *Haemonchus* at the end of the summer (Hubert *et al.*, 1979). The numbers of *H. contortus* found are noteworthy as this species is generally considered secondary in this region. It would appear that the special climatic conditions of 1976 were responsible (Gruner *et al.*, 1977). Gevrey (1969) found a higher number of infective larvae in another region in 1964, a year with a hot and dry summer, compared to the two preceding years. These observations tend to agree with those of Connan (1974) in England, but we found that inhibited larvae were always absent which is at variance with the findings of numerous other Western European investigators (Connan, 1971; Helle, 1971; Eckert and Eisenegger, 1974; Waller and Thomas, 1975; Hendriks *et al.*, 1975).

The year 1977 was therefore characterised by the precocious development of larvae on

the pasture, bringing about a high level of parasitism in lambs during June and July. Fresh larval peaks at the end of the summer prolonged this high level of infestation. The pathological effects rapidly followed the ingestion of a large number of infective larvae, the growth rate being halved with respect to treated lambs. *Ostertagia circumcincta* was the most numerous species, but there was a sizeable number of *H. contortus* and *Trichostrongylus* spp. were also numerous. On the other hand, only a few *Nematodirus* appeared late in the season contrary to the findings of Euzéby *et al.* (1964).

While these results only concern 1977, the observations of a precocious wave of infective larvae probably originating from eggs having survived the winter indicates the necessity of continuing these investigations over several consecutive years. Climatic conditions have a strong influence on the possibilities of survival and development of eggs and larvae and eventually, on the infection of animals.

Accepted for publication October 11th 1979.

Acknowledgments

We want to thank Mr. Guillemain and Mr. Fayaud responsables of the flock for their help and facilities for animal observations.

Summary

An overall study of gastro-intestinal parasitism was initiated in a flock of sheep in the Western central region of France (Limousin) comprising studies on the animals and on the pasture. Results of the study on animal parasitism and the possibilities of using pepsinogen blood level measurements were published previously (Hubert, Kerboeuf and Gruner, 1979). This report is concerned with the distribution of parasites on the pasture and a discussion on the epidemiology of these strongyles.

The pasture was contaminated throughout most the year, first by the ewes and then by the lambs from the second month onwards of their presence on the land. Maximum contamination occurred in Summer, but a precocious wave of *Ostertagia* and *Haemonchus* larvae on the pasture was responsible for the high incidence of *O. circumcincta* infections. Unfavourable summer weather depressed the development of eggs and two secondary waves of larvae at the end of August and the end of September brought about peaks of *H. contortus* and *Trichostrongylus* in lambs at the end of the summer. Far less *Nematodirus* were found than normal.

In comparison with the weight gain of lambs treated regularly, untreated animals suffered a drop

in their rate of growth from the beginning of July to the beginning of September corresponding to the ingestion of a great number on infective larvae.

These preliminary results for the year 1977 show the necessity of continuing these observations for several years to enable the effect of preceding year's contamination to be properly assessed.

References

- BOAG B., THOMAS R.J., 1970. The development and survival of free-living stages of *Trichostrongylus colubriformis* and *Ostertagia circumcincta* on pasture. *Res. Vet. Sci.*, **11**, 380-381.
- CONNAN R.M., 1971. The seasonal incidence of inhibition of development in *Haemonchus contortus*. *Res. Vet. Sci.*, **12**, 272-274.
- CONNAN R.M., 1974. The epidemiology of Haemonchosis in ewes in temperate climates. *Proc. IIIrd Int. Cong. Parasito. Munchen*, vol. **2**, 742.
- ECKERT J., EISENEGGER H., 1974. Epidemiology of Trichostrongylid infections of sheep and cattle in midland and mountain regions of Switzerland. *Proc. IIIrd Int. Cong. Parasito. Munchen*, vol. **2**, 746-747.
- EUZEBY J., GEVREY J., MORAILLON P., 1964. Evolution du parasitisme helminthique dans un troupeau d'ovins. Synthèse des observations de 3 années (1961 à 1964). *Rev. Méd. Vét.*, **115**, 629-643.
- GEVREY J., 1969. Etude du peuplement d'une prairie naturelle par les larves infestantes de "strongles" parasites du tractus digestif des ovins. I. Evolution des populations larvaires. *Rech. Vét.*, **3**, 93-129.
- GIBSON T.E., EVERETT G., 1967. The ecology of the free living stages of *Trichostrongylus colubriformis*. *Parasitology*, **57**, 533-547.
- GIBSON T.E., EVERETT G., 1972. The ecology of the free living stages of *Ostertagia circumcincta*. *Parasitology*, **64**, 451-460.
- GRUNER L., FOIX J., TARANCHON P., 1977. Influence des particularités climatiques de 1976 sur le développement de l'Haemonchose ovine en Limousin. *3^e Jour. Rech. Ov. Cap. INRA-ITOVIC, Paris*, 25-32.
- GRUNER L., FOIX J., HUBERT J., MAULEON H., TARANCHON P., 1978. Observation on the importance of ovine Haemonchosis in the center of France in 1976 and 1977. *Proc. IVth Int. Cong. Parasito. Warszawa*, sect. C, 167-168.
- HELLE O., 1971. Gastro-intestinal parasites in sheep on lowland pastures in eastern Norway. *Acta Vet. Scand.*, Sup. **34**, 118 p.
- HENDRIKX W.H.L., EYSKER M., CREMERS H.J.W.M., JANSEN J., 1975. The epidemiology of *Haemonchus contortus* (Nematoda : Trichostrongylidae) infections in sheep in the Netherlands. *Trop. Geogr. Med.*, **27**, 222-234.
- HUBERT J., KERBOEUF D., GRUNER L., 1979. Study of gastro-intestinal strongylosis in a sheep flock on permanent pastures. I. Sheep parasitism in 1977. *Ann. Rech. Vét.*, **10**, 503-518.
- LANCASTER H.B., 1970. The recovery of infective nematode larvae from herbage samples. *J. Helm.*, **44**, 219-230.
- OLECHOWICZ E., 1974. Analysis of a sheep pasture ecosystem in the Pieniny Mountains (the Carpathians). X. Sheep dung and the fauna colonizing it. *Ekologia Polska*, **22**, 589-616.
- TAYLOR E.L., 1939. Technique for the estimation of pasture infestation by strongyloid larvae. *Parasitology*, **31**, 473-478.
- TAYLOR E.L., 1961. Control of worms in Ruminants by pasture management. *Outlook Agric.*, **2**, 139-144.
- TISSIER M., BECHET G., MOLENAT G., 1975. Appareils de collecte totale des fèces pour agneaux en allaitement ou à l'engrais et pour brebis. *Ann. Zootech.*, **24**, 595-602.
- VANNIER G., 1971. Techniques d'étude des populations de microarthropodes du sol. In Pesson P., *La vie dans les sols*, 83-110, Gauthier Villars, Paris.
- WALLER P.J., THOMAS R.J., 1975. Field studies on inhibition of *Haemonchus contortus* in sheep. *Parasitology*, **71**, 285-291.