



Epidemiology of gastrointestinal helminths infections in Dorper sheep in a semi-arid area of Kenya

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ABSTRACT

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A survey on the prevalence and intensity of infection with gastrointestinal helminths of Dorper sheep in relation to age and weather factors was carried out on a ranch in Kajiado district, a semi-arid area of Kenya for a period of 13 months (May 1999 to May 2000). Faecal samples from lambs (3 months to 1 year), yearlings (1–2 years) and adult breeding ewes (2–4 years) were examined for helminth egg output and helminth genus composition at 3-week intervals. The results indicated that the prevalence of strongyle and tapeworms infections were highest for lambs, followed by the adult breeding ewes and then for the yearlings. In all age groups the proportions of infected animals were higher during the wet season than in the dry season for both nematodes and tapeworms. The mean strongyle egg counts were higher during the dry season for lambs, but were higher during the wet season for the other age groups.

Mixed strongyle infections were detected, with *Trichostrongylus* (55%), *Haemonchus* (28%), *Cooperia* (10.5%) and *Oesophagostomum* (6.5%) being the most frequently encountered genera throughout the study period. The trends in strongyle faecal egg counts indicated the occurrence of hypobiosis, with resumption of development towards the end of the dry season and at the onset of the short rains in October and November. Self-cure was also observed in September and November in all age groups, although less frequently in lactating ewes. The prevalence and intensities of infection with gastrointestinal helminths in this area appeared to be influenced by the age of the host and weather factors.

Keywords: Dorper sheep, gastrointestinal helminths, hypobiosis, self-cure, semi-arid region

INTRODUCTION

Gastrointestinal helminth parasitism is one of the major animal health problems facing ruminant livestock production in Kenya with losses that may be high owing to both clinical and chronic sub-clinical infections (Allonby & Urquhart 1975; Carles 1993; Githigia, Thamsborg, Munyua & Maingi 2001;

Nginyi, Duncan, Mellor, Stear, Wanyangu, Bain & Gatongi 2001). For the necessary rational and sustainable control of these helminths, comprehensive knowledge of the epidemiology of the parasites in relation to specific climatic, management and production environments is crucial (Barger 1999). Since the various regions of Kenya differ widely as regards, breeds of sheep and production systems, studies carried out in one area may not apply to another. Most previous studies in this country were on the woolled breeds of sheep in the high rainfall areas in the Rift Valley (Mbaria, McDermott, Kyule,

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Gichanga & Manyole 1995) and in the central highlands (Maingi, Gichohi, Munyua, Gathuma & Thamsborg 1997; Nginyi *et al.* 2001). Extensive studies in the semi-arid areas have only been carried out on Red Maasai and woolled breeds in Nainasha (Allonby & Urquhart 1975; Preston & Allonby 1979a, b; Gatongi, Prichard, Ranjan, Gathuma, Munyua, Cheruyot & Scott 1998). The objective of the present study was therefore to investigate the prevalence and intensity of infection with gastrointestinal nematodes of Dorper sheep in relation to age of host and weather factors in Kajiado district in a semi-arid area of Kenya.

MATERIALS AND METHODS

Study area

The study was carried out at the Maasai Rural Training Centre Ranch in Isinya Division of Kajiado district. The area lies at an altitude of approximately 1 500 m to 1 850 m above sea level and receives an average annual rainfall of about 600 mm. The rainfall is bimodal, with long rains falling between March and May and short rains from October to December. The mean annual temperatures ranges from 18–20 °C with a mean minimum of 12–14 °C and a mean maximum of 24–26 °C, with little variation between seasons.

Experimental animals and treatments

The study was carried out between May 1999 and May 2000 with sheep of three age groups, namely lambs (3 months to 1 year), yearlings (1–2 years) and adult breeding ewes (2–4 years). Each group consisted of 20 female sheep randomly selected from the flock on the ranch. On 5th May 1999, all the animals were weighed, ear tagged and given a single dose of albendazole (Valbazen®, Novartis East Africa Ltd, Nairobi) at a dosage rate of 5 mg/kg body mass. No further anthelmintic treatments were given except for salvage treatments, which were administered to animals showing clinical signs of helminthosis and those with over 7 000 eggs per gram of faeces. The ewes lambed between October and November 1999 and the lambs were weaned in March 2000. In January 2000 new lambs were recruited at the age of 3 months and the previous ones moved to the group of yearlings.

Faecal sampling and processing

Faecal samples were collected at 3-weekly intervals from the rectum of individual animals and stored

at 4 °C until examined. Nematode egg counts per gram of faeces (EPG) were done and the presence of tapeworm eggs noted for each sample, using a modified McMaster technique (Whitlock 1948) at a sensitivity of 100 eggs, and saturated sodium chloride as the floatation solution. A sedimentation technique was used to detect *Fasciola* eggs and a modified Bearmann method to search for lungworm larvae (Hansen & Perry 1994).

Faecal culture

On each sampling occasion, faecal samples for all age groups were pooled, incubated for 10 days at 27 °C, nematode larvae recovered and at least 100 identified per sample based on morphology and size as described by Reinecke (1983) and in the MAFF (1986) manual.

Pastures sampling and recovery of infective larvae

Herbage samples were collected at 3-weekly intervals around the paddocks where the sheep were grazing. The w-transect and the infectivity levels determined as described by Hansen & Perry (1994) was used. Infectivity levels were expressed as the number of larvae (L_3) per kg dry herbage. The pastures mainly consisted of *Themeda triandra*, *Pennisetum meziannim* and *Setaria* spp., and had been grazed by sheep for the last 5 years.

Statistical analysis

Strongyle egg counts and herbage larval counts were logarithmically transformed [$\log(x + 10)$] to normalize their distribution, and analysis of variance (ANOVA) performed in a Microsoft Excel Program. Comparisons were made between age groups (lambs, yearlings and breeding ewes) and seasons (wet and dry). To exclude the effects of treatment, all the data for May 1999 and data from all animals given salvage treatment was excluded from the analysis.

RESULTS

Rainfall distribution and temperatures

The long-term monthly mean rainfall distribution pattern for the study area, the monthly total rainfall and the number of wet days recorded per month between May 1999 and May 2000 are shown in Fig. 1. Although the total of 292 mm of rainfall recorded was less than half of the long-term mean of 658 mm,

that during the short rainy season from October to December 1999 (228 mm) was higher than the long-term mean (176 mm), in contrast to the long rainy season from March to May 2000 when only 18 % of

the long term mean fell (52 mm vs 285 mm). In Fig. 2 the mean monthly long-term minimum and maximum air temperature for the study area and the minimum and maximum air temperatures recorded

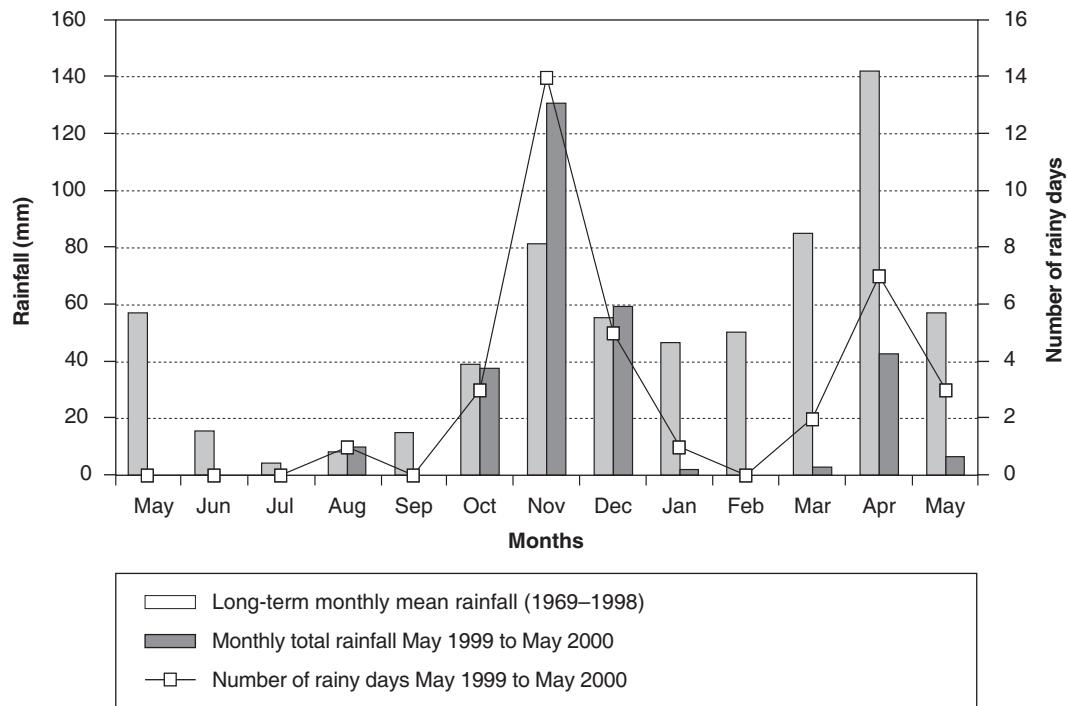


FIG. 1 Long-term monthly rainfall (1969-1998), the total monthly rainfall and the number of rainy days per month (May 1999 to May 2000) for Isinya Division in Kajiado district

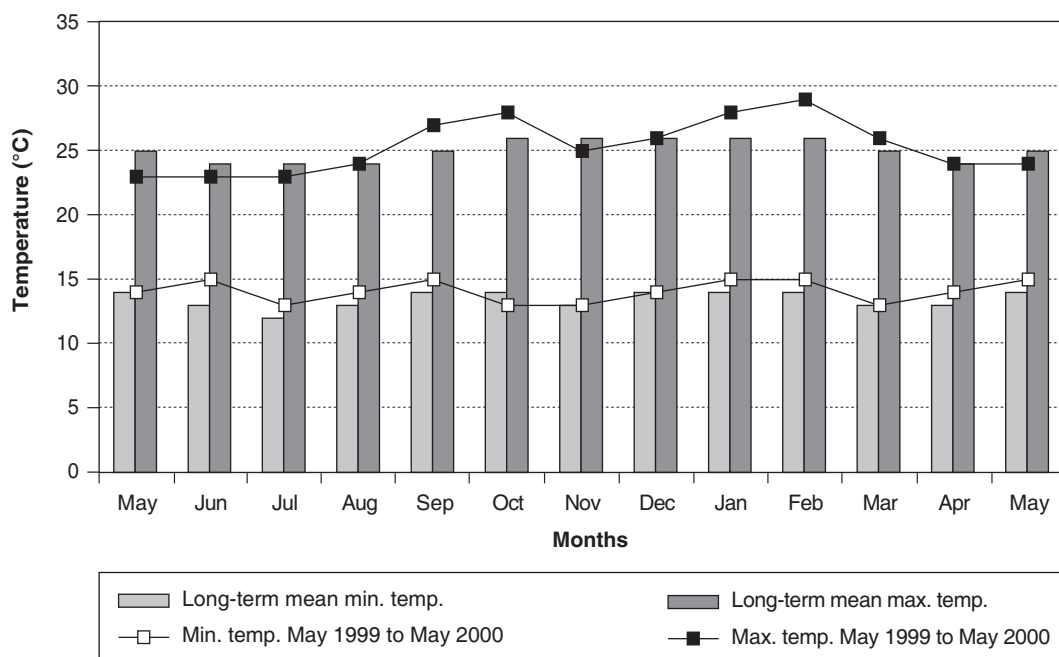


FIG. 2 Long-term mean minimum and maximum monthly temperatures (1969-1998) and the minimum and maximum monthly temperatures (May 1999 to May 2000) for Isinya Division in Kajiado district

TABLE 1 The proportion of faecal samples for Dorper lambs, yearlings and breeding ewes that were found to be positive for strongyle and tapeworm eggs in Kajiado District of Kenya during the period May 1999 to May 2000

Seasons	Parasite eggs	Percentage of positive samples		
		Lambs	Yearlings	Adult breeding ewes
Dry	Strongyle	90.3	85.9	84.6
	Tapeworms	48.4	21.2	25.4
Wet	Strongyle	92.3	89.7	92.3
	Tapeworms	65.2	35.6	40.2

TABLE 2 The mean distribution of genera of gastrointestinal nematodes in faecal cultures from Dorper sheep during the wet and the dry season

Nematode genera	Season	
	Dry (%)	Wet (%)
<i>Trichostrongylus</i>	61	49
<i>Haemonchus</i>	24	32
<i>Cooperia</i>	12	9
<i>Oesophagostomum</i>	3	9
<i>Strongyloides</i>	0	1

TABLE 3 The number of Dorper lambs, yearling and adults given salvage treatment based on clinical manifestation of nematodosis and egg counts (over 7 000 EPG) between May 1999 and May 2000

Treatment basis	Lambs	Yearlings	Adults
Trichostrongylosis (July to September)	5	2	1
Others	1	0	0
Haemonchosis (July to September)	2	2	1
Others	1	1	1
Over 7 000 EPG	3	0	2

from May 1999 to May 2000 are graphically illustrated.

Faecal egg counts

No *Fasciola* eggs or lungworm larvae were detected over the study period. The arithmetic mean EPG for all the three age groups of sheep were nil post-treatment in May 1999. Three major peaks developed one from July to August 1999, one from October to November 1999 and another from January to April 2000. Between the peaks, two major troughs in EPG occurred, in September and in November to December 1999. The mean EPG over the entire sampling period were highest for the lambs (geometric mean 762) followed by the adult ewes (472) and lowest for the yearlings (394). The mean counts were higher during the dry season (June to September 1999 and January to February 2000) for lambs, but higher during the wet season (November to De-

ember 1999 and March to May 2000) for the other age groups.

The proportions of faecal samples from lambs, yearlings and adult breeding ewes that were found positive for strongyle and tapeworm eggs during the wet and the dry seasons are shown in Table 1. The majority of animals in all three age groups (85–92%) were shedding strongyle eggs during both the dry and the wet seasons. The prevalence of strongyle and tapeworm eggs was however, higher during the wet seasons for all age groups of sheep. The prevalence for both strongyle and tapeworms was highest for the lambs, followed by the adult ewes and was lowest for the yearlings.

Differential larval counts

Trichostrongylus, *Haemonchus*, *Cooperia* and *Oesophagostomum* were recovered in that order of

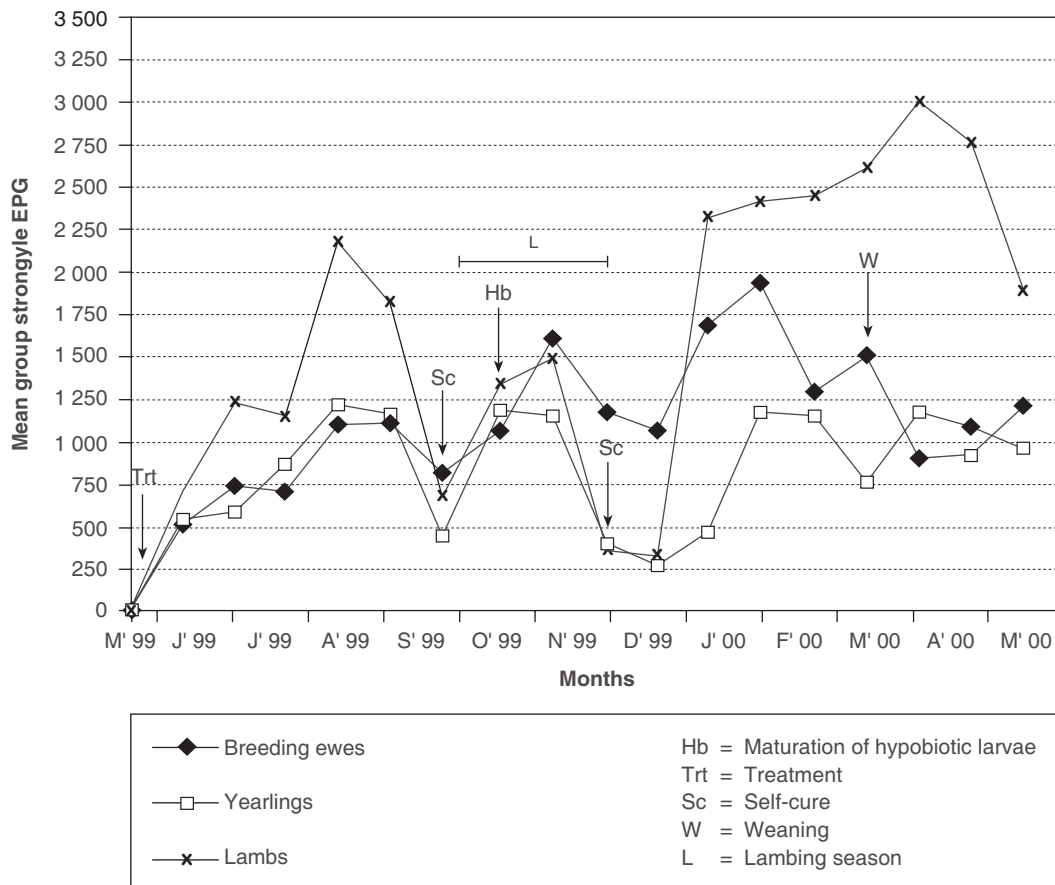


FIG. 3 Arithmetic mean strongyle eggs per gram (EPG) of faeces for Dorper lambs, yearlings and adult breeding ewes recorded every 3 weeks in a semi-arid area of Kajiado district during the period May 1999 to May 2000

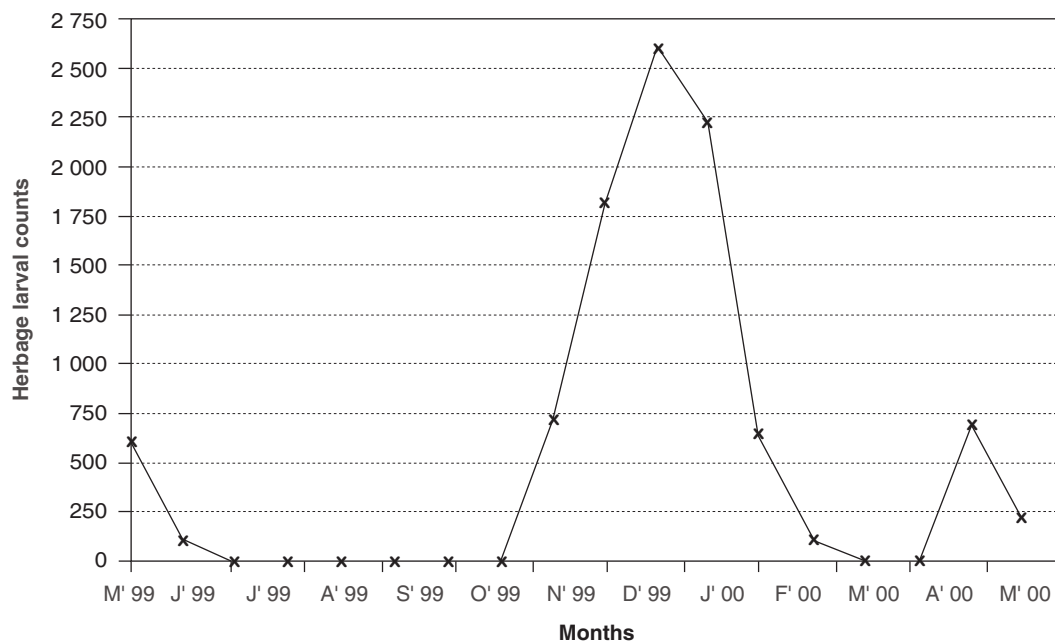


FIG. 4 Number of strongyle larvae per Kg of dry herbage recovered every 3 weeks from pastures grazed by Dorper sheep in a semi-arid area of Kajiado district during the period May 1999 to May 2000

occurrence throughout the year (Table 2). *Strongyloides* was occasionally encountered during the wet season. There was a sudden increase in the proportion of *Haemonchus* from 18 % in September 1999 to 45 % in October 1999 and a decrease in *Trichostrongylus* spp. from 76 % to 40 % over the same period.

Herbage larval counts

Larval counts rose during the wet seasons, closely following the peaks in rainfall in December 1999 and April 2000, with no L₃ being detectable during the dry season from July 1999 to October 1999 (Fig. 4).

Salvage treatments

During the study period, 12 lambs, five yearlings and five adult breeding ewes received salvage treatment based on faecal egg counts and clinical signs of helminthosis which were mostly diarrhoea, unthriftiness and bottle jaw. In all age groups, most clinical cases of helminthosis and salvage treatments occurred between July and September during the dry season, where 87 % were as a result of trichostrongylosis. During the wet season most treatments were made in October and November, where 62 % were as a result of haemonchosis (Table 3).

DISCUSSION

The results of the present study confirmed that age and physiological status of the host influence the susceptibility to helminth infections. The prevalence of infection, the strongyle egg counts and the number of animals that received salvage treatments were highest in the lambs and lowest in the yearlings, probably owing to immunological hypo-responsiveness in lambs (Watson & Gill 1991; Colditz, Watson, Gray & Wilson 1996), compared to developing immunity as the animals age. On the other hand, acquired immunity to nematode infection tends to be lost in late pregnancy and in lactation (Barger 1993). Most of the adult ewes used in this study were pregnant between June and October 1999 and lactating between October 1999 and March 2000.

The peak in strongyle faecal egg output observed from July to August 1999 probably commenced from residual larval population on the pastures (Fig. 4). However, relatively low numbers of L₃ were available on the pastures at the time, and it is possible that maturation of hypobiotic *Haemonchus contortus* may have played a role, as suggested also by Gatongi *et al.* (1998 in sheep and goats in the semi-

arid area of Naivasha and by where they were accompanied by Gatongi *et al.* (2001) in goats in the marginal low potential areas of Thika district. The sudden increase in the proportions of *Haemonchus* in faecal cultures in October and November 1999 further suggests that hypobiosis played a role.

Hypobiosis is a state of arrested development during adverse conditions, with resumption of development when field conditions improve (Gibbs 1968). In the tropics, hypobiosis usually occurs during the dry season and the resumption of development occurs towards the end of the dry season or at the onset of the rains (Ogunsusi 1979; Jacquiet, Colas, Cabaret, Dia, Cheikh & Thiam 1995; Gatongi *et al.* 1998), much as in the present study and that of Githigia *et al.* (2001) in goats. In contrast, Gatongi *et al.* (1998) observed the resumption of development in sheep and goats in a semi-arid area of Naivasha targeted towards the long rains.

Troughs in faecal egg counts in September and November/December 1999 were considered to be the result of self-cure. Similar observations were made in a semi-arid area of Naivasha in Merino and Red Maasai breeds (Preston & Allonby 1979b). In grazing animals, the self-cure is commonly observed after rains when the intake of infective larvae provides the stimulus for resident worms to be eliminated and tends to occur in nearly all the sheep in the flock (Allonby & Urquhart 1973). The phenomenon may also occur in sheep on lush pastures in the absence of re-infection. This may be as a result of an "anthelmintic substance" or an allergic substance in freshly growing grass or owing to physiological alterations in the abomasum (Allonby & Urquhart 1973). The spectrum of the self-cure may range from merely the temporary suppression of egg-laying to complete expulsion of the adult worm burden (Allonby & Urquhart 1973).

In the present study, the self-cure that occurred in November to December may be attributed to re-infection by larvae and or the consumption of lush pastures that resulted from the short rains. However, none of these factors could directly be associated with the phenomenon in September as this was a dry month and not conducive for pasture growth and development of the infective larvae. Similar observations were made in Naivasha where the Red Maasai sheep self-cured during the dry season in the absence of fresh pastures (Preston & Allonby 1979a). The self-cure observed at this time might therefore have resulted from of a temporary cessation in egg production by the parasites.

Most clinical cases of helminthosis and salvage treatments in this study occurred between July and November and is attributed to two main reasons: Firstly, from July to October, when the animals were in poor body condition and therefore highly susceptible to helminthosis, the pastures were mostly dry and of low nutritional value; and secondly, the resumption of development of hypobiotic larvae of *Haemonchus* towards the end of the dry season and at the onset of the short rains (October to November), as also observed by Gatongi *et al.* (1998) in sheep and goats towards the end of the dry season and at the onset of the long rains under the semi-arid environment of Naivasha.

The finding that *Trichostrongylus* spp. were most prevalent in the study area differed from that of Gatongi *et al.* (1998) and Maingi *et al.* (1997) who reported a higher prevalence for *Haemonchus* in sheep in the semi-arid area of Naivasha and the high rainfall area of Nyandarua district in Kenya, respectively. This can be attributed to the fact that *Trichostrongylus colubriformis* free-living stages are more resistant to desiccation than *Haemonchus* and some other species (Banks, Singh, Barger, Pratap & Le Jambre 1990). This conclusion is supported by the fact that animals were treated with albendazole at the start of the trial and that the re-infection that followed occurred during the dry period which was favourable to the more resilient *Trichostrongylus* species. The dominance was further enhanced by the inadequate long rains of March to May 2000.

The results of the study indicate that control of gastrointestinal helminths in the study area should aim at reducing the impact of helminthosis in all age groups. The lambs should be protected from the adverse effects of infection until they acquire immunity and the control of infections in the other age groups be targeted towards reduction of pasture contamination based on the rainfall distribution pattern and the reproductive status of the adult ewes.

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