Onderstepoort J. vet. Res., 53 167–177 (1986)

THE RELATION OF CLIMATE AND TOPOGRAPHY TO GASTRO-INTESTINAL NEMATODE WORM EGG COUNTS OF ANGORA GOATS IN THE EASTERN CAPE

B. MCCULLOCH, R. R. DALBOCK* and H. G. KÜHN, Directorate of Veterinary Services, Veterinary Laboratory, P.O. Box 41, Grahamstown 6140

ABSTRACT

MCCULLOCH, B., DALBOCK, R. R. & KÜHN, H. G., 1986. The relation of climate and topography to gastro-intestinal nematode worm egg counts of Angora goats in the Eastern Cape. *Onderstepoort Journal of Veterinary Research*, 53, 167–177 (1986)

Haemonchus, Trichostrongylus, Ostertagia and *Nematodirus* worm populations of Angora goats, based on differential egg counts, are considered in relation to climatological and topographical data. Egg counts indicated that the estimated worm populations in goats that experienced wet circumstances were higher than those exposed to dry conditions. Wetness was assessed by relating spring, summer, and early autumn rainfalls to ground slope. It is proposed, that tactical anthelmintic treatments of goats be based on the degree of wetness of the grazing or property.

INTRODUCTION

Climate, season, pasture management, grazing rotations and general weather conditions play an important role in the incidence of gastro-intestinal nematode infestations of goats and sheep. When goats and sheep graze together they are, by and large, infested with the same species of worms, although the levels of infestation may differ (Le Jambre & Royal, 1976; Armour, 1980).

In a recent investigation carried out in the Eastern Cape, differential egg counts were used to estimate the prevalence of gastro-intestinal nematodes, namely, *Haemonchus, Trichostrongylus, Ostertagia* and *Nematodirus* spp. in Merino sheep in relation to the degree of wetness on a property or grazing area (McCulloch, Kühn & Dalbock, 1984). At the same time, comparable investigations were being carried out in Angora goats. The findings in Angora goats are described and compared in this paper with the sheep data described by McCulloch *et al.* (1984).

MATERIALS AND METHODS

General

The observations in Angora goats were carried out on 5 properties for some 12 months at a time, from November 1978 to November 1982. The properties were situated about the Eastern Cape towns of Pearston, Somerset East and Bedford, the area as a whole lying between 32° S and 33° S, 25° E and 27° E.

Experimental animals

Eleven different groups of goat wethers, 10 of which contained 128 wethers and one 112, were used. At the commencement of each trial, the goats in each group were numbered and their mass individually determined, and they were then divided into 4 comparable groups based on mass. The goats used in each trial were of uniform age.

After the groups had been identified with colour tags, faecal samples were collected from 12 goats in each of the 4 groups, collection being carried out in the same rank order for each group. Thereafter, the 4 groups of goats that made up the group for each trial were treated with a commercially available anthelmintic. Four of the 11 trial groups were excepted; in the 4 trials the goats had been treated just before grouping and treatment was considered unnecessary.

The anthelmintic treatments which were administered at or just before the start of each of the 11 trials were:

An albendazole* preparation at a dosage rate of approximately 5 mg/kg live mass: Glen Cullen 1978/79; Joubertskraal 1979/80; Glen Cullen 1979/80; Hyndhope 1980/81; Glen Cullen 1981/82 and Eildon 1981/82.

A morantel** preparation at a dosage rate of approximately 15 mg/kg live mass: Eildon 1978/79; Eildon 1979/80 and Glen Cullen 1980/81.

A mebendazole*** preparation at a dosage rate of approximately 17 mg/kg live mass: Joubertskraal 1980/81.

A thiabendazole/rafoxanide**** preparation at a dosage rate of approximately 63 mg/kg and 11 mg/kg live mass respectively: Redcliff 1979/80.

Follow-up anthelmintic treatments

Group 1 was left untreated for the duration of the investigation. All the egg count data from these animals were used in this investigation.

Groups 2 and 3 were treated with an anthelmintic according to rainfall. In the absence of a dangerous 8-week rainfall period (see Terminology below) they were left untreated. Only egg count data from the untreated Groups 2 and 3, were used in these calculations.

Group 4 was treated throughout the trial with an anthelmintic at approximately 4–6-week intervals. Egg count data *per se* from Group 4 were ignored.

Worm egg counts of each of the 4 groups were determined at 4–6-week intervals. The 12 goats initially selected from the 32 or 28 goats making up each group were used for this purpose, faecal samples from these 12 goats being sub-grouped in set order, with 4 samples making up the 3 sub-groups for examination. Egg counts and differential egg counts were carried out, *Nematodirus* eggs being counted separately.

The 11 trials were initiated in spring from late September to early December. All the trials were terminated in the spring following their inception. No special grazing programmes were undertaken, the animals fitting into the farming process as convenient to the management.

Statistical analysis

Chi-squared assessments were effected on geometrical arrangements of worm egg count data by arrangements similar to those described in detail by McCulloch *et al.* (1984).

*Valbazen, Smith Kline
**Banminth 11, Pfizer
***Multispec, Ethnor
****Ranizole, MSD

* Deceased

Received 28 April 1986—Editor

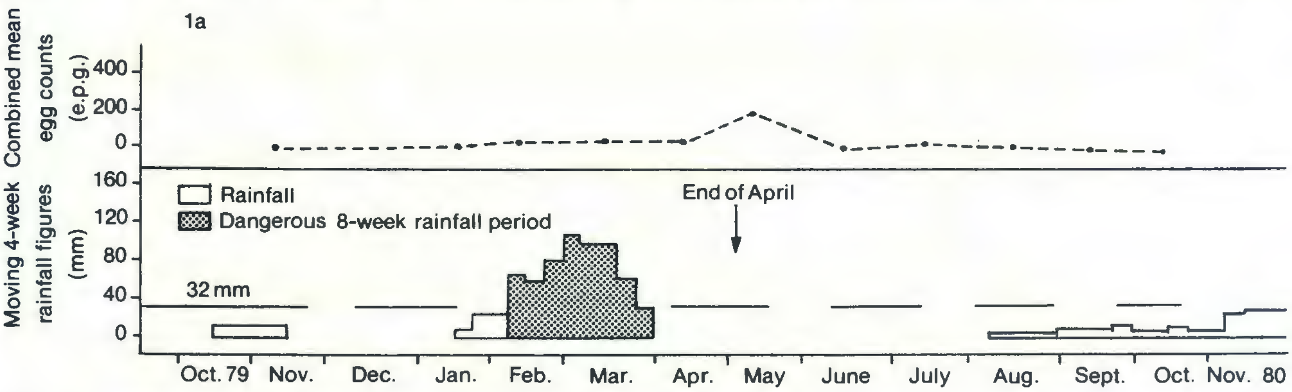

FIG. 1a Joubertskraal 1979/80
Slope 0,77°
Veld type Karoo
Minimum 4-week rainfall requirement adjusted upwards to 32 mm
Annual rainfall 370 mm
1/8 annual rainfall qualifying date 1980-01-22
Date of anthelmintic treatment 1979-11-27

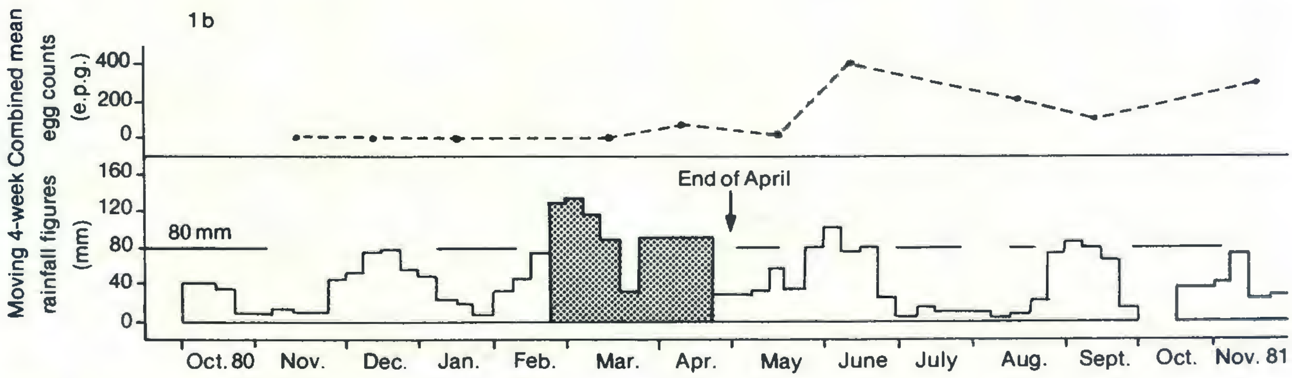

FIG. 1b Hyndhope 1980/81
Slope 8,12°
Veld type grass
Minimum 4-week rainfall requirement 80 mm
Annual rainfall 511 mm
1/8 annual rainfall qualifying date 1980-12-01
Date of anthelmintic treatment 1980-11-11

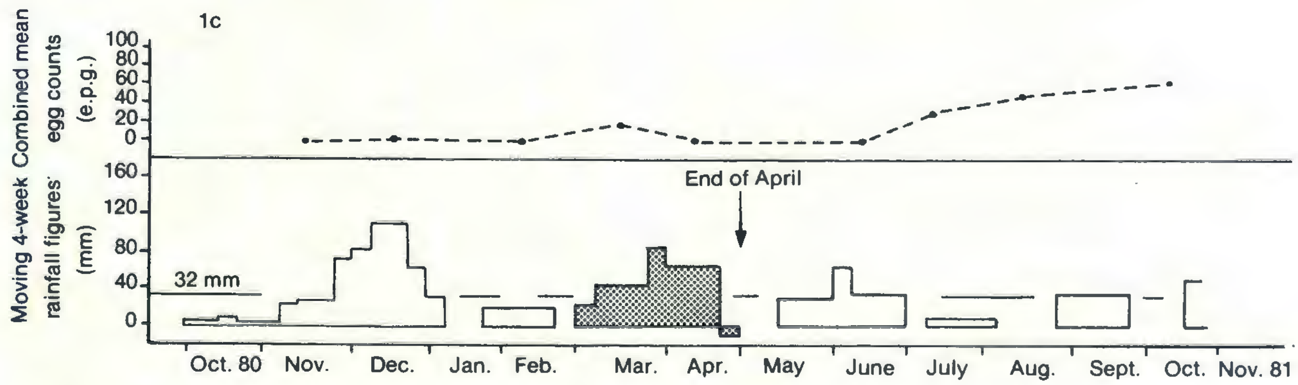

FIG. 1c Joubertskraal 1980/81
Slope, veld type, minimum 4-week rainfall requirement—see Fig. 1a
Annual rainfall 392 mm
1/8 annual rainfall qualifying date 1980-11-28
Date of anthelmintic treatment 1980-11-10

FIG. 1 Combined mean egg counts of goats and related moving 4-week rainfall figures. The moving 4-week rainfall figures are recorded on 2 properties over 3 occasions; on each occasion 1 dangerous 8-week rainfall period was observed over the late summer and early autumn (February/April)

TABLE 1 Mean egg count data (e.p.g.) of goats, recorded on 2 properties on 3 occasions, with 1 dangerous 8-week rainfall period observed over the late summer and early autumn months (February/April). On 1 occasion the dangerous 8-week rainfall period ended in March and on the other 2 occasions in April

Property/year	Egg counts	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
Joubertskraal (1979/80)	**Group 1**														
	Combined		0	–	17	33	33	33	216	17	33	17	0	0	
	Haemonchus		0	–	0	3	5	3	0	3	4	+	0	0	
	Trichostrongylus		0	–	0	26	20	26	194	10	29	+	0	0	
	Ostertagia		0	–	17	4	8	4	22	4	0	+	0	0	
	Nematodirus		50	–	17	50	67	33	0	0	0	0	0	0	
Hyndhope (1980/81)	**Group 1**														
	Combined		0	0	0	–	0	67	17	400	–	217	100	–	300
	Haemonchus		0	0	0	–	0	+	+	387	–	217	88	–	300
	Trichostrongylus		0	0	0	–	0	+	+	13	–	0	12	–	0
	Ostertagia		0	0	0	–	0	+	+	0	–	0	0	–	0
	Nematodirus		0	0	0	–	0	50	50	0	–	33	0	–	0
	Group 2														
	Combined		0	0	0	–	0	33	17	0	–	0	17	–	300
	Haemonchus		0	0	0	–	0	+	+	0	–	0	+	–	278
	Trichostrongylus		0	0	0	–	0	+	+	0	–	0	+	–	18
	Ostertagia		0	0	0	–	0	+	+	0	–	0	+	–	4
	Nematodirus		0	17	0	–	17	0	0	17	–	0	0	–	0
Joubertskraal (1980/81)	**Group 1**														
	Combined		0	0	–	0	17	0	–	0	33	50	–	67	
	Haemonchus		0	0	–	0	12	0	–	0	+	+	–	67	
	Trichostrongylus		0	0	–	0	3	0	–	0	+	+	–	0	
	Ostertagia		0	0	–	0	2	0	–	0	+	+	–	0	
	Nematodirus		17	33	–	66	0	0	–	0	0	0	–	0	

+ = Culture failure

TABLE 2 Mean egg count data (e.p.g.) of goats, recorded on 3 properties on 8 occasions, with no dangerous 8-week rainfall period observed on any of the 8 occasions

Property/year	Egg counts	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
Redcliff (1979/80)	**Group 1**														
	Combined	33	0	–	0	17	0	0	0	0	0	0	67	0	
	Haemonchus	0	0	–	0	0	0	0	0	0	0	0	0	0	
	Trichostrongylus	29	0	–	0	0	0	0	0	0	0	0	67	0	
	Ostertagia	4	0	–	0	17	0	0	0	0	0	0	0	0	
	Nematodirus	17	17	–	17	83	0	50	17	33	0	17	17	0	
Eildon (1978/79)	**Group 1**														
	Combined		0	50	83	67	217	183	100	250	50	67	0		
	Haemonchus		0	6	0	3	88	67	0	0	0	+	0		
	Trichostrongylus		0	43	71	48	129	112	82	190	47	+	0		
	Ostertagia		0	1	12	16	0	4	18	60	3	+	0		
	Nematodirus		33	50	83	67	83	100	67	17	0	0	0		
Eildon (1979/80)	**Group 1**														
	Combined	33	–	0	0	17	0	0	0	0	0	–	0	0	
	Haemonchus	0	–	0	0	+	0	0	0	0	0	–	0	0	
	Trichostrongylus	20	–	0	0	+	0	0	0	0	0	–	0	0	
	Ostertagia	13	–	0	0	+	0	0	0	0	0	–	0	0	
	Nematodirus	50	–	0	0	0	0	0	0	0	0	–	0	0	
	Group 2														
	Combined	0	–	0	0	17	0	0	0	0	0	–	0	17	
	Haemonchus	0	–	0	0	+	0	0	0	0	0	–	0	+	
	Trichostrongylus	0	–	0	0	+	0	0	0	0	0	–	0	+	
	Ostertagia	0	–	0	0	+	0	0	0	0	0	–	0	+	
	Nematodirus	0	–	0	0	0	0	0	0	0	0	–	0	0	
Eildon (1981/82)	**Group 1**														
	Combined		0	0	0	17	0	0	0	0	67	33	50	17	50
	Haemonchus		0	0	0	+	0	0	0	0	+	+	+	+	50
	Trichostrongylus		0	0	0	+	0	0	0	0	+	+	+	+	0
	Ostertagia		0	0	0	+	0	0	0	0	+	+	+	+	0
	Nematodirus		0	0	17	0	0	0	0	0	0	0	100	0	0
	Group 2														
	Combined		83	0	0	0	0	0	0	0	33	17	84	50	33
	Haemonchus		+	0	0	0	0	0	0	0	+	+	42	+	17
	Trichostrongylus		+	0	0	0	0	0	0	0	+	+	42	+	16
	Ostertagia		+	0	0	0	0	0	0	0	+	+	0	+	0
	Nematodirus		17	0	0	50	33	17	0	0	17	0	17	67	0
	Group 3														
	Combined		0	0	0	0	0	0	0	0	0	0	50	0	50
	Haemonchus		0	0	0	0	0	0	0	0	0	0	7	0	+
	Trichostrongylus		0	0	0	0	0	0	0	0	0	0	43	0	+
	Ostertagia		0	0	0	0	0	0	0	0	0	0	0	0	+
	Nematodirus		0	17	0	17	0	17	0	0	17	0	33	33	17
Glen Cullen (1978/79)	**Group 1**														
	Combined		0	0	33	0	100	50	83	50	67	17	0		
	Haemonchus		0	0	0	0	0	4	0	0	0	+	0		
	Trichostrongylus		0	0	33	0	100	44	48	50	67	+	0		
	Ostertagia		0	0	0	0	0	2	35	0	0	+	0		
	Nematodirus		0	12	200	17	83	17	17	17	17	0	0		

TABLE 2 Mean egg count data (e.p.g.) of goats, recorded on 3 properties on 8 occasions, with no dangerous 8-week rainfall period observed on any of the 8 occasions

Property/year	Egg counts	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.
Glen Cullen (1979/80)	**Group 1**														
	Combined	0	–	0	0	0	0	67	0	100	17	–	67	17	
	Haemonchus	0	–	0	0	0	0	46	0	0	0	–	0	+	
	Trichostrongylus	0	–	0	0	0	0	9	0	100	17	–	67	+	
	Ostertagia	0	–	0	0	0	0	12	0	0	0	–	0	+	
	Nematodirus	67	–	0	0	33	17	33	17	0	0	–	17	0	
	Group 2														
	Combined	17	–	0	0	17	0	33	0	17	17	–	83	17	
	Haemonchus	0	–	0	0	+	0	17	0	+	0	–	0	+	
	Trichostrongylus	17	–	0	0	+	0	11	0	+	17	–	83	+	
	Ostertagia	0	–	0	0	+	0	5	0	+	0	–	0	+	
	Nematodirus	67	–	0	17	17	0	17	17	17	0	–	33	0	
Glen Cullen (1980/81)	**Group 1**														
	Combined		0	0	0	0	0	–	17	0	17	–	100	300	
	Haemonchus		0	0	0	0	0	–	+	0	+	–	+	272	
	Trichostrongylus		0	0	0	0	0	–	+	0	+	–	+	28	
	Ostertagia		0	0	0	0	0	–	+	0	+	–	+	0	
	Nematodirus		0	0	0	0	0	–	0	17	0	–	0	0	
	Group 2														
	Combined		0	0	0	0	0	–	0	33	17	–	83	17	
	Haemonchus		0	0	0	0	0	–	0	+	+	–	70	17	
	Trichostrongylus		0	0	0	0	0	–	0	+	+	–	13	0	
	Ostertagia		0	0	0	0	0	–	0	+	+	–	0	0	
	Nematodirus		17	33	0	0	0	–	17	17	0	–	0	0	
Glen Cullen (1981/82)	**Group 1**														
	Combined		17	0	0	0	0	50	33	50	50	17	0	–	67
	Haemonchus		17	0	0	0	0	0	+	+	+	+	0	–	0
	Trichostrongylus		0	0	0	0	0	50	+	+	+	+	0	–	67
	Ostertagia		0	0	0	0	0	0	+	+	+	+	0	–	0
	Nematodirus		50	0	33	83	0	17	0	17	17	0	0	–	0
	Group 2														
	Combined		0	0	17	0	0	17	0	0	17	0	17	–	83
	Haemonchus		0	0	+	0	0	+	0	0	+	0	8	–	0
	Trichostrongylus		0	0	+	0	0	+	0	0	+	0	9	–	83
	Ostertagia		0	0	+	0	0	+	0	0	+	0	0	–	0
	Nematodirus		17	0	50	17	17	0	17	0	0	33	0	–	0
	Group 3														
	Combined		33	0	0	0	0	0	0	0	33	17	83	–	118
	Haemonchus		33	0	0	0	0	0	0	0	+	+	0	–	59
	Trichostrongylus		0	0	0	0	0	0	0	0	+	+	83	–	59
	Ostertagia		0	0	0	0	0	0	0	0	+	+	0	–	0
	Nematodirus		0	0	50	0	17	17	17	0	0	0	0	–	0

TABLE 3 Chi-squared evaluation of combined, *Haemonchus*, *Trichostrongylus* and *Nematodirus* mean egg count data (e.p.g.) of goats on 5 properties on 11 occasions. Of the 11 occasions, 3 (Section 1) showed 1 dangerous 8-week rainfall period over the late summer and early autumn months (February/April) and 8 (Section 2) showed no dangerous 8-week rainfall period. The egg count data are in geometrical arrangement, first term/common ratio—16/2

Property/year	Mean egg count data (e.p.g.) in geometrical arrangement																
	Combined					*Haemonchus*					*Trichostrongylus*				*Nematodirus*		
	≥256 / ≤255	≥128 / ≤127	≥64 / ≤63	≥32 / ≤31	≥16 / ≤15	≥256 / ≤255	≥128 / ≤127	≥64 / ≤63	≥32 / ≤31	≥16 / ≤15	≥128 / ≤127	≥64 / ≤63	≥32 / ≤31	≥16 / ≤15	≥64 / ≤63	≥32 / ≤31	≥16 / ≤15
Section 1 Joubertskraal—1979/80 Hydhope—1980/81 Joubertskraal—1980/81	3/33	5/31	8/28	15/21	22/14	3/33	4/32	6/30	6/30	6/30	1/35	1/35	1/35	6/30	2/34	8/28	12/24
χ^2 values* Section 1/2	5,2	6,2				5,2	9,0	9,3	4,3								
Section 2 Redcliff—1979/80 Eildon—1978/79 Eildon—1979/80 Eildon—1981/82 Glen Cullen—1978/79 Glen Cullen—1979/80 Glen Cullen—1980/81 Glen Cullen—1981/82	1/157	4/154	24/134	44/114	68/90	1/157	1/157	4/154	8/150	11/147	2/156	14/144	25/133	29/129	11/147	26/132	66/92

* χ^2 values—10,8 ($P \leq 0{,}001$); 6,6 ($P \leq 0{,}01$); 5,4 ($P \leq 0{,}02$); 3,84 ($P \leq 0{,}05$); only significant values at $P \leq 0{,}05$ are shown

$$\chi^2 = \frac{n(|ad - bc| - \frac{1}{2}n)^2}{(a+b)(c+d)(a+c)(b+d)}$$ (with Yates's correction)

TABLE 4 Chi-squared evaluation of combined, *Haemonchus*, *Trichostrongylus* and *Nematodirus* mean egg count data (e.p.g.) of 6 goat trials and 6 sheep trials carried out on the same 4 properties on the same 6 occasions. The egg count data are in geometrical arrangement, first term/common ratio—16/2

Property/year	Mean egg count data (e.p.g.) in geometrical arrangement																
	Combined					*Haemonchus*					*Trichostrongylus*				*Nematodirus*		
	≥256/≤255	≥128/≤127	≥64/≤63	≥32/≤31	≥16/≤15	≥256/≤255	≥128/≤127	≥64/≤63	≥32/≤31	≥16/≤15	≥128/≤127	≥64/≤63	≥32/≤31	≥16/≤15	≥64/≤63	≥32/≤31	≥16/≤15
Sheep Joubertskraal—1979/80 Hyndhope—1980/81 Joubertskraal—1980/81 Eildon—1979/80 Glen Cullen—1978/79 Glen Cullen—1979/80	7/79	14/72	28/58	39/47	56/30	3/83	5/81	10/76	16/70	26/60	5/81	13/73	25/61	32/54	4/82	13/73	22/64
χ^2 values* Sheep/goats			4,5							10,6			7,0	5,6			
Goats Joubertskraal—1979/80 Hyndhope—1980/81 Joubertskraal—1980/81 Eildon—1979/80 Glen Cullen—1978/79 Glen Cullen—1979/80	3/83	5/81	15/71	26/60	43/43	3/83	4/82	6/80	7/79	8/78	1/85	6/80	10/76	17/69	4/82	13/73	30/56

* χ^2 values—10,8 ($P \leq 0{,}001$); 6,6 ($P \leq 0{,}01$); 5,4 ($P \leq 0{,}02$); 3,84 ($P \leq 0{,}05$); only significant values at $P \leq 0{,}05$ are shown

$$\chi^2 = \frac{n(|ad - bc| - \frac{1}{2}n)^2}{(a+b)(c+d)(a+c)(b+d)} \text{ (with Yates's correction)}$$

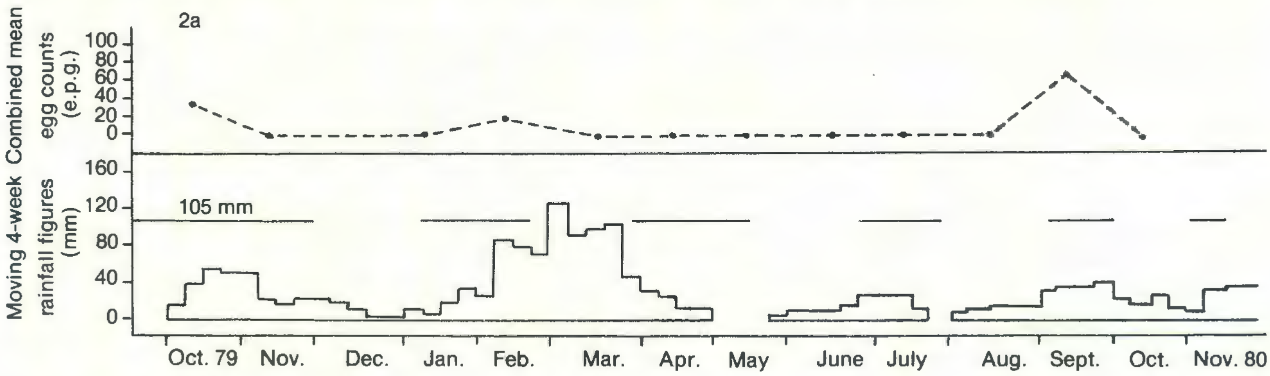

FIG. 2a Redcliff 1979/80
Slope 11,05°
Veld type mixed Karoo and scrub
Minimum 4-week rainfall requirement 105 mm
Annual rainfall 496 mm
1/8 annual rainfall qualifying date 1979-10-11
Date of anthelmintic treatment 1979-10-22

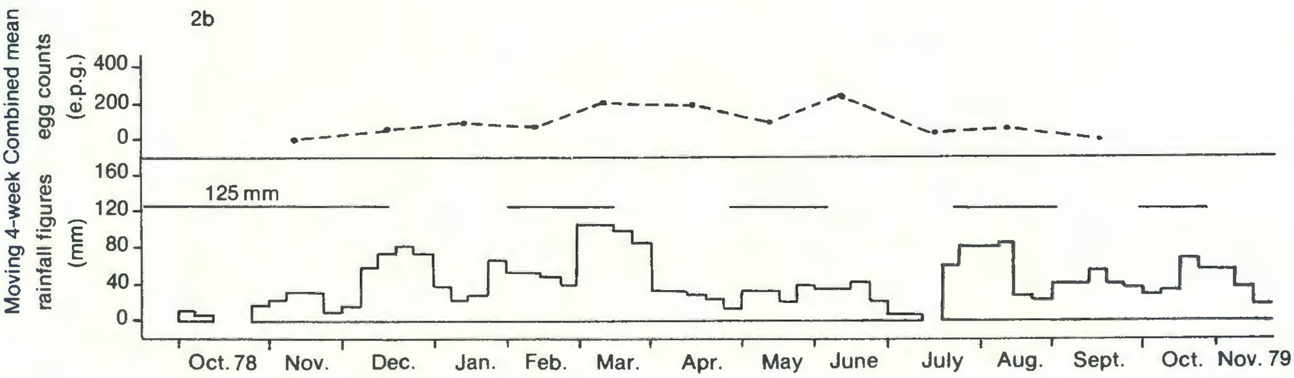

FIG. 2b Eildon 1978/79
Slope 11,58°
Veld type mixed grass and Karoo
Minimum 4-week rainfall requirement adjusted downwards to 125 mm
Annual rainfall 565 mm
1/8 annual rainfall qualifying date 1978-12-10
Date of anthelmintic treatment 1978-10-11

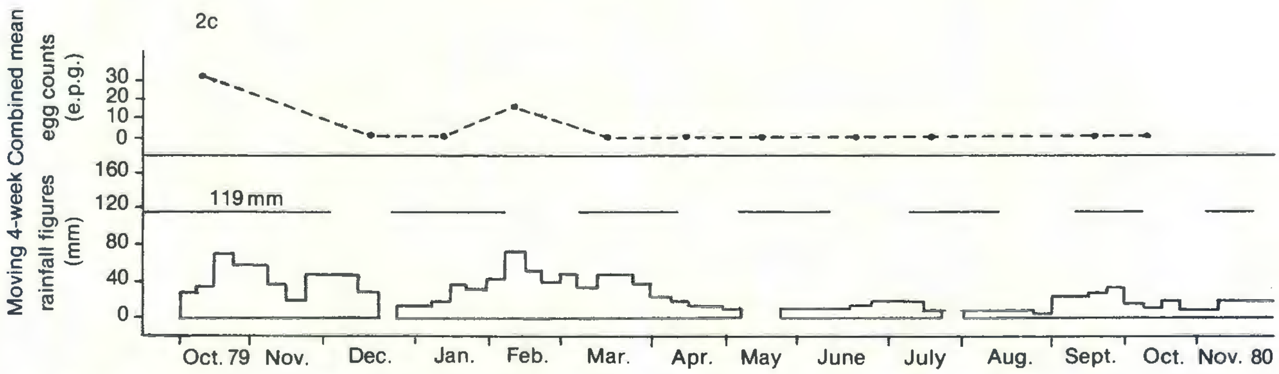

FIG. 2c Eildon 1979/80
Slope, veld type—see Fig. 2b
Minimum 4-week rainfall requirement 119 mm
Annual rainfall 536 mm
1/8 annual rainfall qualifying date 1979-10-18
Date of anthelmintic treatment 1979-10-31

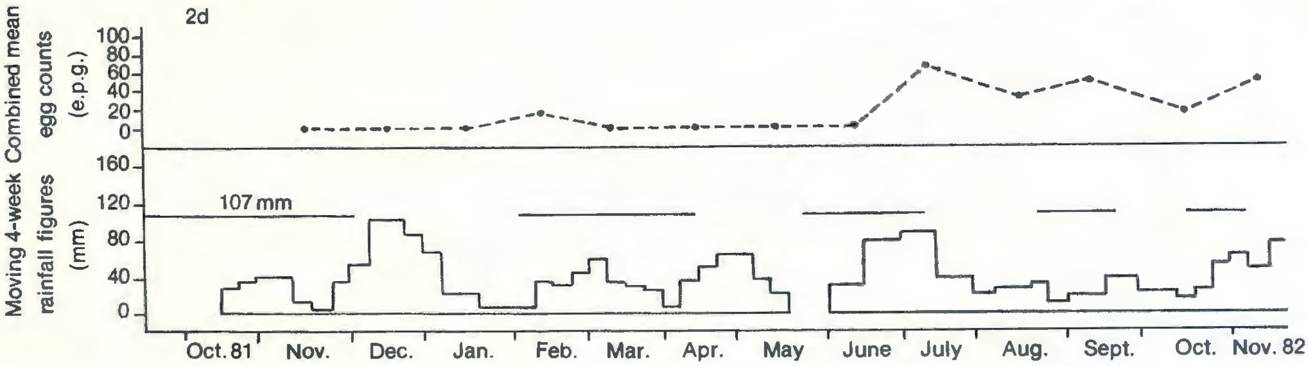

FIG. 2d Eildon 1981/82
Slope, veld type—see Fig. 2b
Minimum 4-week rainfall requirement 107 mm
Annual rainfall 480 mm
1/8 annual rainfall qualifying date 1981-11-25
Date of anthelmintic treatment 1981-11-02

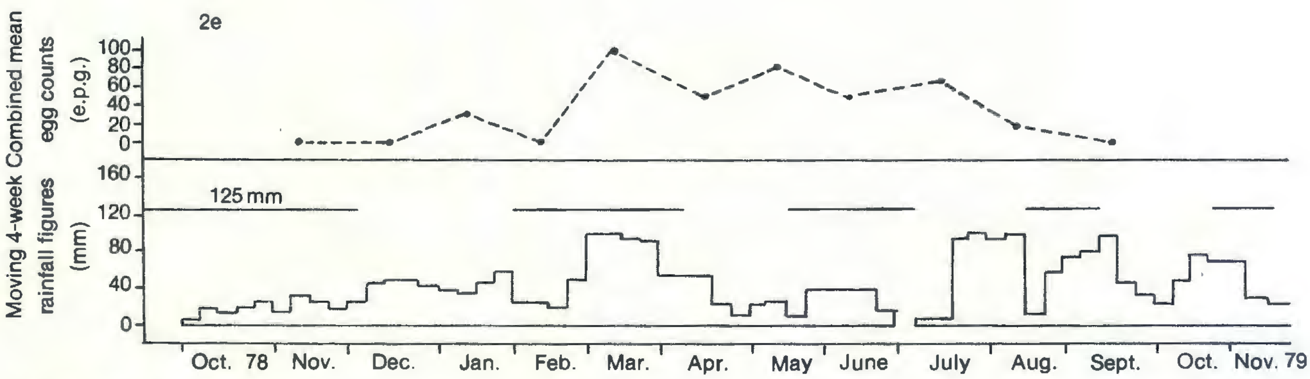

FIG. 2e Glen Cullen 1978/79
Slope 14,68°
Veld type mixed grass and Karoo
Minimum 4-week rainfall requirement adjusted downwards to 125 mm
Annual rainfall 714 mm
1/8 annual rainfall qualifying date 1978-12-10
Date of anthelmintic treatment 1978-10-31

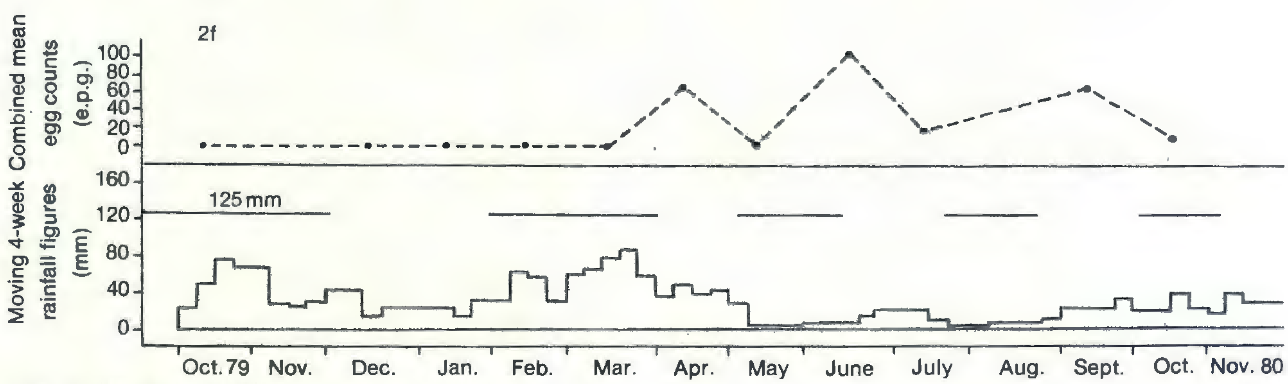

FIG. 2f Glen Cullen 1979/80
Slope, veld type, minimum 4-week rainfall requirement—see Fig. 2e
Annual rainfall 595 mm
1/8 annual rainfall qualifying date 1979-10-18
Date of anthelmintic treatment 1979-10-30

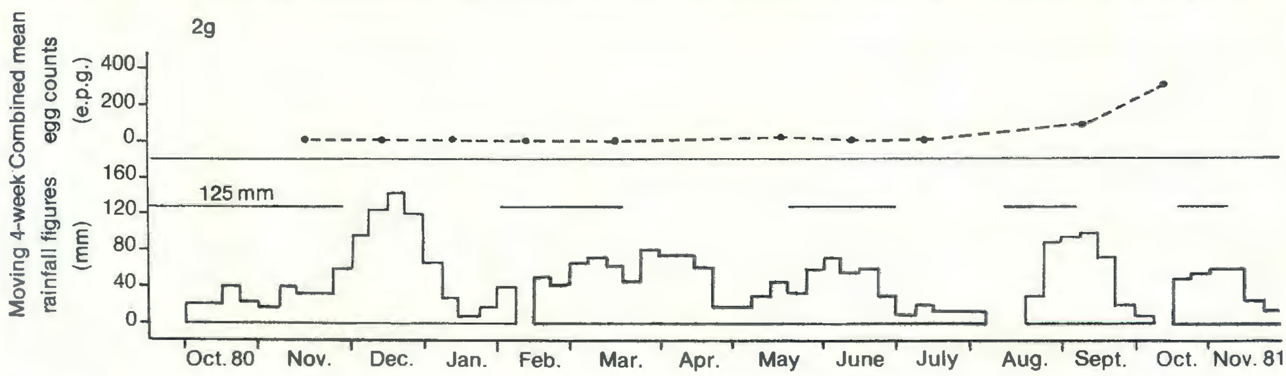

FIG. 2g Glen Cullen 1980/81
Slope, veld type, minimum 4-week rainfall requirement—see Fig. 2e
Annual rainfall 578 mm
1/8 annual rainfall qualifying date 1980-11-29
Date of anthelmintic treatment 1980-10-28

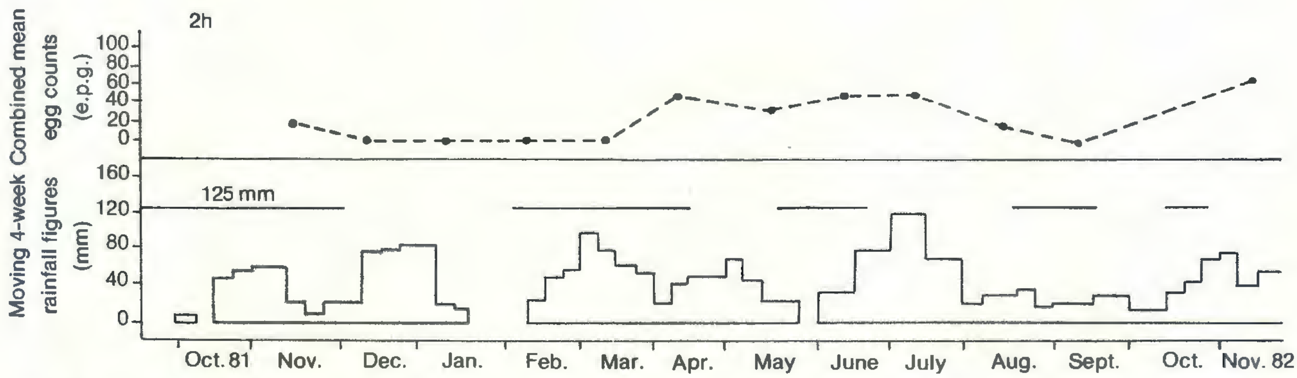

FIG. 2h Glen Cullen 1981/82
Slope, veld type, minimum 4-week rainfall requirement—see Fig. 2e
Annual rainfall 499 mm
1/8 annual rainfall qualifying date 1981-10-23
Date of anthelmintic treatment 1981-11-16

FIG. 2 Combined mean egg counts of goats and related moving 4-week rainfall figures. The moving 4-week rainfall figures are recorded on 3 properties over 8 occasions; on no occasion was a dangerous 8-week rainfall period observed

Chi-squared assessments were also effected on the geometrically grouped egg count data recorded from 6 of the 11 goat trials and on 6 of 16 sheep trials (McCulloch *et al.*, 1984), which were carried out over the same periods of time on the same properties.

Terminology

Descriptive terms, such as slope, 1/8 annual rainfall qualifying date, 4-week rainfall figures, minimum 4-week rainfall requirement and dangerous 8-week rainfall period, are described by McCulloch *et al.* (1984).

Topographical considerations—slope calculations

On one property, a calculation of the ground slope from the lowest to the highest point of the grazing area was an adequate expression of the overall position. On the other 4 properties, 3 slopes were calculated and mean values utilized.

RESULTS

Angora goat trials

Moving 4-week rainfall figures pertaining to the trials are recorded (Fig. 1 & 2), as are faecal worm egg counts of Group 1 (Fig. 1 & 2, Tables 1 and 2). Faecal worm egg counts of Group 4 and Groups 2 and 3 are excluded, unless Groups 2 and 3 could be considered supplementary to Group 1 (Tables 1 and 2), as happened from time to time.

Mean undifferentiated faecal worm egg counts are shown as combined counts, mean *Haemonchus*, *Trichostrongylus* and *Ostertagia* egg counts being differentiated, while the mean *Nematodirus* count is listed separately (Tables 1 and 2).

Where one dangerous 8-week rainfall period occurred over the late summer and early autumn months (February/April), combined egg counts tended to be higher in subsequent months than those recorded in the absence of an equivalent dangerous 8-week rainfall period (Fig. 1, Table 1 and Fig. 2, Table 2, respectively).

Haemonchus and *Trichostrongylus* egg counts predominated and made up the greater part of the combined egg counts. As in the case with the combined egg counts, the *Haemonchus* counts were favourably influenced by wet conditions during the late summer and early autumn months. The position with regard to the *Haemonchus* counts was more clearly defined than that of the combined counts (Table 3: Section 1/Section 2). There were no distinct indications that the *Trichostrongylus* counts were influenced by wet or dry conditions (Table 3: Section 1/Section 2).

Nematodirus egg counts were low throughout. There were no signs that the *Nematodirus* counts were favoured by wet or dry conditions (Table 3: Section 1/Section 2).

Ostertagia counts were very low during the period of observation and no trends could be determined.

Angora goat and Merino sheep trials

Comparisons of worm egg counts recorded in the 6 goat trials and 6 sheep trials (McCulloch *et al.*, 1984), which were carried out over the same periods of time and on the same properties, namely Joubertskraal 1979/80, Hyndhope 1980/81, Joubertskraal 1980/81, Eildon 1979/80, Glen Cullen 1978/79 and Glen Cullen 1979/80, showed that combined *Haemonchus* and *Trichostrongylus* egg counts were only slightly lower in goats than in sheep (Table 4).

DISCUSSION

The area under consideration is representative of the heart of the Angora goat industry in South Africa. Farmers were asked to supply some 150 Angora goats and/or 150 Merino sheep for gastro-intestinal nematode survey purposes, provision of both goats and sheep for concurrent trials being a particularly valuable contribution.

Haemonchus contortus infestations are particularly favoured by wet summer weather conditions. The same criteria of rainfall, ground slope, 1/8 annual rainfall qualifying date, 4-week rainfall figures, minimum 4-week rainfall requirement and dangerous 8-week rainfall period assessments etc., as employed in the sheep trials (McCulloch *et al.*, 1984), were used in the assessment of wetness and in the evaluation of the goat trials.

On the properties where the goat trials were held (Fig. 1 & 2), conditions were often considerably drier in spring and summer than those on which the sheep trials took place (McCulloch *et al.*, 1984; Fig. 1, 2, 3 & 4). The rainfall patterns of the goat trials showed only limited variation; only 3 out of 11 trials showed dangerous 8-week rainfall periods and on the 3 occassions the dangerous 8-week rainfall periods were recorded from the late summer. Notwithstanding, the combined and *Haemonchus* egg counts of the goats were in general, as in the case with sheep, favourably influenced by wet conditions in the late summer and early autumn (Table 3: Section 1/Section 2). However, within the limits of the goat trials, there were no indications that the *Trichostrongylus* egg counts were favoured by wet conditions nor the *Nematodirus* egg counts by dry conditions, as was observed in the sheep trials.

Results from work in the pastoral areas of Sukumaland, Tanzania, by McCulloch & Kasimbala (1968), indicated that goats and sheep were equally susceptible to *H. contortus* worm infestation, but that goats were less susceptible than sheep to *Trichostrongylus colubriformis* worm infestation. In a survey carried out by Le Riche, Efstathiou, Altan & Campbell (1973) in Cyprus, it was noted that mature goats had lower worm infestations than adult sheep. Observations made on sown pastures in Australia by Le Jambre & Royal (1976), showed, after a 4-month period of a trial using 15 month old Angora goats and Merino sheep of the same age that the goats carried significantly more *H. contortus, T. colubriformis* and other worms than the sheep.

Assessments of the relative susceptibility of goats and sheep to gastro-intestinal nematodes are at variance. Inferences are that the preferences of goats to browse shrubs and bushes, such as thorn-bush, are responsible at times for the lower infestations accorded to goats. The generally higher growth levels of browse to graze could be of importance. Silangwa & Todd (1964) observed that only 2–3 % of the infective trichostrongylid larvae placed in a position to migrate vertically did so, and that of this percentage less than 1 % attained heights greater than 127 mm.

Browse was readily available on the veld utilized for this present work. A comparison of the goat and sheep worm egg counts in the 6 respective goat and sheep trials conducted over the same periods of time on the same properties would indicate that egg counts were only slightly lower in goats than in sheep (Table 4).

It would seem reasonable to anticipate that under veld conditions in the Eastern Cape these differences would be of limited importance in terms of gastro-intestinal nematode control, and that control in Angora goats could be based on tactical anthelmintic treatments related to dangerous 8-week rainfall periods, as appeared warranted in Merino sheep (McCulloch *et al.*, 1984).

ACKNOWLEDGEMENTS

We are grateful to the South African Mohair Growers' Association for their help in initiating the trials, to the Director of Veterinary Services for permission to publish and to various members of the farming community for providing the animals and facilities required for the programme. Our thanks are also due to the laboratory staff associated with the work, especially Miss H. A. Amos and Mrs T. P. Fry and to Dr C. van N. Jonker for his support throughout.

REFERENCES

ARMOUR, J., 1980. The epidemiology of helminth disease in farm animals. *Veterinary Parasitology*, 6, 7–46.

LE JAMBRE, L. F. & ROYAL, W. M., 1976. A comparison of worm burdens in grazing Merino sheep and Angora goats. *Australian Veterinary Journal*, 52, 181–183.

LE RICHE, P. D., EFSTATHIOU, G. C., ALTAN, Y. & CAMPBELL, J. B., 1973. A helminth survey of sheep and goats in Cyprus. Part 11. Age distribution and the severity of infection with gastro-intestinal parasites. *Journal of Helminthology*, 47, 251–262.

MCCULLOCH, B. & KASIMBALA, S., 1968. The incidence of gastro-intestinal nematodes of sheep and goats in Sukumaland, Tanzania. *British Veterinary Journal*, 124, 177–195.

MCCULLOCH, B., KÜHN, H. G. & DALBOCK, R. R., 1984. The relation of climate and topography to worm egg counts of gastro-intestinal nematodes of sheep in the Eastern Cape. *Onderstepoort Journal of Veterinary Research*, 51, 223–238.

SILANGWA, S. M. & TODD, A. C., 1964. Vertical migration of trichostrongylid larvae on grasses. *Journal of Parasitology*, 50, 278–285.