

Seasonal dynamics of the Karoo paralysis tick (*Ixodes rubicundus*): a comparative study on Merino and Dorper sheep

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ABSTRACT

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Karoo paralysis in South Africa is induced in livestock by feeding female *Ixodes rubicundus* ticks when infestation densities on hosts exceed certain critical levels. It has been shown previously that Angora goats are at a higher risk of being paralysed than Merino sheep, and such differences have been related to differences in feeding behaviour and spatial distribution of the two small-stock breeds. We hypothesized that differences in infestation densities with Karoo paralysis ticks would also occur between Merino and Dorper sheep breeds. A study was conducted under natural conditions in the south-western Free State, to compare infestation burdens of the two sheep breeds and also to investigate seasonal patterns and annual variations in terms of rainfall and temperature. Ten animals of each breed ran free in an area with a known history of Karoo paralysis and were examined on an approximately fortnightly basis, from March 1992 to December 1995, to determine tick abundance. Differences between the two breeds were significant ($P < 0,05$) during 1992 and 1993, but not during 1994. During the first two years, peak abundance of ticks was reached earlier in Dorper than in Merino sheep, and it also reached higher levels in Dorper than in Merino sheep ($\bar{x} = 17,9$ and $7,3$, respectively). In 1993, two Dorper, but no Merino sheep, were paralysed. Dorper sheep are clearly at a higher risk of being paralysed than are Merino sheep, and as such, they can serve as indicators of adult tick activity and hence of the time to commence prophylactic treatment. Differences between the two breeds are probably related to differences in grazing patterns. Marked variation in abundance and the time of onset of peak activity of *I. rubicundus* occurred over the years. Tick numbers were high in 1993 and 1995, but very low in 1992. In 1993, peak activity occurred earlier (April) than during the other years (June or July). These differences are related to differences in prevailing environmental conditions that influence tick activity in a complex manner. Heightened humidity and lower temperatures during the early stages of seasonal activity of the tick (April or May), normally result in peak abundance of ticks on hosts at that time.

Keywords: *Ixodes rubicundus*, Karoo paralysis, sheep, ticks

INTRODUCTION

Interaction between ticks and their hosts is governed by tick- and host-dependent phenomena (Sonens-

shine 1975). Host predilection, activity patterns, opportunism or a combination of these are tick dependent, whereas host-dependent phenomena would include activity patterns, habitat utilization, social behaviour, home range and body size of hosts. The degree of temporal and spatial congruencies in the

activity pattern of ticks and their hosts will influence the level of host-tick contact and hence infestation burdens.

Karoo paralysis, caused by feeding female *Ixodes rubicundus* ticks, is induced when infestation densities on hosts reach certain critical levels (Fourie, Petney, Horak & De Jager 1989; Fourie, Horak & Van Zyl 1992). It has previously been demonstrated that differences in the infestation densities between Merino sheep and Angora goats are related to their feeding behaviour and spatial distribution, which influence host-tick contact (Fourie & Kok 1992). Angora goats became infested with the Karoo paralysis tick before Merino sheep, and were therefore also at risk of being paralyzed sooner. No such studies comparing different sheep breeds have been performed before.

We hypothesized that differences in infestation densities with Karoo paralysis ticks would also occur between Merino and Dorper sheep breeds. A study was conducted to compare the infestation burdens of the two sheep breeds and also to investigate seasonal patterns and annual variations in infestation burdens in terms of rainfall and temperature. The significance is that the data generated could serve as a guideline for producers on which to base control programmes.

MATERIAL AND METHODS

The study was conducted between 1992 and 1995 on the farm Preezfontein, situated 10 km from the town Fauresmith (29°46'S; 25°19'E) in the south-western Free State. A 190 ha fenced area of natural veld, with a history of Karoo tick paralysis, was used to keep the sheep. The heterogeneous vegetation in the area is classified as Eastern Mixed Nama Karoo (Hoffman 1996).

The experimental animals consisted of 5–7-month-old Merino and Dorper ewes (ten of each). The sheep were replaced each year, but breed and age composition remained the same. During 1995, only Merino sheep were used. On an approximately fortnightly basis, from March 1992 to December 1995, all the sheep were subjected to a whole-body search for attached female ticks which were removed, identified and counted.

Rainfall was recorded on Preezfontein, but because the weather station at Fauresmith closed down during early 1991, data on mean monthly minimum and maximum temperatures were not available. Data from Bloemfontein were used to calculate the corresponding values for Fauresmith. Based on weather data for the period before 1991, the relationship between Fauresmith data and Bloemfontein data was determined as:

$$F_{\min} = 2,2194 + 0,885 B_{\min} (r = 0,99)$$

$$F_{\max} = 1,0467 + 1,064 B_{\max} (r = 0,97)$$

where F = mean monthly temperature (°C) at Fauresmith and B = mean monthly temperature at Bloemfontein.

Tick burdens of Dorper and Merino sheep were compared by the use of $\ln + 1$ transformed data in paired T -tests.

RESULTS

The seasonal variations in abundance of *I. rubicundus* ticks between Dorper and Merino sheep are presented graphically in Fig. 1, together with data on rainfall. The differences in abundance between Dorper and Merino sheep ($P < 0,05$) were significant during 1992 and 1993, but not during 1994.

Marked annual variations in tick abundance on hosts were recorded. During 1992, it was low and during 1995, very high (Fig. 1). During 1992, Dorper sheep became infested with *I. rubicundus* ticks before the Merino sheep did. Peak abundance on the Dorpers was recorded towards the end of June, as compared with the end of July, for Merino sheep. Compared with the other observation years, rainfall was low during 1992, and the mean monthly maximum temperatures recorded during the tick activity period of 1992, were almost consistently higher (Table 1). During 1993, peak abundance on Dorper sheep ($\bar{x} = 17,9$ ticks) was recorded during April, and for Merino sheep ($\bar{x} = 7,3$ ticks), during May. The maximum mean number of ticks recorded from Dorper sheep was 2,5 times higher than that from Merino sheep (Fig. 1). Two Dorpers, but no Merino sheep, were paralysed during 1993. Peak infestation burdens during 1994 for both Dorper and Merino sheep were recorded during early June. None of the sheep became paralysed. During 1995, 50% of the Merino sheep were paralysed. A maximum mean of 65 ticks per sheep was recorded during May. Sheep had to be withdrawn from the camp for a 10 d period before reintroduction. Paralysed sheep were reintroduced into the group after recovery.

DISCUSSION

The infestation rate of hosts with *I. rubicundus* ticks, is closely related to the extent of movement or ground covered by the host in tick-infested habitat (Fourie & Kok 1992). It has been shown that the walking distance of Dorper and Merino sheep in mixed Karoo vegetation is either the same (Roux & Schlebusch 1987), or Merino's may walk longer distances (Roux, unpublished thesis 1993). Differences in grazing patterns and in selection for diet between the two breeds were, however, evident (Roux, unpublished

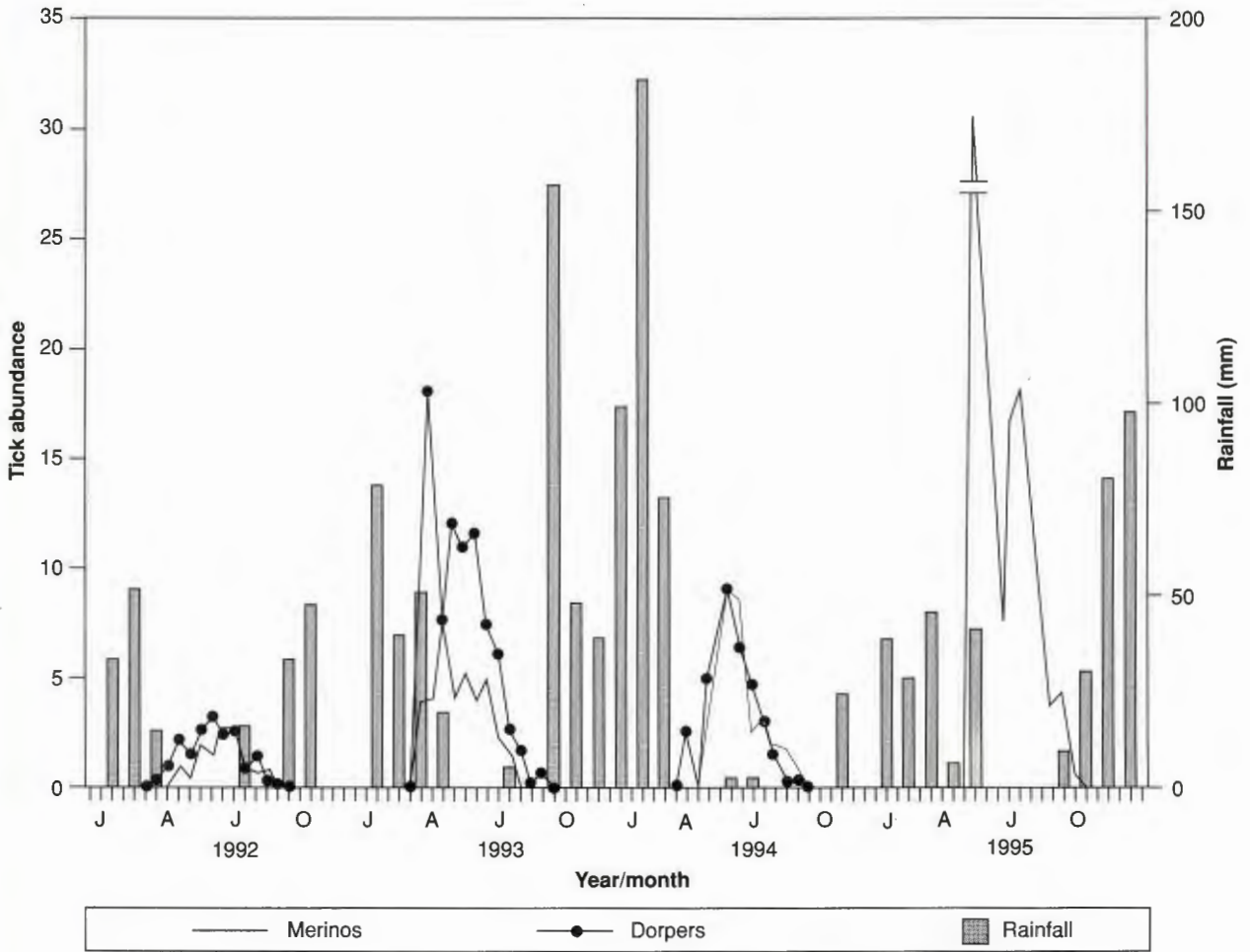


FIG. 1 Annual variation in rainfall and the abundance of female *Ixodes rubicundus* ticks on Dorper and Merino sheep

TABLE 1 Mean monthly minimum and maximum temperatures (March to September 1992–1995) for Fauresmith

Month	1992		1993		1994		1995	
	Min. temp.	Max. temp.	Min. temp.	Max. temp.	Min. temp.	Max. temp.	Min. temp.	Max. temp.
March	13,0	30,6	12,8	28,7	11,8	27,3	13,7	28,2
April	10,6	27,5	8,2	23,7	7,5	25,5	8,1	24,4
May	1,6	23,1	3,5	22,0	3,6	22,1	5,2	20,1
June	-1,3	18,6	-0,1	17,9	-1,1	16,1	0,4	18,0
July	0,8	19,1	1,9	19,7	-2,0	16,9	-1,0	17,6
August	2,8	19,3	3,4	20,9	2,0	20,8	3,4	21,9
September	7,7	28,0	6,5	27,8	7,0	26,4	7,3	27,5

thesis 1993). It is possible that the aforementioned differences contributed to a greater degree of host-tick contact in Dorper than in Merino sheep, thus accounting for the observed differences in infestation burdens. The fact that Dorpers can become infested with *I. rubicundus* before Merino sheep and also, in general, attain higher infestation burdens earlier in the season, implies that they are more at risk of be-

coming paralysed. This contention is confirmed by the data gained for 1993. The absence of any cases of paralysis burdens (Fourie *et al.* 1989; Fourie *et al.* 1992). From a practical point of view, Dorper sheep could serve as indicators of adult tick activity and hence as indicators of when to commence prophylactic treatment.

The results gained during the current study, indicated that there are marked variations in the seasonal pattern of occurrence of *I. rubicundus*. The late attainment of peak abundance of ticks on Dorper (June) and Merino (July) sheep during 1992, is related to the dry and relatively warm conditions that prevailed during that winter. Research has shown that the extent of vertical migration of *I. rubicundus* is markedly depressed at high temperature and low relative humidity ($T = 21^{\circ}\text{C}$; $\text{RH} < 50\%$) compared with lower temperature and high relative humidity ($T = 12^{\circ}\text{C}$; $\text{RH} > 80\%$) (Snyman, Fourie, Kok & Horak 1994). Rainfall, and hence heightened humidity, during the early stages of seasonal activity of the tick (April or May), will result in peak abundance on hosts during April or May. The data gained during the 1993 and 1995 tick-activity seasons in this study, support this contention. In the southern Free State, sheep constantly kept in a specific camp during winter, may become paralysed as late as July (Fourie *et al.* 1989). Sheep introduced into a camp which was spelled during the winter may, however, become paralysed as late as September (Fourie, personal observation 1993). Producers should be advised that, should precipitation during the latter part of the seasonal activity period of the tick follow an initially warm and dry spell that depresses vertical migration, late cases of paralysis may occur.

The high incidence of paralysis during 1995, is related to the very high infestation burdens of the sheep. A factor that could most likely have contributed to the high occurrence of the tick during 1995, was the above-normal rainfall during the latter part of 1993 and the first quarter of 1994. The high content of moisture in the soil, would have contributed to the survival of eggs and larvae. The life-cycle of the tick extends over a period of 2 years (Fourie & Horak 1994). Other factors such as the potential increase in availability of hosts for the immatures, particularly *Elephantulus* spp. (Fourie, Du Toit, Kok & Horak 1995) during 1994, may also have played an important role.

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