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RESISTANCE OF NGUNI, BONSMARA AND HEREFORD CATTLE TO TICKS IN A BUSHVELD REGION OF SOUTH AFRICA

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ABSTRACT

SPICKETT, A. M., DE KLERK, D., ENSLIN, C. B. & SCHOLTZ, M. M., 1989. Resistance of Nguni, Bonsmara and Hereford cattle to ticks in a Bushveld region of South Africa. *Onderstepoort Journal of Veterinary Research*, 245–250 (1989)

Counts of engorged female ticks on naturally infested cattle over a 2 year period, showed that indigenous Nguni cattle harboured significantly fewer *Amblyomma hebraeum, Boophilus decoloratus* and *Hyalomma* spp. during periods of peak abundance than either Bonsmara or Hereford cattle. Fewer abscesses, associated with tick bite, were also present in the Nguni cattle. Individual tick resistance indices, determined after artificial tick infestation in the field, could not be correlated with hair length, skin thickness or conglutinin titres. The consistently large percentage of Nguni cattle showing high tick resistance according to index determinations, indicates a superior level of natural immunity in this breed. The relative incidence of individuals in high, medium and low resistance classes reflected an increase in resistance with exposure to ticks and the potential for the selection for tick resistance within all 3 breeds.

INTRODUCTION

The existence of breeds of cattle more resistant to ticks than others is well established for the one-host tick, *Boophilus microplus* (Powell & Reid, 1982; Norton, Sutherst & Maywald, 1983) while evidence of resistance to 2- and 3-host-ticks has been shown for *Haemaphysalis longicornis* (Wagland, Sutherst & Roberts, 1985), *Amblyomma americanum* (Strother, Burns & Smart, 1974; Garris, Stacey, Hair & McNew, 1979), *Rhipicephalus appendiculatus* (Cunningham, 1981) and implied for other African tick species (Bonsma, 1944, 1981; Sutherst, 1981). More recently Rechav (1987) showed that Brahman cattle carry fewer *Amblyomma hebraeum, R. appendiculatus* and *Rhipicephalus evertsi evertsi* than do Hereford cattle. Utech, Wharton & Kerr (1978) determined that resistance is directly proportional to the amount of zebu genes in a herd and Hewetson (1972) confirmed that selection for tick resistance in cross-bred animals was feasible.

The existence of a resistance potential to ticks naturally infesting them in South African pure indigenous and transient breeds has been implied (Bonsma, 1944; Sutherst, 1981; Spickett, 1982) and has formed the basis of speculation with regard to strategic tick control programmes. This paper records the results obtained during a 2-year period with pure-bred indigenous Nguni, transient breed Bonsmara and pure-bred Hereford animals in a Bushveld environment under minimal tick control conditions.

MATERIALS AND METHODS

Study area

All experimental procedures were conducted on the farm "Loskop Suid" (29° 20′ S, 25° 18′ E), situated in a Bushveld region, south-east of Groblersdal, in the south-eastern Transvaal. Approximately 5 000 ha are fenced for use on the farm.

Acocks (1975) classifies the veld type as a tree savannah consisting of fairly dense bush with sour grass types comprising the main grazing component. Rainfall varies between 350 and 650 mm p.a. Mean monthly rainfall, gleaned from 20 years of weather bureau records is illustrated in Fig. 1. During the experimental period from 1983–1985, however, rainfall was much reduced because of a prolonged drought (Fig. 1). Mean monthly maximum and minimum temperatures during the experimental period are given in Fig. 2.

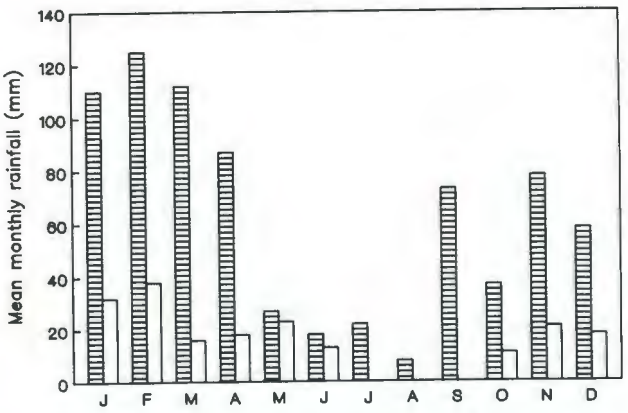

FIG. 1 Mean monthly recorded rainfall (mm) (▤) gleaned from weather bureau records for the experimental area and actual mean monthly rainfall during the trial period (□)

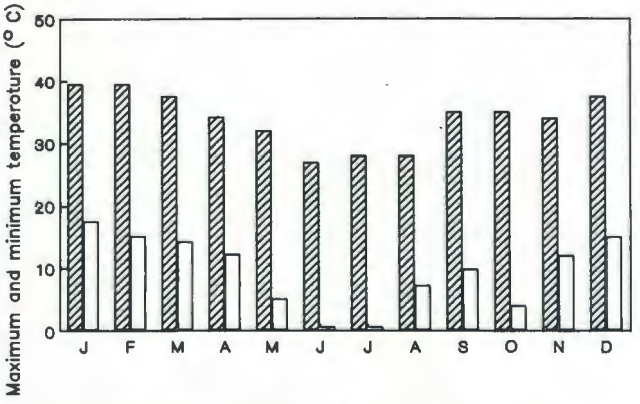

FIG. 2 Mean monthly minimum and maximum temperatures (°C) for the experimental area during the trial period

Animals

Ten bulls and 10 cows each of the Nguni, Bonsmara and Hereford breeds, all 18 months of age, were introduced onto the farm during November 1982 at the height of the summer. Four

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TABLE 1 Mean number of adult ticks collected from domestic hosts for species identification of ticks present on the property "Loskop Suid"

Host species	Number of collections	Tick species	Mean number of adults/collection
Cattle	14	*Boophilus decoloratus*	25,0
		Amblyomma hebraeum	14,0
		Hyalomma marginatum rufipes	12,0
		Rhipicephalus evertsi evertsi	7,5
		Rhipicephalus appendiculatus	6,5
		Rhipicephalus simus	3,0
		Hyalomma truncatum	2,5
Goats	7	*Amblyomma hebraeum*	8,5
		Rhipicephalus e. evertsi	2,5
Dog	2	*Rhipicephalus sanguineus*	3,0
		Haemaphysalis l. leachi	2,0

Herefords died of unconfirmed babesiosis within the initial 2-month adaptation period and were replaced by similar animals before tick counts commenced during January of the following year. Animals in the experimental group were allowed to become naturally infested with ticks without acaricidal intervention except for patch treatments applied to contain screwworm infestation caused by *Chrysomyia bezziana*. The experimental animals were kept separate from the main herd of Nguni animals also run on the farm.

Ticks

Adult ticks were periodically collected from domestic hosts on the farm. These were identified in order to establish the species present and their relative abundance (Table 1).

Boophilus decoloratus larvae, cultured in the laboratories of the Veterinary Research Institute, Onderstepoort, were used in all artificial infestations of the animals on the farm for the determination of resistance indices.

Experimental procedure

All the animals were mustered at 2-weekly intervals and individually neck clamped for examination. Two officers, one on either side, carefully examined the restrained animals, recording all engorged female ticks according to species, all abscessation sites associated with tick attachment and all subsequently ruptured abscesses. Breed differences were analysed by Duncan's multiple range test.

In addition to the continuous monitoring of the naturally infested animals, the same animals were artificially infested during November of each year for individual resistance index determinations. Twenty thousand *B. decolaratus* larvae (hatched from 1 g of eggs) were applied between the shoulder blades of each animal. The engorged, successful females from a 2nd infestation, 14 days after the 1st, were counted, and resistance indices determined according to Wharton, Utech & Turner (1970).

Serum was collected from each animal at the time of each artificial infestation and conglutinin titres were determined (Du Plessis & Bezuidenhout, 1979) in an attempt to correlate these with resistance indices using simple regression analysis.

Specimens of hair were taken from 4 sites on each animal during winter and during summer: between the shoulder blades; behind the left scapula; at the tail root and along the ventral belly hairline. Mean hair length was determined for each animal and correlation attempted with resistance indices, calculated after artificial infestations, for each group.

Double skin thickness was measured with a spring caliper for each individual at the same 4 sites as where the hair specimens were taken, and group differences were analysed using Duncan's multiple range test.

RESULTS AND DISCUSSION

Tick infestation

Amblyomma hebraeum

Counts of engorged females showed that this tick species was present throughout the year with marked peaks of abundance during March of both years and October of the 2nd year. Higher numbers were encountered on all 3 breeds during the 2nd than during the 1st year (Fig. 3) Very little difference in relative numbers on Hereford and Bonsmara

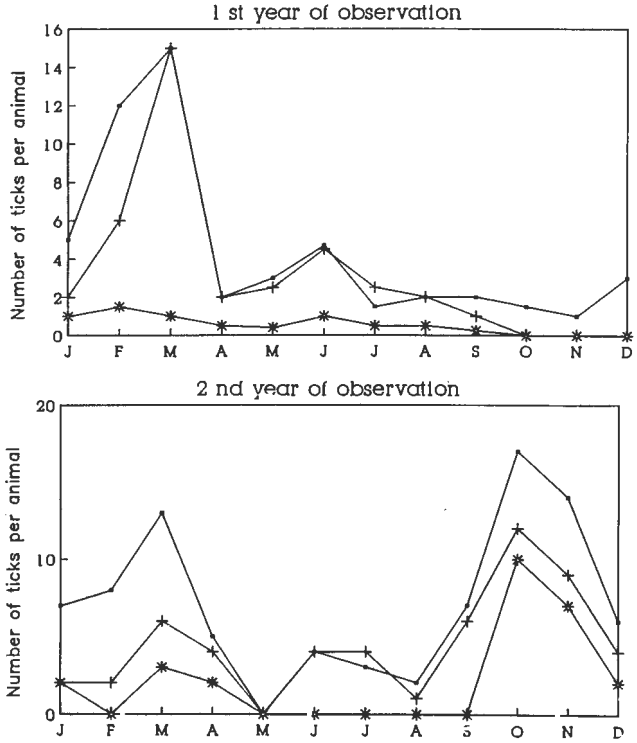

FIG. 3 Mean monthly number of engorged *Amblyomma hebraeum* females on Hereford (■), Bonsmara (+) and Nguni (*) animals during the 1st and 2nd years of observation

cattle was evident during the 1st year (Fig. 3), both differed significantly (P = 0,05) from the low numbers counted on the Ngunis during the summer months. During the summer months of the 2nd year (Fig. 3), counts on the Bonsmaras were intermediate between the relatively high numbers found on the Hereford and lower numbers on the Nguni animals. Winter counts on all 3 breeds were similar during both years.

Boophilus decoloratus

Seasonal peaks of engorged females were evident during the summer months of February of both years and October of the 1st year and July and December of the 2nd year on all 3 breeds (Fig. 4). During both years the counts on Hereford and Bonsmara animals were significantly (P = 0,05) higher than on the Ngunis. The smaller burdens counted during the 2nd year differed very significantly (P = 0,01) from the high numbers encountered during the 1st year (Fig. 4), the opposite of that found for *A. hebraeum*.

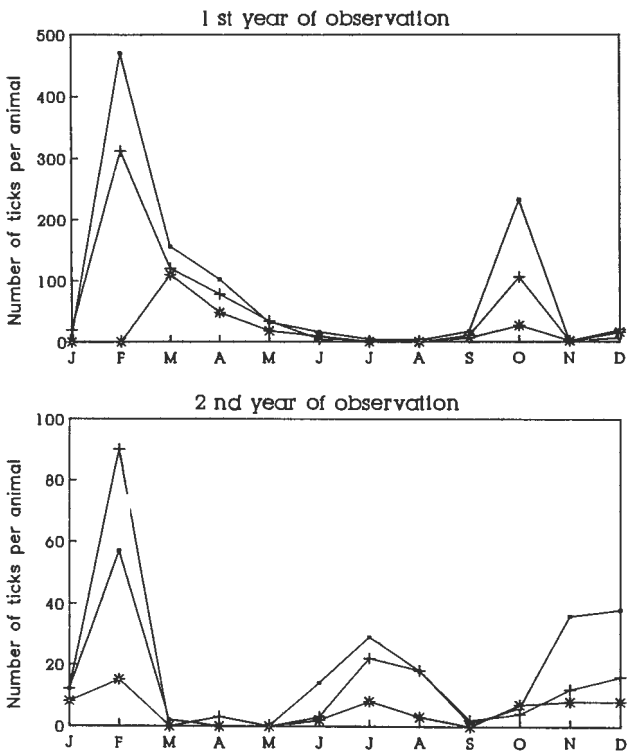

FIG. 4 Mean monthly number of engorged *Boophilus decoloratus* females on Hereford (■), Bonsmara (+) and Nguni (*) animals during the 1st and 2nd years of observation

Hyalomma *spp.*

Although both *Hyalomma marginatum rufipes* and *Hyalomma truncatum* were present (Table 1), they were lumped in this analysis because of the difficulty in distinguishing between them macroscopically.

Peak numbers of engorged females occurred during March and November of the 1st year (Fig. 5). Bonsmaras carried significantly (P = 0,05) more females than Hereford and Nguni animals during the March peak but similar numbers were found on all 3 breeds during the rest of the experimental period. Significantly fewer engorged females were found during the 2nd year of the counts (Fig. 5).

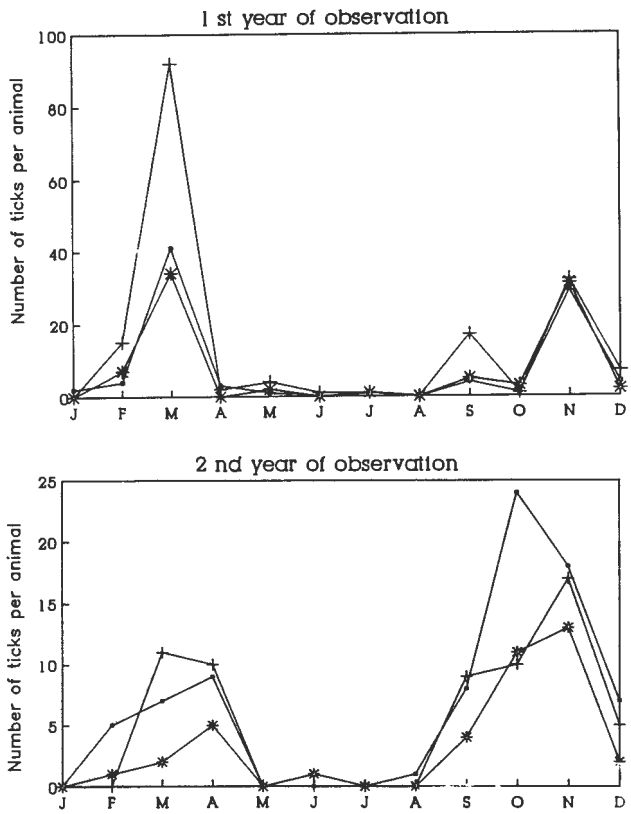

FIG. 5 Mean monthly number of engorged *Hyalomma* spp. females on Hereford (■), Bonsmara (+) and Nguni (*) animals during the 1st and 2nd years of observation

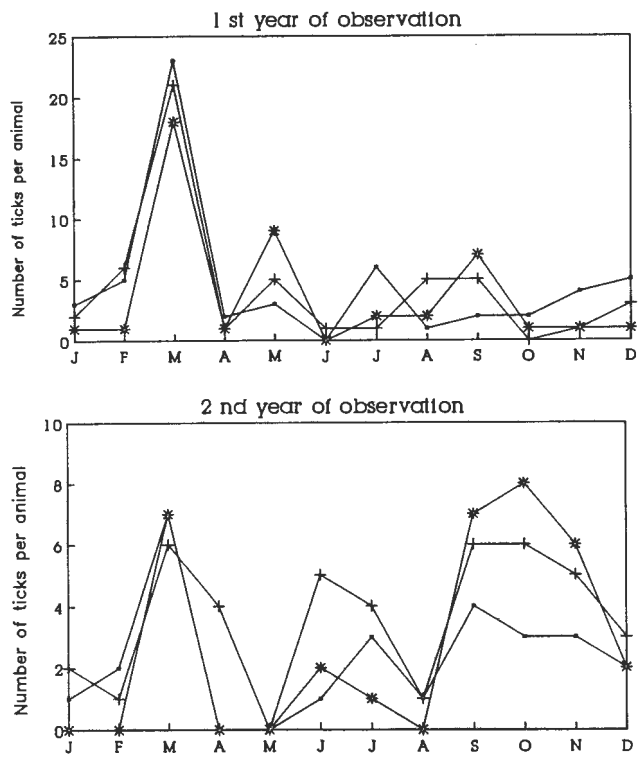

FIG. 6 Mean monthly number of engorged *Rhipicephalus evertsi evertsi* females on Hereford (■), Bonsmara (+) and Nguni (*) animals during the 1st and 2nd years of observation

Rhipicephalus evertsi evertsi

No significant difference could be found between the numbers of engorged females on the 3 breeds (Fig. 6). The ticks occurred throughout the year with

TABLE 2 Relative percentage of animals within each of the 3 cattle breeds in the low, medium and high resistance class after 1 and 2 years of exposure to natural tick infestation

Breed	Sex	Number of animals	Percentage of animals per resistance class					
			Low		Medium		High	
			1 year	2 years	1 year	2 years	1 year	2 years
Nguni		20	30	30	40	15	30	55
	Males	10	30	40	60	10	10	50
	Females	10	30	30	20	20	50	50
Bonsmara		18	56	56	22	17	22	27
	Males	9	55	44	11	22	34	34
	Females	9	56	67	33	11	11	22
Hereford		18	50	56	39	33	11	11
	Males	9	44	56	56	44	0	0
	Females	9	56	56	22	22	22	22

peak numbers in March and from September to November of the 2nd year. Although fewer females were encountered during the 2nd year, this difference was not significant.

Abscessation

Mean monthly numbers of ruptured abscesses per breed for the 2 years are given in Fig. 7, with most occurring between October and January. The Herefords had a significantly (P = 0,05) higher number of abscesses than either the Nguni or Bonsmara animals. The Bonsmaras were intermediate in this respect while the Ngunis suffered very little from abscessation and were never subject to screwworm infestation. The Hereford animals had to be patch-treated in January and again in November of each year to contain screwworm strike. Most abscesses were present during the summer months corresponding with peak tick numbers. Abscessation was attributed particularly to *Amblyomma* and *Hyalomma* infestation, occurring in the region of clumping of the former species and at isolated attachment sites of the latter species, especially on the udder, scrotum, axillae and at the tail root.

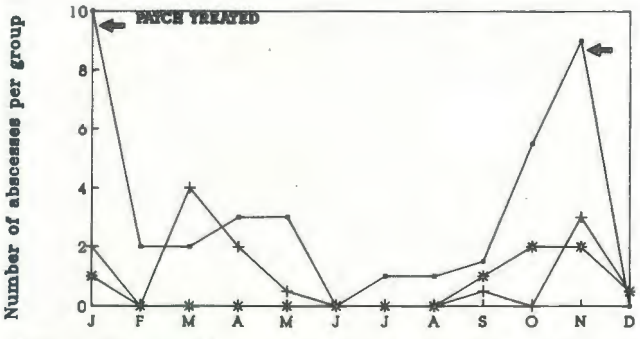

FIG. 7 Mean monthly number of ruptured abscesses per breed found on Hereford (■), Bonsmara (+) and Nguni (*) animals during the 2 year experimental period

Tick resistance

Three resistance classes, high, medium and low, were delineated according to the yield of engorged females following artificial infestation.

The relative percentages of animals of both sexes of the 3 breeds in the high, medium and low resistance classes are summarized in Table 2. The proportion of Bonsmara and Hereford animals in the respective classes remained nearly static during the 1st and 2nd years of exposure. After the 2nd year of exposure the proportion on Nguni male animals in the high resistance class increased markedly while that in the low resistance class increased slightly. This is indicative of a high potential of the Nguni animals to develop resistance with exposure to tick infestation while the other 2 breeds do not show this potential to the same extent. The presence of animals of all 3 breeds in the low and high resistance classes suggests that selective culling and selection procedures would improve tick resistance within the 3 breeds. More Bonsmara males than females attained the high resistance class after 2 years of exposure. The same number of male and female Nguni animals were classed as highly resistant and although a low percentage of Hereford females fell into this class, no males could be classed as such.

Fig. 8 shows the relative ranking of the 10 Nguni bulls from the experimental group using the following ranking methods:

1. Artificial infestation with 20 000 *B. decoloratus* larvae
2. Ranking according to relative counts of naturally acquired engorged *Boophilus* females.
3. Ranking as for 2, but with *Boophilus* and *Amblyomma* counts combined
4. As for 2, but with *Boophilus, Amblyomma* and *Hyalomma* counts combined

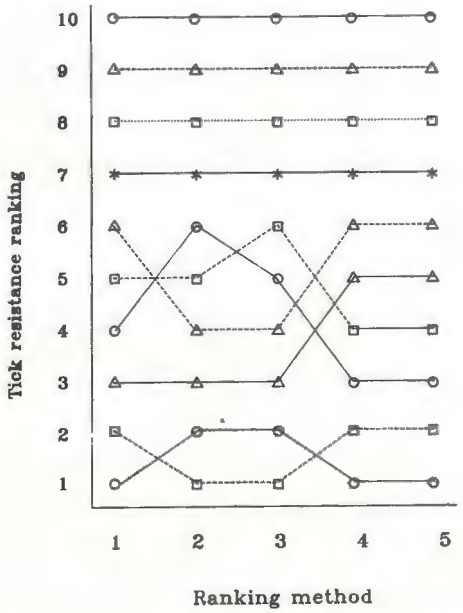

FIG. 8 Relative ranking for tick resistance of 10 Nguni bulls according to 5 assessment methods

TABLE 3 Mean double skin thickness (cm) and range for each sex of the 3 cattle breeds in the trial. Means with the same letter are not significantly different

Breed	Nguni		Bonsmara		Hereford	
Sex	Male	Female	Male	Female	Male	Female
Thickenss	2,77[a]	2,72[a]	2,81[a]	2,83[a]	2,99[a]	2,8[a]
Range	2,6–3,0	2,12–3,6	2,26–3,2	2,26–3,4	2,6–3,3	2,4–3,4
SD	0,136	0,544	0,235	0,413	0,273	0,408

TABLE 4 Mean hair lengths (mm) for each sex and for the 3 cattle breeds in the trial. Means with the same letter are not significantly different

Breed	Nguni		Bonsmara		Hereford	
Sex	Male	Female	Male	Female	Male	Female
Breed mean	20,7[b]		21,4[b]		54,9[a]	
Sex mean	20,69[D]	29,17[C]	21,44[D]	31,47[C]	54,98[A]	43,91[B]
SD	1,58	1,59	4,23	3,65	9,89	2,10

TABLE 5 Regression coefficients (r) determined in the attempted correlation of individual tick resistance indices with hair lengths for each sex of the 3 cattle breeds tested

Group	Number of animals (n)	Regression coefficient (r)
Hereford cattle	18	0,273
Hereford males	9	0,151
Hereford females	9	0,237
Bonsmara males	9	0,117
Bonsmara females	9	0,114
Nguni males	10	0.015
Nguni females	10	0,1004

5. As for 2, but with *Boophilus, Amblyomma, Hyalomma* and *R. evertsi evertsi* counts combined.

Ranking by the 5 different methods employed shows very little variation in the position of the bulls within the top 2 (ranking 1 and 2) and bottom 4 positions (ranking 7–10). Variation in relative position within the middle range (ranking 3–6) was more pronounced but still served to group these animals. In practice only the 2 highest ranked bulls would be selected for breeding, the tick resistance index of the others being too low.

Skin thickness and tick resistance

Double skin thickness, range and standard deviation for the 3 breeds are summarized in Table 3. No significant difference in double skin thickness was found between the 3 breeds or between the sexes of the 3 breeds. As a result of this no correlations with any other parameters aimed at defining breed differences were attempted.

Hair length and tick resistance

Mean hair lengths for the 3 breeds are summarized in Table 4. Hereford hair length was very significantly ($P = 0,01$) longer than both Bonsmara and Nguni hair lenghts with significant ($P = 0,05$) differences being evident between the sexes within each breed. Because the Hereford cattle had the lowest percentage of highly resistant animals, the assumption that longer hair is condusive to tick infestation was tested on an individual basis for each sex within each breed by regression analysis (Table 5).

No correlation between hair length and tick resistance could be demonstrated for the sexes within each of the 3 breeds or for any of the breeds.

Conglutinin titre and tick resistance

The highest regression coefficient was found during November of the 2nd year ($r = -0,009$), an indication that there was no direct correlation between reciprocal conglutinin titre and tick resistance index.

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Dr J. L. du Plessis determined the conglutinin titres and Dr E. M. Nevill reviewed the manuscript.

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