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STUDIES ON TICKS (ACARI: IXODIDAE) INFESTING CATTLE IN THE EASTERN FREE STATE PROVINCE OF SOUTH AFRICA: INDIVIDUAL HOST VARIATION

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ABSTRACT

Monthly collections were made of all male and female ticks from 10 female cows (*Bos taurus* crosses) between 18 months and 4 years of age, once a month over a period of 12 months at monthly intervals at Qwa-Qwa in the Eastern Free State province, South Africa, from May 1998 to April 1999. The most common species were *Boophilus decoloratus* Koch and *Rhipicephalus evertsi evertsi* Neumann. *Rhipicephalus follis* Donitz, *R. gertrudae* Feldman-Muhsam and *R. punctatus* Warburton were also present in fewer numbers. Cattle were ranked according to their degree of resistance to the total tick infestations. Tick numbers varied throughout the year on all individuals but some animals consistently tended to have either higher or lower numbers than the mean of the group. Tick burdens on cattle classified as having a relatively low resistance to tick infestations increased eleven-fold, compared to a four-fold increase on cattle with high resistance from August 1998 to April 1999. Thirty-two percent of the cattle in the total study group (n=10) carried 50% of the total tick burden. Farmers in the region can visually assess *B. decoloratus* and *R. evertsi evertsi* burdens, the most abundant tick species, and sell or cull the most susceptible cattle. This should eventually result in the direct improvement of the overall tick resistance of their cattle and will help in management and control of tick populations infesting their animals.

Key words: Cattle, ticks, host resistance

INTRODUCTION

Ticks are of considerable veterinary, medical and economic importance as vectors of infectious diseases of man and animals throughout the world, especially in Africa. Although different species of ticks and tick-borne diseases occur in various ecological regions, their impact on animal production is similar in nature and importance. They are responsible for severe losses either by tick worry, blood loss, damage to hides and udders and the injection of toxins or through mortality or debility by the diseases transmitted.

Results of a study conducted in the Eastern Free State has indicated that high tick burdens, especially *Boophilus decoloratus*, occur throughout the year (Hlatshwayo 2000). Tick control methods used by the small-scale farmers in the area include the use of commercial acaricides (pour-on, hand spray and tick grease), deticking by hand, Jeyes fluid (a household disinfectant), used-engine oil and chickens as predators of ticks infesting cattle (Hlatshwayo 2000).

A control method that can potentially be used by the livestock farmers is the use of resistant hosts with either an innate or acquired resistance, or both. Many studies have confirmed the fact that certain cattle, such the *Bos indicus* breeds, are more resistant to ticks than others due to an innate resistance (Fourie et al. 1996). It has been shown that host resistance can regulate *Boophilus microplus* populations in the field (Sutherst et al. 1979). The use of tick-resistant cattle breeds in an integrated tick management plan could be a pragmatic, alternative approach to the intensive use of acaricides (Latif and Pegram 1992). It has also been shown that some animals in a herd kept under similar conditions may constantly carry fewer ticks than others (De Castro 1986), due to a stronger acquired resistance. Parasites are usually overdispersed within the host population, in which case most of the ticks occur on only a few hosts while the majority of hosts harbor only a few ticks. Overdispersion in tick infestations may be due to a number of reasons including heterogenicity in the host's ability to reduce or limit tick burdens by an immune response or other means (Petney et al. 1990). Consistently above or below average tick burdens on hosts could therefore be indicative of a relatively low or high resistance to tick infestations.

The objective of this study was to determine the differences in tick infestation levels on individual cattle, under traditional management systems in Qwa-Qwa, and to relate these observations to the relative resistance levels of the host animals.

MATERIALS AND METHODS

The study took place over a period of 12 months from May 1998 to April 1999 on the communal grazing area of Qwa-Qwa (28°50'E, 28°35'S). The area lies at the altitude of 1600 m above sea level, and belongs to the grassland biome with the mean annual rainfall of 800 mm.

The cattle in the area are generally of mixed-breed origin with predominantly Friesian-crosses. Animals were matched for age and physiological status and only *Bos taurus* were used. A total of 10 female animals were used in the study and, according to dentition (West 1988), all of the animals were between 18 months and four years of age. The cattle were ear-tagged for individual identification. Generally, tick control with commercial acaricides is not practiced regularly by the farmers in the study area, but traditional methods such as the use of engine-oil and Jeyes fluid are frequently used (Hlatshwayo 2000). The study cattle had never received any vaccinations, anthelminthics or commercial acaricides up to the start of the study.

Adult male and female ticks in all stages of engorgement were collected between May 1998 and April 1999 from different parts of the bovine body (n=10) and preserved in labeled bottles containing 70% alcohol. The collected ticks were counted, identified and recorded to species level using a standard stereo-microscope (Nikon, SMZ-2T). Identification was done according to methods of Walker (1961).

Animals were classified according to the tick burdens they carried each month. Tick burdens of the different animals were compared with one another as well as with the mean tick burdens of the group as a whole (n=10). Animals were classified as either of high resistance (HR), indicating those that consistently carried few ticks, or of low resistance (LR) for which the body counts were consistently high. Subsequently, the mean tick burden on two most susceptible animals (LR) was compared to the mean burden of the group (n=10) and to the mean burden on the two most resistant animals (HR) to

demonstrate their relationship in overall tick population dynamics.

The data sets were analyzed statistically using appropriate analysis of variance techniques. All statistical analyses were done on Mecer-desktop computer. The software program used was Statistica 1998 Edition for Windows (StatSoft, Inc.). A One-may analysis of variance (ANOVA) test (Barnard et al. 1993) was used to determine if there was any significant difference in the relative tick resistance of the different individuals. The test was done for monthly total tick burdens. This was followed by a Multiple Range procedure, the Least Significant Difference (LSD) test, to indicate the individuals with higher or lower burdens causing the variance (Zar 1974). A significance level of $p<0.05$ was used throughout.

RESULTS

Tick numbers varied throughout the year on all individuals, but some individuals consistently tended to have either higher or lower tick numbers compared to the mean value for the group (Table 1). Individual animals in order of decreasing tick burdens were cattle number 9, 5, 3, 1, 6, 2, 8, 10, 7, and 4. Relatively to the mean monthly tick burdens of the group (n=10), animal number 9 showed significantly ($p<0.05$) higher tick burdens, and thus a low tick resistance throughout the year. The total tick number on this cow was 1.62 times higher than the mean total number of the group, and 3.63 times higher than that of the total number on the most resistant individual (animal number 4). The monthly tick burden of animal number 9 was higher than the mean monthly tick burden of the group for the entire 12 months of the study. In contrast, individuals # 4, 7, 8 and 10 had significantly ($p<0.05$) lower mean monthly tick burdens than the rest of the group. They were also lower than the mean total tick burden of the group (n=10), indicating relatively high resistance levels to ticks. These highly resistant (HR) cattle showed very little variation in seasonal tick numbers throughout the year compared to the low resistant (LR) group of comprising of animals # 5 and 9. The tick burden on # 4 was 2.24 times lower than the mean tick burden of the group.

The mean monthly tick numbers of individuals # 5 and 9 were used to illustrate the tick numbers on LR cattle while the mean monthly tick burdens on # 4 and 7 were used to illustrate the burdens of HR cattle, in comparison to the mean monthly tick burdens of the whole group (n=10) (Fig. 1). Pronounced seasonal variations in tick numbers on the LR cattle, with a peak in April 1998, were seen. There was an eleven-fold increase in tick burdens of the LR group, compared to a four-fold increase in tick burdens of the HR group had from August 1998 to April 1999.

The above mentioned results thus indicated that certain individual animals consistently carried higher tick burdens than others. Animals were arranged according to their relative resistance, starting with the LR cattle and ending with the most resistant cattle, and it was found that thirty-two percent (32%) of cattle in the group (n=10) carried 50% of the total tick burden.

DISCUSSION

Certain individuals in the herd of cattle studied carried constantly higher or lower tick burdens. The HR cattle showed relatively small seasonal fluctuations in total tick numbers, even during the high tick challenge months of May and June 1998 and May 1999. The susceptible animals showed an eleven-

fold increase in the magnitude of the total tick burden, during April 1999, compared to the four-fold increase of the HR group. Seasonal changes in tick burdens are normal for all tick species (Hlatshwayo 2000), and the changes observed in the tick burdens on the group of cattle in Qwa-Qwa were possibly as a result of increased tick challenge, due to an accumulation of free-living stages associated with a more favorable climate for the development of ticks. Another influence resulting in seasonal variations in tick burdens could have been the changes in resistance levels of all the hosts, due to stress and poor nutrition in winter nd concurrent loss in resistance (Orskov 1993).

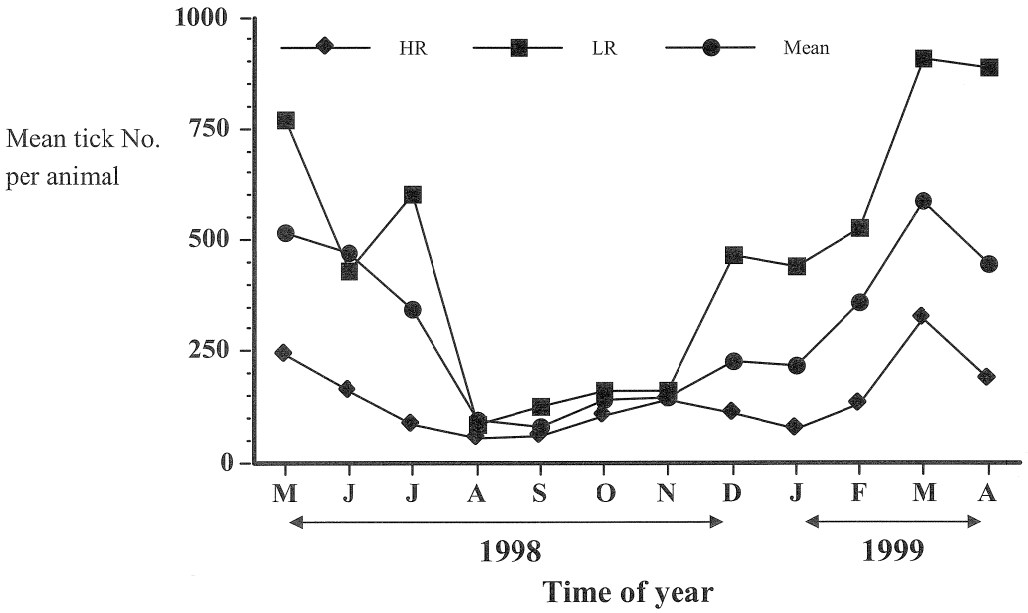

Figure 1. Mean monthly counts of tick burdens on the group of cattle in Qwa-Qwa, indicating variations in individual relative host resistance (n=10). M: May, J: June, J: July, A: August, S: September, O: October, N: November, D: December, J: January, F: February, M: March, A: April.

Throughout the study, the HR group showed a single pronounced peak in March 1999, compared to the more dramatic fluctuations in tick counts of the two low resistant cattle (# 5 and 9) with a massive peak in May1998, and other peaks in July 1998, December and April 1999. This demonstrates that the LR group contributed in a major way to the propagation of the field population of ticks. In contrast, the HR cattle would tend to limit the overwhelming multiplication of ticks (De Castro 1986). The results of the present study compare well with results of similar studies on individual host resistance conducted in Kenya (Latif et al. 1991) and in South Africa (Dreyer et al. 1998). In the Kenyan study, the seasonal increase in tick numbers on LR cattle showed an almost seven-fold increase in magnitude when tick challenge was high, whereas HR cattle showed little or no seasonal fluctuations with only a two-fold increase.

About 3.2 cattle (32%) carried 50% of the total tick population infesting the group.

These findings are in accordance with results obtained in studies done Latif et al. (1991) in western Kenya and Dreyer et al. (1998) in the southern Free State province of South Africa. In all these studies, about 30% of the cattle herd carried 50% of the total parasitic population. Individuals with relatively low resistance are responsible for much of the tick multiplication in the field (Latif et al. 1991). The culling of about 9-10% of the most susceptible animals in a herd, would lead to an almost 50% reduction in the overall tick population on that herd (Latif 1984).

Tick resistance is better developed and more prominent in certain cattle such as the *B. indicus* breeds (Fourie et al. 1996). In Qwa-Qwa, however, cattle are of mixed-breed origin with predominantly *B. taurus* bloodlines. The main use of these herds is milk production, with the cattle kept in a specific traditional management system (Hlatshwayo 2000). Age, nutrition, hormone levels of the host, pregnancy and lactation can also influence the natural or acquired immunity to ticks (Rechav 1992).

The group of cattle used in this study were all of *B. taurus* crossbred origin, with predominantly Friesian blood. Thus all were of mixed breeds, with no *B. indicus* influence. Furthermore, all cattle used were of an average age of two to three years, with a minimum of 18 months and a maximum of four years. All cattle were kept under similar management and husbandry systems, with no extra supplementary feeding, thus the possible influence of differences in nutritional status could be ignored. The only factors that could have had an influence on host resistance of cattle to tick infestation, are that of pregnancy and lactation, because only breeding cows were used and four of them were either pregnant or lactating during the 12-month study period. But only one of the lactating cows was in the LR group, and this does not carry enough evidence that lactation influenced the extreme burdens recorded during the study.

The differences in resistance could be observed by the naked eye, due to the fact that individuals with relatively low tick resistance carried notably larger tick burdens. Thus it is necessary to educate farmers on firstly, tick species which are of economic importance in their area, secondly, the predilection feeding sites of these species (Hlatshwayo 2000) and, thirdly, the fact that about 30% of their herd carries about 50% of the total tick burden of the specific herd. With this knowledge, farmers can visually select and cull the LR individuals by themselves. Only the adult stages of ticks are of economical importance in animal production, and these can easily be recognized on the animal by the farmer (De Castro 1986). In the Qwa-Qwa area, farmers only need to visually assess the *B. decoloratus* burdens, as it is the most prominent species, or alternatively *Rhipicephalus evertsi evertsi*, the second most important tick in the Eastern Free State Province (Hlatshwayo 2000). The culling of susceptible cattle would lead to the direct improvement of the overall resistance of their cattle as a group. Furthermore, less acaricide would be necessary for hand-dressing, because the mean tick burden will be lowered.

Indirectly this culling would also positively influence the tick resistance of the progeny, especially if bulls with resistant genes are introduced, since resistance has been shown to be heritable. A further important factor which needed to be highlighted to the farmers, are that the selection for tick resistance and selection for milk production within a certain breed are not antagonistic (Hewetson 1981).

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