Onderstepoort J. vet Res., 50, 3–5 (1983)

THE EFFECT OF TICK CONTROL ON THE EPIDEMIOLOGY OF BOVINE BABESIOSIS

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ABSTRACT

DE VOS, A. J. & POTGIETER, F. T., 1983. The effect of tick control on the epidemiology of bovine babesiosis. *Onderstepoort Journal of Veterinary Research*, 50., 3–5 (1983)

The effect of tick control on the infection rates of *Babesia bovis* and *Babesia bigemina* are reported for 6 geographical regions in South Africa. Under conditions of poor tick control the situation for *B. bovis* was one of apparent enzootic instability in the 2 regions where its presence was recorded. Under similar conditions the situation for *B. bigemina* was generally stable.

With good tick control *B. bovis* infection rates were reduced to very low levels, with minimal losses being recorded. In the case of *B. bigemina*, good tick control reduced the infection rates in cattle but increased the risk of outbreaks.

We concluded that, unless regular dipping is necessary to limit damage done by ticks *per se*, control of ticks is not justified economically as a means of minimizing the risks of babesiosis outbreaks in South Africa.

INTRODUCTION

Epidemiology has been defined as the study of reasons for the prevalence of disease and the nature and causes of variations in it (MacDonald, 1957, cited by Joyner & Donnelly, 1979). In this paper we shall deal with the effect of tick control on the epidemiology of bovine babesiosis caused by *Babesia bovis* and *Babesia bigemina* in enzootic regions in South Africa.

The studies of Mahoney and co-workers as reviewed by McCosker (1981) have clearly defined the epidemiological factors that determine whether babesiosis is stable or unstable in an enzootic area. Where the inoculation rate of *Babesia* defined by Mahoney (1969) is adequate to ensure that all calves are infected while they are protected by innate and colostral immunity, clinical babesiosis is minimal and enzootic stability is achieved. The important factor is the proportion of calves that become infected before they are 9 months of age (Mahoney, 1974). If this figure is 75–100%, the situation should remain stable.

The inoculation rate is determined by the number of *Babesia*-infected ticks to which cattle are exposed, a factor influenced by climatic and animal management conditions (McCosker, 1981). These conditions are also known to be involved in South Africa (De Vos, 1979), but in this paper only the effect of tick control on enzootic stability will be examined.

MATERIALS AND METHODS

During the past 3 years, farms were visited in various parts of South Africa as part of a survey to determine the distribution and incidence of infection of bovine *Babesia* spp., *Theileria* spp. and *Anaplasma marginale*. In each case, animals approximately 15 months of age and born on the property were bled for serum. In addition, information was collected on the incidence of tick-borne diseases, immunization programmes, movement of cattle and the efficacy and methods of tick control. The degree of tick control was roughly evaluated, using the following 3-point scale: *Good:* No, or virtually no, adult or nymphal *Boophilus*, very few *Rhipicephalus evertsi* and/or *Hyalomma* spp. present on the animals.

Moderate: Boophilus spp. detectable in small numbers. Multihost tick species readily detectable but present in small numbers only.

Poor: Numerous *Boophilus* spp. and multihost tick species present on most of the animals. Farms where no tick control was practised were included in this group.

All the farms were visited during the summer months and the date of the last dipping was taken into consideration when the effect of dipping was evaluated.

In an attempt to relate the serological data obtained in this study with actual outbreaks of babesiosis, 150 farms with serological evidence of *B. bovis* and/or *B. bigemina* were divided into 3 categories, namely, those with more than 70% of animals serologically positive, those with less than 20% positive animals and those between these 2 extremes. The farms in each category with histories of recent outbreaks of babesiosis were then expressed as the percentage of farms in that category known to be infected with the *Babesia* sp. involved (Table 1). An outbreak for the purpose of this paper is defined as the situation in which at least 1 animal contracted clinical or fatal babesiosis on a farm at any one time.

To study the effect of tick control on *Babesia* transmission, 88 of the survey farms were selected for studies from 6 geographical regions differing in altitude and mean annual rainfall (Table 2). The farms in each region were grouped according to the degree of tick control practiced. The mean percentage of animals serologically positive in each group for *B. bovis* and *B. bigemina* was then calculated (Table 3). An indirect fluorescent antibody test was used for the serological study and was performed, as outlined by Gray & De Vos (1981). A total of 25–30 sera were tested from each farm and the result, expressed as a percentage, was taken to be the infection rate on the particular farm.

TABLE 1 Enzootic instability of *B. bovis* and *B. bigemina* on 150 farms

Infection rate (%)	Percentage of farms where outbreaks were recorded	
	B. bovis	*B. bigemina*
<20	0	20
20–70	65	50
>70	20	10

TABLE 2 Geographical regions where surveyed farms were located

Region	No. of farms	Altitude (m)	Mean annual rainfall (mm)
Zululand	22	<500	>600
North-eastern Transvaal	6	500	600
Northern Transvaal	26	500–1 000	<600
Western Transvaal	6	1 000	<600
Natal Midlands	12	1 000–1 500	>600
Eastern Transvaal Highveld	16	>1 500	>600

This paper is reprinted from the *Proceedings of the Symposium on Ectoparasites of Cattle* held at the South African Bureau of Standards, 1 Dr Lategan Road, Groenkloof, Pretoria, Republic of South Africa 0181 from 15–16 March 1982.

Received 3 September 1982—Editor

TABLE 3 Effect of tick control on the infection rates of *B. bovis* and *B. bigemina* in 6 regions in South Africa

Region	Districts	Tick control	No. of farms	Infection rate	
				B. bovis	*B. bigemina*
Zululand	Hlabisa	Good	5	2	27
	Ubombo	Moderate	12	15	52
		Poor	5	58	80
N.E. Tvl.	Letaba	Good	2	0	50
		Moderate	2	0	74
		Poor	2	0	100
N. Tvl.	Marico	Good	2	0	4
	Messina Pietersburg Potgietersrus	Moderate	10	0	59
	Waterberg	Poor	14	0	85
W. Tvl.	Christiana	Good	0	—	—
	Klerksdorp	Moderate	3	0	50
	Potchefstroom	Poor	3	0	73
Natal Midlands	Estcourt	Good	2	0	6
	Mooi River	Moderate	5	0	46
	Ixopo	Poor	5	0	80
E. Tvl. Highveld	Belfast Piet Retief	Good	2	0	8
	Standerton Wakkerstroom	Moderate	5	10	28
	Witbank	Poor	9	57	83

Results and Discussion

Enzootic instability for B. bovis

The interrelationship between the infection rate and the percentage of farms where outbreaks were recorded is presented in Table 1. If we apply the inoculation rates reported by Mahoney (1973) for *B. bovis* in Australia to the South African situation, we can readily explain the figures obtained for this species in the present study. The farms with infection rates of less than 20% will have inoculation rates below 0,0005 and according to Mahoney & Ross (1972), the risk of outbreaks is small at these inoculation rates. As is shown in Table 1, these farms experienced a low risk disease situation for *B. bovis* infection.

Farms with infection rates of 20–70%, however, will have inoculation rates of 0,0005–0,003 and Mahoney & Ross (1972) demonstrated that there is a maximum risk of outbreaks associated with inoculation rates between 0,0005 and 0,005. The enzootic instability on these farms is clearly demonstrated by the high percentage of farmers reporting outbreaks of babesiosis (Table 1).

Infection rates of at least 90% would be necessary to ensure the inoculation rates of 0,005 necessary for enzootic stability. Hence, it is not surprising that 20% of the farms with infection rates of more than 70% reported outbreaks of *B. bovis* (Table 1).

Enzootic instability for B. bigemina

The data obtained in this study for *B. bigemina* could not be related to inoculation rates. However, as can be seen from Table 1, 50% of the farms with infection rates between 20% and 70% reported outbreaks and were therefore noticeably more unstable than those above and below this range.

Effect of tick control on stability for B. bovis

The results of the serological survey of farms with different levels of tick control are summarized in Table 3. In the 2 regions where *B. bovis* occurred, namely, Zululand and the Eastern Transvaal Highveld, the situation was clearly unstable under conditions of poor tick control. On the other hand, good tick control all but eliminated this *Babesia* sp. (Table 3). The results from the Zululand farms came as a surprise, as we regarded both the rainfall and the temperature in those parts as adequate to ensure stability if tick control is poor. The enzootic instability of *B. bovis* on the Highveld is a well-known phenomenon and has been reported before (De Vos, 1979).

Regular dipping is essential in Zululand to control multihost tick species and, if effective, it will reduce the infection rate of *B. bovis* to very low levels.

On the Eastern Transvaal Highveld, where *Boophilus* spp. are the principal tick species present, tick "worry" is not a great concern to farmers, and the situation is therefore different. We conclude that it will not be economically justified in that region to control *B. bovis* by tick control alone. Thus, the use of a babesiosis vaccine might, in the long run, prove to be a less costly solution to a very important problem.

Effect of tick control on stability for B. bigemina

B. bigemina appeared to be enzootically stable on most of the farms in the different regions with histories of poor tick control (Table 3). The only exception is the Western Transvaal where outbreaks are reported from time to time and in the Natal Midlands where outbreaks occur in dairy herds under special circumstances (De Vos & Every, 1981). The wider distribution of *B. bigemina* and the higher infection rates of this species compared with those of *B. bovis* are well-known phenomena and are related to differences in the vectors and transmission rates of the 2 species (Mahoney, 1969; De Vos, 1979).

Good tick control reduced *B. bigemina* infection rates in cattle to low levels in all the regions. However, as is shown in Table 1, 50% of the farms with infection rates of 20–70% and 20% of those with infection rates of less than 20% reported outbreaks of babesiosis. It is very evident, therefore, that although tick control reduced infection rates to a minimum on some farms, it increased the risks of outbreaks of *B. bigemina* on others.

The parts of South Africa where enzootic instability for *B. bigemina* occurs are generally the drier parts of the country, such as the Western Transvaal. Tick control can be used in that area to reduce the risks of outbreaks but, because ticks *per se* are not considered a problem in most

of these parts, we consider it highly unlikely that such measures will be economically justified. Vaccination may be a more economical way of stabilizing the situation.

In conclusion, we should like to quote McCosker (1981). In this discussion of the global importance of babesiosis, he considered it "apparent that, if there is an economic justification for eradication of babesiosis by vector eradication, it is based solely on the economic importance of the tick".

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