RESEARCH COMMUNICATION

Progression towards endemic stability to bovine babesiosis in cattle introduced onto a game ranch

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ABSTRACT

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An opportunity to study progression toward endemic stability to *Babesia bigemina* arose when cattle were reintroduced onto a game ranch in 1999 after an absence of three years. The study was conducted between August 2000 and June 2001. The unvaccinated breeding cows were sampled only once. Calves born during October 1999 were initially vaccinated against *B. bigemina* and *Babesia bovis* at the age of 4 months and were then bled at 10, 17 and 20 months of age. Calves born during 2000 were bled at 7 and 8 months of age. Sera were collected from all the cattle sampled and later tested for antibodies against *B. bigemina* and *B. bovis* using the indirect fluorescent antibody (IFA) test. Although endemic stability to *B. bigemina* had not been achieved at Nooitgedacht 2 years after resumption of cattle ranching, the high seroprevalence in the unvaccinated 8-month-old calves suggested that the situation was approaching stability and that calf vaccination against bovine babesiosis was not required. Tick control should therefore be restricted to prevent excessive tick worry. Only vaccinated cattle were positive to *B. bovis* and it was concluded that the parasite was absent from the ranch.

Keywords: *Babesia bigemina, Babesia bovis,* bovine babesiosis, endemic stability, immunization, redwater, South Africa

Bovine babesiosis or redwater, caused by *Babesia bovis* and *Babesia bigemina*, results in serious economic losses worldwide (Carson & Phillips 1981; McCosker 1981). It is estimated that half a billion cattle in tropical and subtropical countries are at risk to babesiosis (Ristic & Levy 1981). Both *B. bigemina* and *B. bovis* occur in many areas of South Africa, coinciding with the distribution of their vectors (De Vos 1979). *Babesia bigemina* is transmitted by both *Rhipicephalus (Boophilus) decoloratus* and *Rhipicephalus (Boophilus) microplus* and has a much wider distribution than *B. bovis,* which is only transmitted by *R. (B.) microplus* (De Vos 1979). *Rhipicephalus (B.) microplus* is expanding its range in South Africa (Tønnesen, Penzhorn, Bryson, Stoltsz & Masibigiri 2004).

Bovine babesiosis is not an important cause of mortality in cattle in endemically stable situations (Norval, Fivaz, Lawrence & Dailecourt 1983). Endemic stability to bovine babesiosis occurs when the inoculation rate of *Babesia* by ticks into cattle is sufficiently high to infect virtually all calves while they are protected by colostral and innate immunity (Mahoney & Ross 1972). If the inoculation rate is low and calves are not infected during this period, then endemic instability and clinical disease

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results. According to the definition of Norval *et al*. (1983), an endemically stable situation occurs when 81–100 % of the herd are infected with a particular *Babesia* species.

An opportunity to study progression towards endemic stability in a newly introduced cattle population arose when cattle were reintroduced onto a 2 780-ha game ranch in 1999 after an absence of 3 years —the ranch had been managed solely for wildlife in the interim. The ranch (Nooitgedacht; 24° 33' S; 28° 36' E), in the Mokopane (previously Potgietersrus) district, Limpopo Province, South Africa, is hilly, with an average altitude of 1 380 m above sea level. The vegetation was classified as Sour Bushveld (Acocks 1988). The rainfall during the periods July 1999 to June 2000 and July 2000 to June 2001 was 1 000 mm and 670 mm, respectively.

The antelope population on Nooitgedacht comprised eland (*Taurotragus oryx*) (*n* = 26), gemsbok (*Oryx gazella*) (*n* = 21), red hartebeest (*Alcelaphus buselaphus*) (*n* = 30), blue wildebeest (*Connochaetes taurinus*) (*n* = 38), blesbok (*Damaliscus pygargus philipsi*) (*n* = 180), impala (*Aepyceros melampus*) (*n* = 200), greater kudu (*Tragelaphus strepsiceros*) (*n* = 60), nyala (*Tragelaphus angasii*) (*n* = 3), waterbuck (*Kobus ellipsiprymnus*) (*n* = 30), reedbuck (*Redunca arundinum*) (*n* = 28), mountain reedbuck (*Redunca fulvorufula*) (*n* = 20), grey duiker (*Sylvicapra grimmia*) (*n* = 40), steenbok (*Raphicerus campestris*) (*n* = 10) and klipspringer (*Oreotragus oreotragus*) (*n* = 10) (F.S.H. du Preez, personal communication 2000). Nooitgedacht ranch falls outside the known distribution of *R. (B.) microplus*. The *R. (B.) decoloratus* vector tick population on Nooitgedacht would probably have remained at fairly high levels even in the absence of cattle, as impalas and greater kudus, which were present in relatively large numbers, are preferred hosts for this species (Horak, Boomker, Spickett & De Vos 1992; Horak, Gallivan, Braack, Boomker & De Vos 2003).

From 1999 onwards the management objectives at Nooitgedacht were to produce Brahman steers and to run a Brahman stud. The founding cattle breeding stock were obtained from Kareefontein ranch, 100 km south of Nooitgedacht, an area where *Babesia bigemina* was endemic. The cattle were not dipped or treated with antibabesial drugs before being moved. We were unable to ascertain what the level of infection in the herd had been at the time of introduction. Outbreaks of clinical babesiosis had not been recorded on Nooitgedacht ranch, however, and no clinical cases of the disease were reported during the study period (F.S.H. du Preez, personal communication 2001). Ticks on the cattle were controlled by hand-spraying with Bayticol (2 % flumethrin, Bayer), at irregular intervals, whenever the owner judged the tick burden to be excessive.

Our study commenced in August 2000, one year after cattle had been reintroduced to Nooitgedacht. The first calf crop (*n* = 30), born in October 1999, had been vaccinated against *B. bigemina* and *B. bovis* at the age of 4 months. The main objective of our study was to assess whether endemic stability to *B. bigemina* had been achieved in the newly introduced cattle population, but we also report on the effects of vaccinating against *B. bovis* in the 1999 calf crop. The study involved breeding cows, as well as calves born during October 1999 and October 2000. Cattle were selected for sampling by the simple random sampling technique (Thrusfield 1995). The breeding cows (*n* = 50) were sampled once only, when sampling was commenced in August 2000. The calves born during October 1999 were sampled when they were 10 months old (*n* = 49), and then re-sampled at 17 (*n* = 39) and 20 months (*n* = 30). The October 2000 calf crop was sampled at 7 months (*n* = 47) and 8 months (*n* = 20) of age.

The cattle were restrained with a neck-clamp and blood was collected aseptically from the caudal vein into 10 mℓ plain Vacutainer tubes (Sherwood Medical) using 20-gauge needles (Becton Dickinson). At the laboratory, the tubes were centrifuged and the serum decanted. The sera were then frozen and stored at the Department of Veterinary Tropical Diseases until they were transferred to the Onderstepoort Veterinary Institute, where serological testing was performed. All serum samples were tested for the detection of antibodies against *Babesia bigemina* using standard indirect fluorescent antibody test (IFAT) procedures (Anon. 2000).

Data generated from the work were recorded and analyzed by means of the SAS statistical package, Version 8.1. Comparative analyses were carried out using the chi-square test.

The prevalence of antibodies to *B. bigemina* and *B. bovis* in vaccinated and unvaccinated cattle of various age groups is shown in Fig. 1.

Seventeen percent of the 7-month-old calves were seropositive to *B. bigemina*. Twenty-eight days later (at the age of 8 months), this had increased significantly to 70 % (χ^2 = 10.1411, P = 0.0015).

The prevalence of antibodies to *B. bigemina* in 10- and 17-month-old cattle did not differ significantly (χ^2 = 0.9594, P = 0.3273), while the 10-month-old

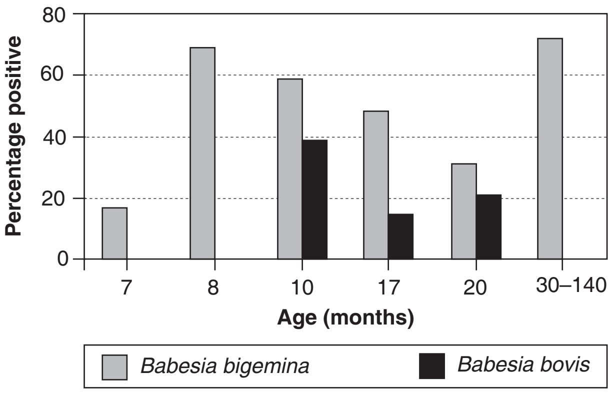

FIG 1. Prevalence of antibodies against *Babesia bigemina* and *Babesia bovis*, as determined by IFA test, in vaccinated (10-, 17- and 20-month-old) and unvaccinated (7-, 8- and 30–140-month-old) Brahman cattle at Nooitgedacht ranch

calves had significantly higher antibody prevalence to *B. bovis* than the 17-month-old cattle ($\chi^2 = 5.8419$, $P = 0.0156$). The prevalence of antibodies to *B. bigemina* in 17- and 20-month-old cattle did not differ significantly ($\chi^2 = 2.1473$, $P = 0.1428$). This was also the case with prevalence of antibodies to *B. bovis* ($\chi^2 = 0.3221$, $P = 0.5704$).

Seventy-two percent of the breeding cows were seropositive to *B. bigemina* 1 year after being transferred to Nooitgedacht ranch and their serological status was significantly higher than that of the 20-month-old cattle, born on the ranch ($\chi^2 = 12.5644$, $P = 0.0004$). The breeding cows were all negative to *B. bovis.*

In endemically stable scenarios, the age incidence of *B. bigemina* parasitaemia is generally lower in older animals when compared with the younger ones (Mahoney 1969). Although the serological status of the breeding cows at the time of transfer to Nooitgedacht was unknown, this group retained a higher seroprevalence to *B. bigemina* than their calves. The breeding cows were probably the main source of *B. bigemina* infection to ticks after the reintroduction of cattle to the ranch. *Babesia bigemina* infections rarely persist for longer than a year, and infected cattle normally only remain infective to ticks for 4–7 weeks (Johnston *et al.* 1978; Mahoney 1969). Any loss of infection would contribute to a reduced parasite transmission rate, as fewer animals would serve as sources of infection to ticks. The antelope that remained on the ranch mingled freely with the cattle. As is the case with cattle, greater kudus and impalas (*ca* 260 on the ranch) are also preferred hosts of *R. (B.) decoloratus*. It seems likely, therefore, that a substantial number of larvae of this tick species attaching to cattle during the study period were the offspring of adults that had fed on antelope, and were therefore not infected with *B. bigemina*. The overall level of infection of the vector tick population would thus tend to be low.

In the vaccinated 1999 calf crop, which was sampled at the age of 10, 17 and 20 months, the seroprevalence to *B. bigemina* decreased with age. This may have been due to the loss of IFA antibody titres as a result of a low number of superinfections. Todorovic (1975) reported that cattle challenged with *B. bigemina*-infected blood reached peak levels of IFA reacting antibody titres 21 days post infection and the titres decreased gradually thereafter. De Vos (1977, unpublished data cited by De Vos 1979), also using the IFA test, found that 93 % of the cattle were positive to *B. bigemina* 2 months after vaccination, whilst only 60 % were still positive 19 months later. He observed that in the absence of adequate natural challenges, the titres of vaccinated cattle decreased and more cattle became seronegative.

The percentage of animals positive to *B. bovis* at the age of 10, 17 and 20 months declined with increasing age, probably due to loss of IFAT-reacting antibody titres in the absence of natural challenge. Using the IFAT, De Vos (1977, unpublished data cited by De Vos 1979) determined that seroprevalence in a vaccinated herd gradually decreased in the absence of adequate natural challenge: a herd that was 97 % positive to *B. bovis* 2 months post vaccination, was only 60 % positive 19 months later.

The unvaccinated 2000 calf crop showed a sharp increase in prevalence of antibodies to *B. bigemina* at 8 months, a situation approaching endemic stability. A similar trend was also observed in calves of the same age group in a trial conducted concurrently at another ranch in Limpopo Province (Regassa, Penzhorn & Bryson 2003). Mahoney (1969) found that the age incidence of *B. bigemina* parasitaemia rose from zero at birth, attained a maximum between 6 months and 2 years of age and then declined sharply in the older animals.

In summary, endemic stability to *B. bigemina* had not been achieved at Nooitgedacht 2 years after resumption of cattle ranching. The high seroprevalence in the unvaccinated 8-month-old calves suggested that the situation was approaching stability and that calf vaccination was not required. Tick control should therefore be restricted to prevention of excessive tick worry.

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