

A survey of the incidence and importance of the tick-borne diseases heartwater, redwater and anaplasmosis in the heartwater-endemic regions of South Africa

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ABSTRACT

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In an almost 50% response to a survey questionnaire, farmers in the heartwater-endemic regions of South Africa indicated that they were experiencing losses of 1,3, 0,3 and 0,2% in cattle due to heartwater, redwater and anaplasmosis, respectively. In small stock, the heartwater mortality was 3,8%. Only 35% of cattle farmers and 15% of farmers keeping sheep and goats, vaccinate their animals against heartwater. It would seem that the present vaccine does not control heartwater adequately and, with 9% of farmers claiming poor protection after immunization, it would be difficult to recommend wider use of the heartwater vaccine. Likewise, vaccination against redwater and anaplasmosis on 11,8 and 14,2% of farms, respectively, appears to have had no beneficial effect on the mortality rates of these diseases.

Many farmers still believe that very few or no ticks should be seen on cattle. In fact, it would appear that a considerable proportion of farmers find so few ticks on their cattle, that the frequency of acaricidal treatment is in many cases too high. Although there is no correlation between the incidence of heartwater and the intensity of tick control, there is also no serological evidence to support the possibility of an endemically unstable condition. The concept that endemic stability as a means to control heartwater in cattle can be achieved by allowing more ticks on animals, has not yet been established.

The overall impression is that farmers do not regard heartwater in cattle as such a serious problem as it is generally believed to be. In small stock, however, heartwater is a severe constraint in the bushveld regions of the Transvaal and in the valley bushveld of the eastern Cape Province. In the latter, it is particularly Angora goats that are affected.

INTRODUCTION

It is often reported by state and private veterinarians, and also by farmers, that heartwater is one of the most worrying tick-borne disease in regions of South

Africa where the tick vector, *Amblyomma hebraeum*, occurs. However, there are no recent accounts of the actual losses experienced and, therefore, of the true economic impact of the disease. There are also many publications on the causal agent, *Cowdria ruminantium*, the vertebrate and tick hosts, the clinical and pathological manifestations and the epidemiology of the disease. Research workers believe they know on

which problems to focus their research, but little is known of the importance attached to the disease by the farmer, and of his attitude towards control measures. Information of this nature may be helpful in identifying and planning meaningful future research projects.

In order to obtain information on the incidence of the three tick-borne diseases and the measures taken by farmers to control them, a selected group of farmers in the heartwater-endemic regions of South Africa were asked to return a questionnaire on the risk potential of these diseases, vaccination procedures and tick-control programmes implemented against them.

MATERIALS AND METHODS

The survey questionnaire used, was based on a questionnaire designed to investigate tick-control practices in the eastern Cape Province of South Africa (Spickett & Fivaz 1992b), and was adapted to emphasize the incidence and control of the tick-borne diseases, heartwater, redwater and anaplasmosis. In addition to direct questions to establish the names and localities of farms, and the assessments, judgments and personal opinions of the farmers, multiple-choice questions were also included to establish:

- The losses and numbers of clinical cases due to the diseases in cattle and small stock.
- The extent to which vaccines against these diseases were used and how effective they were.
- The manner of tick control practised by producers, particularly with regard to the type of acaricide used, and the technique and frequency of application.

State veterinarians in northern, north-western and eastern Transvaal, Natal and the eastern Cape were asked to submit the names of leading farmers in their regions. A total of 265 questionnaires were dispatched, 127 of which were returned from the magisterial districts indicated in Fig. 1. Since heartwater is confined to those areas where the tick vector *A. hebraeum* occurs, questionnaires from these regions only, were taken into consideration and none from babesiosis- and anaplasmosis-endemic regions where heartwater does not occur.

RESULTS AND DISCUSSION

The results are based on the 127 returns involving 67 525 cattle (27 333 cross-bred beef cattle, 15 030 Bonsmara, 11 311 Friesian, 9 109 Brahman, 2 630 Drakensberger, 1 330 Simmentaler and 782 Jersey) and 44 558 small stock (Angora goats, Boer goats and sheep). Farmers were asked to furnish data recorded during the course of 1993.

Incidence of heartwater, redwater and anaplasmosis

Mortalities due to heartwater amounted to 1,3% in cattle and 3,8% in small stock. Over the same period 0,3% cattle died from redwater and 0,2% from anaplasmosis (Fig. 1). The majority of these animals, as can be expected, were older than 6 months. In cases where farmers mentioned the ages of the animals lost from these two diseases, however, 8,3% and 16% of deaths due to redwater and anaplasmosis, respectively, occurred in calves younger than 6 months of age. It must be pointed out that the regions in South Africa covered by the questionnaire do not include those where anaplasmosis and particularly redwater are most prevalent. The ratio between mortalities due to heartwater and those due to redwater and anaplasmosis therefore does not reflect the overall situation in the country. The higher incidence of heartwater is in agreement with an earlier observation by Neitz (1968) that in regions where these three diseases occur endemically, the mortality rate due to heartwater is three times that of redwater and anaplasmosis combined.

A further 3,1% of cattle and 5,6% of small stock showed clinical signs attributed to heartwater and were treated with tetracyclines (Fig. 2). A further 1% and 0,8% of cattle were likewise treated for redwater and anaplasmosis, respectively. Sixty-eight per cent of the cattle and 48% of the small stock treated for heartwater, recovered.

Camus & Barré (1988) cite several authors who maintain that heartwater is an important tick-borne disease (Neitz 1968; Uilenberg 1983; Da Graça 1964), but few authors furnish mortality and morbidity rates. In the present study, the mortality rate in cattle is only slightly higher than the 44 mortalities in 1 000 adult cattle over the age of 4 years in the northern Transvaal, as recorded by Neitz & Alexander (1945), but lower than the average annual mortality rate of 1,9% recorded and confirmed in a Hereford herd over the course of 6,5 years in the same region (Du Plessis, Look & Lüdemann 1992).

Although leading farmers were selected for this survey, the accuracy of these mortality and morbidity figures is not altogether beyond doubt, since only 4% of the producers indicated that the diagnoses, both at post-mortem and clinically, had been made by a veterinarian. In all other cases, it had been made by the producers themselves. This is a surprisingly low percentage, but perhaps it also reflects the farmers' confidence in their ability to recognize the disease.

Acaricide usage and treatment frequency

By far the greatest number of farmers (66,1%) use synthetic pyrethroids, the formamidines and pyrethroid/organophosphate combinations being the second most utilized groups of acaricides (both at 15%),

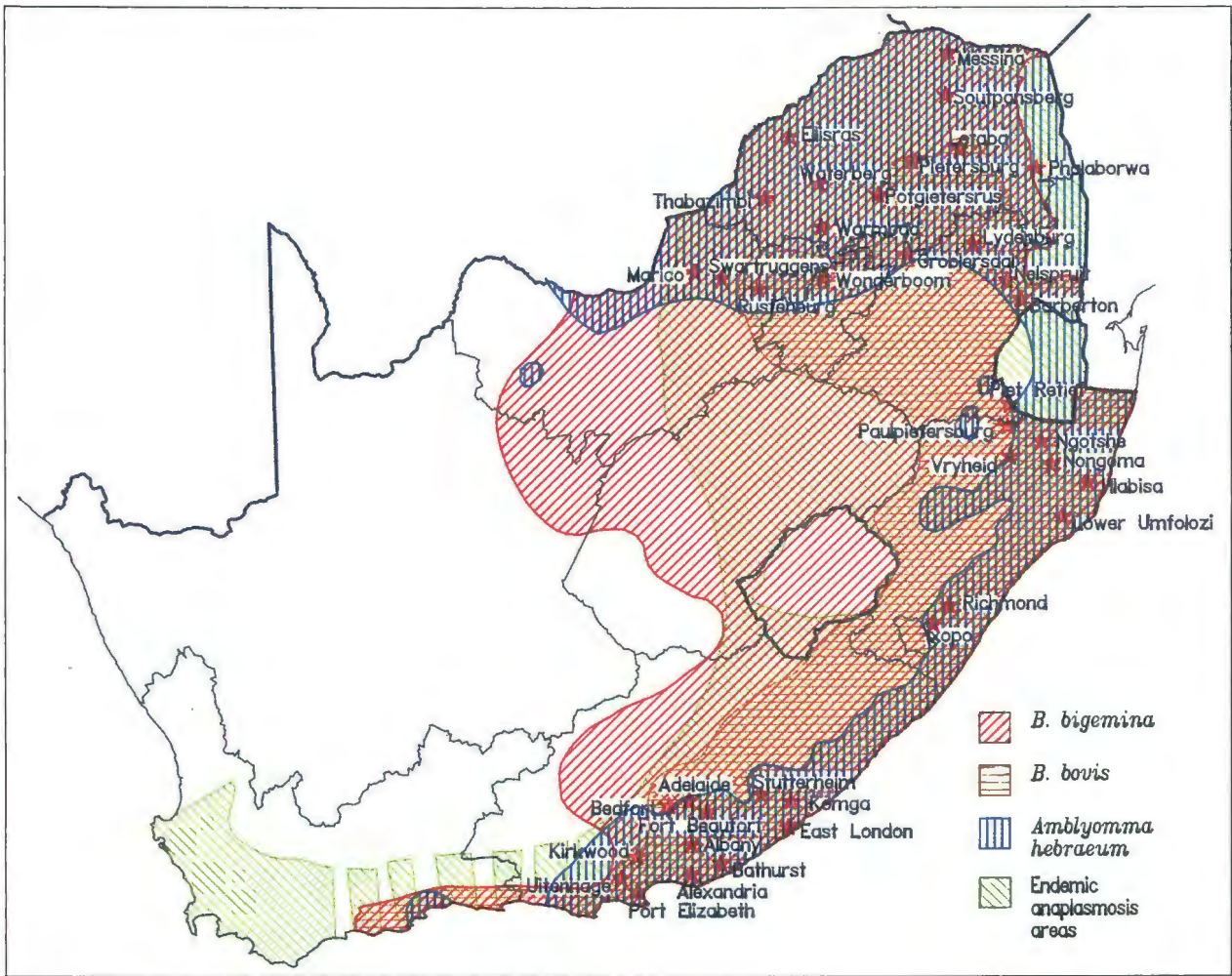


FIG. 1 The distribution of heartwater (*Amblyomma hebraeum*), redwater (*Babesia bigemina* and *B. bovis*) and anaplasmosis in South Africa and the districts from which questionnaires were returned

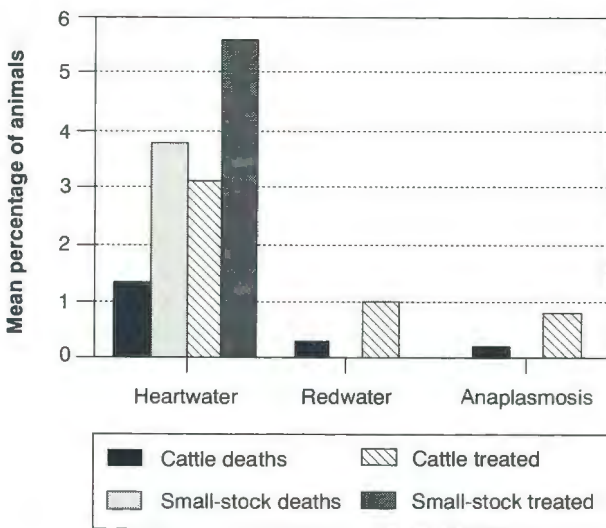


FIG. 2 Mean heartwater, babesiosis and anaplasmosis mortalities and clinical cases treated in cattle and small stock

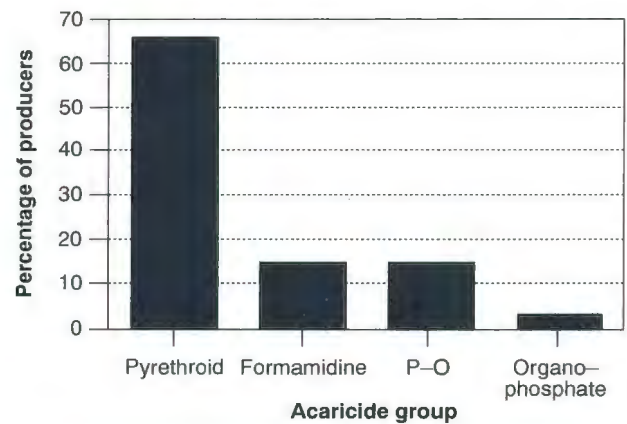


FIG. 3 Relative percentage preference for the different acaricide groups (P-O = pyrethroid-organophosphate combination) as displayed by acaricide usage

while only 3,6 % of farmers use organophosphates (Fig. 3). These findings largely confirm an earlier study confined to the eastern Cape (Spickett & Fivaz 1992b), in which it was found that 62,3 % of cattle farmers used synthetic pyrethroids, but a larger percentage producers used the formamidines (24,8 %), and considerably fewer (4,6 %), the combination compounds.

The highest percentage of cattle farmers in this survey treat their animals 21–25 times per annum (p.a.) (Fig. 4), whereas the majority (34,8 %) of small-stock farmers treat their sheep and goats less than six times p.a. (Fig. 5). Thirty-four per cent of cattle farmers treat their animals more than 25 times p.a. and 44,5 % less than 16 times p.a. These findings are in agreement with those of Spickett & Fivaz (1992b) in that they also found that the highest percentage of beef-cattle farmers treat 21–25 times p.a., but they found that a larger percentage of farmers treated their animals more often than 25 times p.a. than less than 16 times p.a.—the inverse of the present survey. The more intensive tick control applied in the eastern Cape Province can probably be ascribed to the greater abundance of ticks in this region, as compared to that in the Transvaal (with the exception of the eastern Transvaal), where the majority of the farmers questioned in this survey, are located. Small-stock farmers apply tick control much less stringently, since only 13 % of farmers treat their animals more than 25 times p.a., as against 71,8 % who treat less than 21 times p.a. This trend is again in agreement with the findings in a survey conducted in the eastern Cape (Spickett & Fivaz 1992a).

Vaccination against the tick-borne diseases and tick control

Only 35,4 % of cattle farmers vaccinate their calves against heartwater within 4 weeks after birth, while 11,8 and 14,2 % vaccinate calves against redwater and anaplasmosis, respectively (Fig. 6), at approximately 6 months of age or older. Fifty-five and 56 %, respectively, of producers that vaccinate, prefer to use the unfrozen rather than the frozen redwater and anaplasmosis vaccines, respectively. Nine per cent of farmers stated that they had at some stage in the past practised calf vaccination against heartwater, but that they had ceased to do so, chiefly because they considered it to be ineffective. In the eastern Cape Spickett & Fivaz (1992b) found that even fewer producers made use of vaccines against heartwater and redwater, possibly because dairy cattle (which formed a considerable part of the cattle population they studied) are vaccinated even more seldomly.

The view held by some farmers, that heartwater immunization in calves is not beneficial, appears to be substantiated by a comparison of the heartwater mortalities experienced by 45 farmers who do, and

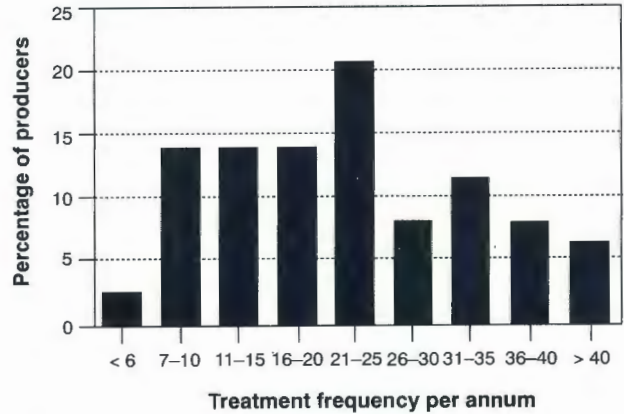


FIG. 4 The acaricide treatment frequency practised by cattle farmers

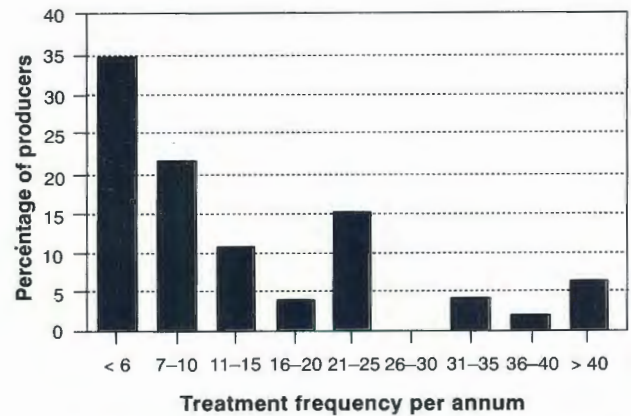


FIG. 5 The acaricide treatment frequency practised by small-stock farmers

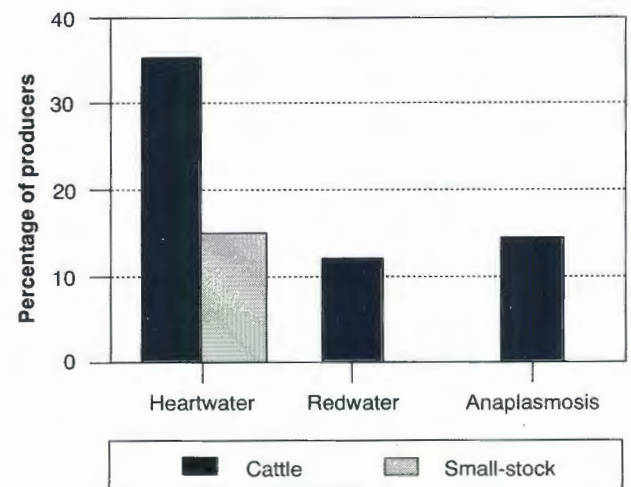


FIG. 6 Percentage of producers practicing vaccination against heartwater, babesiosis and anaplasmosis

TABLE 1 Heartwater, redwater and anaplasmosis mortality rates experienced by farmers practising and not practising calf vaccination in relation to frequency of acaricidal treatment

Frequency intervals of acaricidal treatment applied p.a.	Calves vaccinated						Calves not vaccinated					
	No. of farms			Mean mortality rate			No. of farms			Mean mortality rate		
	H	R	A	H	R	A	H	R	A	H	R	A
≤ 10	9	3	3	2,0	1,8	0,3	17	13	13	0,5	0,1	0,2
11-15	8	1	1	2,2	1,6	1,4	9	14	13	0,6	0,2	0,4
16-20	7	3	3	1,4	0,4	0,1	10	12	13	0,5	0,4	0,3
21-25	7	2	3	1,4	2,3	0,8	18	21	20	0,9	0,2	0,1
26-30	5	2	2	1,4	0,2	0,4	5	6	8	2,2	0,1	0,0
31-35	3	2	1	0,7	0,8	0,7	11	14	13	1,5	0,4	0,2
36-40	1	1	2	1,4	1,1	0,6	8	5	5	1,9	0,2	0,3
> 40	5	2	3	2,6	0,9	0,9	4	6	6	2,5	0,5	0,3
Mean rate for all vaccinated and non-vaccinated animals				1,6	1,1	0,7				1,3	0,3	0,2

H = heartwater

R = redwater

A = anaplasmosis

82 who do not, practise vaccination (Table 1). Not only was there no beneficial effect from vaccination, but the mean heartwater mortality rate experienced by farmers practising vaccination (1,6%) was higher than that of farmers not vaccinating (1,3%). It is interesting to compare the mortality rates of the two groups with the frequency of acaricidal treatment applied (Table 1).

- *Where calf vaccination is practised*, there is virtually no difference between the mean heartwater mortality rate (1,8%) on 31 farms where acaricidal treatment is applied 10-25 times p.a., and that (1,6%) on 14 farms where treatment is applied 26 to more than 40 times p.a.
- *Where calf vaccination is not practised*, the mean mortality rate in the lower frequency range of treatment is markedly lower (0,6%) than the rate in the higher frequency range of treatment (2%). This would suggest, firstly, that more intensive acaricidal treatment impedes the acquisition of immunity by calves, resulting in more deaths and clinical cases and, secondly, that vaccination may, after all, have a stabilizing influence under conditions where stringent tick control is practised.

When the effect of the vaccination of calves on the heartwater mortality rate is considered, the exposure of calves to ticks during the first few months after birth should also be borne in mind. On 72 farms, calves were not subjected to acaricidal treatment for 1-2 months after birth, in order that they might intentionally be exposed to ticks (Table 2). On 27 of these farms where vaccination is practised, a mean heartwater mortality rate of 1,6% was recorded, compared to only 0,5% on 45 farms where calves were not immunized. On the other 45 farms, where the calves were not exposed to ticks, there was no marked dif-

TABLE 2 Heartwater mortality experienced by farmers practising and not practising calf vaccination in relation to whether or not calves are intentionally exposed to ticks

Vac. practised	Calves exposed to ticks		Calves not exposed to ticks	
	No. of farms	Mean heart-water mortality	No. of farms	Mean heart-water mortality
Yes	27	1,6	18	2,0
No	45	0,5	27	1,6
Total	72		45	

ference between farms where vaccination was practised and those where it was not practised. It is difficult to explain why the combined effect of vaccination and early exposure to ticks is so ineffective, but it is certainly no recommendation for the vaccination of calves. What is significant, is that the lowest mortality rate of only 0,5% was experienced on farms where non-vaccinated calves were intentionally exposed to ticks. These findings are in agreement with the results of earlier experiments in which it was found that no benefit was derived from vaccinating Afrikaner-cross calves in a heartwater-endemic area (Du Plessis, Bezuidenhout & Lüdemann 1984).

As for *redwater and anaplasmosis*, 16 and 18 farmers, respectively, of those who responded, vaccinate their calves against these diseases, while 91 do not vaccinate against either of these two diseases (Table 1). With redwater and anaplasmosis, as in the case of heartwater, the mean mortality rates for vaccinated animals were 1,1% and 0,7% respectively, which is distinctly higher than the 0,3% and 0,2% on the

91 farms where vaccination is not practised (Table 1). Although this suggests that vaccination is of doubtful value, the possibility must be borne in mind that vaccination is practised on those farms where redwater and anaplasmosis constitute a risk, and that the incidence on farms not practising vaccination is low in any case. The question arises, however, why vaccination does not reduce the mortality rates on these farms where calves are vaccinated.

Contrary to the finding in heartwater, there is no difference between the redwater- and anaplasmosis-mortality rates on farms where acaricidal treatment is applied 10–25 times p.a., and the mortality rates on farms where treatment is more stringent (26 to more than 40 applications p.a.), irrespective of whether immunization is practised or not.

Assessment of tick control and incidence of heartwater

An attempt was made to assess the tick control practised by each farmer, in relation to the incidence of heartwater on his farm. In a letter of acknowledgement and appreciation of questionnaires returned, it was suggested that the farmer consider whether his tick control was adequate or perhaps too severe. In the absence of other data, such as the immune status of animals based on serology, no attempt was made to make specific recommendations.

The incidence of heartwater (mortality and clinical cases) and the frequency of acaricidal treatment in relation to the geographical region, were the main considerations. Where the combined mortality and morbidity rates exceeded 3%, and treatment was applied more than ten times p.a., in all regions of the Transvaal except the eastern part, it was suggested that the breeder consider allowing more ticks on his cattle by treating them less frequently. This frequency of treatment was based on the finding that, during the same dry spell of several years in this region, cattle had to be dipped only 3–4 times p.a. to ensure an average tick load of ten *A. hebraeum* adults per animal, the approximate number of ticks necessary to ensure a nearly 100% infection rate in calves before they were 6 months old (Du Plessis *et al.* 1992). In the remainder of the heartwater-endemic areas, a reduction in the treatment frequency was recommended only if cattle were treated more than 20 times p.a., and heartwater incidence exceeded 3%.

Since very few producers (12%) were able to state the precise number of ticks that they would allow on their cattle, an indication by a farmer that he would allow only a low infestation level was considered sufficient evidence to suggest less stringent tick control.

Taking these criteria into account, 70 out of the 127 farmers were advised to consider allowing more ticks on their cattle. Farmers applying acaricidal treatment

more than 30–40 times p.a., and indicating that they allow no ticks or only a few, were advised that since a large proportion of their herds was probably susceptible to heartwater, it was inadvisable to change their tick-control programme without prior serology and the use of the vaccine, particularly where exogenous cattle breeds were concerned.

Farmers were also advised not to treat calves under the age of 2 months with acaricides, unless there was real evidence of a tick problem. A very real risk in not treating calves for ticks, is losses due to sweating sickness. In this survey, no less than 38% of farmers indicated that, to a greater or lesser extent, they were experiencing problems with this disease.

Heartwater in small stock

Data were received of a total of 44 558 sheep and goats in flocks varying in size from 20–10 200. While the overall heartwater mortality rate was 3,8% (Fig. 1), an interesting observation was that on 43 farms with flocks smaller than 300 animals, 11,9% of sheep and goats succumbed to heartwater, whereas on 18 farms in the eastern Cape Province, with flocks of 300–10 000 animals, the mortality rate was only 2,8%. Another 5,6% of small stock showing clinical signs of what was suspected to be heartwater, were treated and had a recovery rate of 48%. Mortalities occurred in almost equal numbers in animals of all ages from under 6 months of age to older than 18 months.

The acceptability and efficacy of the heartwater vaccine is even poorer in the case of small stock than in that of cattle. Only nine out of 61 (15%) farmers vaccinate their lambs and kids before the age of 3 weeks. The average mortality rate on the nine farms, (all of them with flocks smaller than 300) was 19,7%, which is considerably higher than the 11,9% recorded on all of the 43 farms with flocks smaller than 300 animals. On none of the 18 farms in the eastern Cape Province with flocks of 300–10 000 animals, where an average heartwater mortality rate of 2,8% was recorded, is heartwater immunization practised.

There may be several reasons for this unsatisfactory state of affairs: the immunization procedure might not have been carried out correctly, the Ball 3 stock of *C. ruminantium* used in the vaccine might not have protected against the tick-borne stock with which the animals were challenged (Du Plessis, Van Gas, Olivier & Bezuidenhout 1989), or the sheep and goats might not have been exposed to infected ticks soon enough or not at all after having been vaccinated as lambs and kids. These smaller flocks of sheep and goats, mainly confined to the Transvaal bushveld, are usually kept on pastures or old lands close to the homestead where there are few ticks or none at all. Since it is inevitable that these animals will sooner or later become exposed to infected ticks, mortalities and morbidity are high in the absence of adequate immunity.

Although the majority of small-stock farmers in the eastern Cape Province who have flocks of 300–10000 animals do not experience heavy losses, there are others, particularly Angora-goat farmers in the "valley bushveld", who suffer serious losses from heartwater. One example will suffice to illustrate the seriousness of the problem. A particular farmer in the eastern Cape valley bushveld, keeps 9 000 Angora goats and 1 200 Dorper sheep under excellent management conditions. During the course of one year he lost 472 animals (4.6%) from heartwater. Of these, 185 were 6–18 months old, and 279 were older animals, the majority of which were Angora goats. Following outbreaks of heartwater in his goats, he attempted vaccination, but with little success. An experiment on the farm, conducted by veterinarians, in which 90 Angora goats were vaccinated, revealed that when these animals were challenged with the homologous stock one month later, they were immune. When they were exposed to a tick challenge, however, several animals died, and several more showed clinical signs of the disease 3–4 months after vaccination. To prevent further losses, the farmer was obliged to immediately treat the whole experimental group (B.J. Zietsman & L. Kritzing, personal communication).

This apparent inability of the Angora goat to mount an adequate immune response to immunization, is in accordance with an earlier finding that, with regard to *C. ruminantium*, these animals are immunologically incompetent (Du Plessis, Jansen & Prozesky 1983). As a result of the poor response to immunization, and after careful consideration of all the relevant cost factors, this farmer has resorted to the laborious and costly practice of dipping his goats at monthly intervals and treating all animals with tetracyclines every 10 d. He stated that he would prefer to keep his animals free of ticks, but with some 1 000 kudus (*Tragelaphus strepciseros*), a favoured host to *A. hebraeum* in the eastern Cape Province (Horak, Boomker, Spickett & De Vos 1992), on his farms, this is practically impossible, irrespective of the stringency of the tick control.

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