Onderstepoort J. vet. Res. 58, 71–74 (1991)

THE EFFECT OF TICK INFESTATION ON THE PRODUCTIVITY OF COWS OF THREE BREEDS OF CATTLE

M. M. SCHOLTZ[1], A. M. SPICKETT[2], P. E. LOMBARD[1] and C. B. ENSLIN[1]

ABSTRACT

SCHOLTZ, M. M., SPICKETT, A. M., LOMBARD, P. E. & ENSLIN, C. B., 1991. The effect of tick infestation on the productivity of cows of three breeds of cattle. *Onderstepoort Journal of Veterinary Research* 58, 71–74 (1991).

The effect of tick infestation of Hereford, Bonsmara and Nguni cows on the weaning masses of their calves in a dipping versus non-dipping situation was investigated. Breed had a major effect on the level of tick infestation, Herefords being most susceptible and Ngunis least. The productivity of Nguni cows, as measured by the weaning masses of their calves was also least affected. The effect of infestation on the productivity of Hereford cows was the greatest and that on the Bonsmara cows was intermediate. It was estimated that each engorged female tick (predominantly *Boophilus decoloratus*) caused a reduction of 8,9 g, 8,0 g and 8,6 g in the weaning masses of calves from Hereford, Bonsmara and Nguni cows respectively. The effect of infestation on the productivity of the Nguni cows was nevertheless small because a limited number of ticks fed to maturity on this breed due to its natural resistance.

INTRODUCTION

Cattle are the most important livestock species in Africa and account for approximately 70 % of its domestic stock (Leng & Brumby, 1985). In 1986 there were approximately 177 million cattle in Africa (Sullivan, 1990). Large numbers of these animals are treated with acaricides frequently in an attempt to contain tick-borne diseases and on the general assumption that the numerous tick species present cause losses in productivity (Norval, Sutherst, Kurki, Gibson & Kerr, 1988a). However, the wisdom of intensive dipping of cattle in Africa has been questioned in recent times (Norval, 1981; Sutherst, 1981; Tatchell, 1981). This view is substantiated by the success and availability of tick-resistant cattle in Australia (Wharton, 1976; Hewetson, 1981) and southern Africa (Bonsma, 1981, Scholtz, Lombard, De Bruin, Enslin & Spickett, 1989; Spickett, De Klerk, Enslin & Scholtz, 1989; Rechav, Dauth & Els, 1990). It has also been supported by the major losses caused by the onset of disease epidemics in Africa, after the loss of endemic stability when intensive dipping has been disrupted (Norval *et al.*, 1988a).

Tick infestation can reduce live mass gains and milk yield of cows. However, limited data are available on the extent of such losses, and therefore it is impossible to design economic and efficient control programmes (Norval *et al.*, 1988a). Norval *et al.* (1988a) estimated the mean damage caused by each adult female *Rhipicephalus appendiculatus* (brown ear-tick) counted on an animal in Africa to be 4,4 ± 0,8 g loss in live mass gain. Other results indicate a loss of about 0,6 – 1,5 g for the one-host tick *Boophilus microplus* (blue-tick) in Australia (Sutherst, Maywald, Kerr & Stegemen, 1983) and approximately 10 g for *Amblyomma hebraeum* (bont-tick) (Norval, Sutherst, Jorgenson, Gibson & Kerr, 1988b) in Africa.

Nkoni cattle (equivalent to Nguni cattle of South Africa), avoid damage by preventing a very large proportion of ticks which attach from feeding to maturity. The mean loss in productivity caused by each tick that does feed to maturity on these animals is the same as that caused in susceptible *Bos taurus* cattle (Norval *et al.*, 1988a).

Spickett *et al.* (1989) conducted a study in which the resistance of Nguni, Bonsmara and Hereford cattle to ticks in a bushveld region of South Africa was determined. Although that study was designed to determine tick resistance, data collected during the experiment enabled us to evaluate the effect of tick infestation on the subsequent performance of cows of the 3 breeds as displayed by the weaning masses of their progeny. These data are presented in the present paper.

MATERIALS AND METHODS

All experimental procedures were conducted on the farm Loskop South (29° 20′ S, 25° 18′ E) situated in a Bushveld region south-east of Groblersdal in the south-eastern Transvaal. The vegetation can be described as tree savannah consisting of fairly dense bush as well as sourgrass types which form the main grazing component (Acocks, 1975). Rainfall varies between 350 and 650 mm per year.

The Hereford is a British breed of cattle *(B. taurus)* originating from Herefordshire in England. The Bonsmara is a composite breed developed from crosses between the Afrikaner, an improved indigenous breed originating principly from the cattle of the Khoikhoin people from the west coast of southern Africa, and exotic breeds (Shorthorn and Hereford). Sanga cattle, which according to Meyer (1984), should be classified as *Bos taurus africanus,* were originally found along the east coast of southern Africa, and are known as the Nguni. The east coast is climatically one of the most trying and disease ridden cattle farming regions in southern Africa.

Animals from the three breeds were introduced onto the farm at 18 months of age (May 1982). They were never dipped in an acaricide until they reached the age of 3½ years (June 1984). The udders of all the heifers were patch-treated with acaricidal ointment at 2-weekly intervals during periods of peak infestation to prevent udder damage and teat losses. The levels of tick resistance exhibited by the 3 breeds for the first two years of the study have been reported by Spickett *et al.* (1989). Fourteen Hereford (7 heifers, 7 bulls), 15 Bonsmara (8 heifers, 7 bulls) and 15 Nguni (7 heifers, 8 bulls) animals were available for the present study. During December 1982–January 1983 all the females ran for 45 days with the same Nguni bull. During the 1983 calving season, 5 calves were born to Hereford, 6 to Bonsmara and 5 to Nguni cows. From October 1983–April 1984, when the calves were weaned, tick counts were done

[1] Animal and Dairy Science Research Institute, Private Bag X2, Irene 1675, South Africa

[2] Veterinary Research Institute, Onderstepoort 0110

Received 17 January 1991—Editor

on a monthly basis on the adult animals. All successful female ticks were recorded according to species as described by Spickett *et al.* (1989).

During December 1983–February 1984 all the females again ran with the same Nguni bull as used previously for 75 days. In June 1984 the original experimental bulls were discarded, and the females transferred to the farm herd, where they were dipped every three weeks with a pyrethroid acaricide. Five calves from each of the 3 breeds were born during the calving season of 1984.

Twenty Nguni females of the same age group as the experimental cows, were available from the farm herd as a control group and were dipped every three weeks during both seasons. This group gave birth to 15 calves in 1983 and 13 in 1984. No tick counts were carried out on the control group. All calves were regularly mass-measured as for the Phase D test of the Bull Testing Scheme and the 205 day weaning mass used as criterion for cow production.

The data collected were analysed with the LSML 76 computer programme of Harvey (1988). Corrections were made for the following fixed effects where appropriate:

Sex of calf (male, female)

Sexual or physiological status [subfertile heifer (mated heifer that did not conceive), lactating cow, bull]

Breed (Hereford, Bonsmara, Nguni).

Results and Discussion

Tick counts

Tick counts were divided into one-host *(Boophilus decoloratus)* and multi-host ticks *(A. hebraeum; Hyalomma truncatum; Rhipicephalus evertsi evertsi)*. The incidence of multi-host engorged female ticks was very low and averaged 0,8; 0,8 and 0,4 ticks per count on the Hereford, Bonsmara and Nguni cows respectively.

The mean number of one-host *B. decoloratus* (blue tick) per count on the 3 breeds, corrected for sexual or physiological status, are presented in Table 1. Very high infestations of *B. decoloratus* were experienced during the months of October, November and December. The counts were, therefore, separated into a peak infestation period (October, November, December) and infestation over the whole suckling period (October–April). Breed had a very marked effect on tick infestation, the Herefords being most susceptible and the Ngunis the least.

TABLE 1 Mean numbers of one-host tick *(Boophilus decoloratus)* per count and **F-values** for comparison of burdens on Hereford, Bonsmara and Nguni cows

Peak infestation period			
		Hereford	Bonsmara
	Mean numbers of ticks	37,4	24,1
Bonsmara	24,1	**10,62*** **	—
Nguni	5,3	**61,47*** **	**22,27*** **
Infestation over whole suckling period			
		Hereford	Bonsmara
	Mean numbers of ticks	15,3	9,9
Bonsmara	9,9	**9,76*** **	—
Nguni	1,9	**57,42*** **	**20,47*** **

*** = significant difference at 1 %

The mean number of *B. decoloratus* per count for subfertile heifers (heifers that were mated, but did not conceive), lactating cows and bulls, corrected for breed effects, are presented in Table 2. There were no differences in tick infestation level between lactating cows and bulls. Subfertile heifers, however, had much higher tick burdens than lactating cows and bulls, suggesting that these heifers were either highly susceptible to tick infestation because of their physiological status, or that they did not conceive because of high tick burdens.

TABLE 2 Mean number of one-host tick *(Boophilus decoloratus)* per count and **F-values** for comparison of burdens on subfertile heifers, lactating cows and bulls

Peak infestation period			
		Subfertile heifer	Lactating cow
	Mean numbers of ticks	36,6	14,6
Lactating cow	14,6	**17,62*** **	—
Bull	15,6	**17,34*** **	**0,08*** **
Infestation over whole suckling period			
		Subfertile heifer	Lactating cow
	Mean numbers of ticks	5,0	5,7
Lactating cow	5,7	**17,22*** **	—
Bull	6,6	**15,09*** **	**0,36*** **

*** = significant difference at 1 %

Table 3 summarizes the tick counts recorded during the mating season (December 1982–January 1983) for heifers that conceived and heifers that did not. There were no differences in tick infestation between these 2 groups during this period. Consequently the difference in tick burdens between lactating cows and subfertile heifers seems to be as a result of physiological status.

TABLE 3 One-host and multi-host tick burdens during the mating season of 1982–1983 on heifers that subsequently conceived and heifers that did not

Tick numbers	Heifers that conceived	Heifers that did not conceive	F-value
One-host ticks	113,9	113,2	0,00
Multi-host ticks	14,5	18,0	1,38

Weaning mass

The 205 day weaning masses of calves, corrected for sex, from cows of the 3 breeds and from the Nguni control group for the seasons 1983/84, when the animals were not dipped, and 1984/85 when the animals were dipped, are presented in Tables 4 and 5 respectively. The Nguni control group were dipped every 3 weeks during both seasons.

With no dipping, the Hereford cows weaned calves with a significantly lower body mass than those of the other 2 breeds. There were no significant differences between the weaning masses of calves from the undipped Bonsmara and Nguni cows. The masses of calves from the Nguni control group were approximately 7 kg greater than calves

TABLE 4 The 205 day weaning masses (kg) of calves from cows of 3 breeds for the 1983/84 season when the experimental animals were not dipped and **F-values** for comparison of weaning masses

	Weaning mass	Hereford 137,0	Bonsmara 166,5	Nguni 164,7
Bonsmara	166,5	**4,08***	—	
Nguni	164,7	**3,29***	**0,02**	—
Nguni controls	171,9	**4,42****	**0,17**	**0,28**

* = significant difference at 10 %

** = significant difference at 5 %

TABLE 5 The 205 day weaning masses (kg) of calves from cows of 3 breeds for the 1984/85 season when the animals were dipped at three-weekly intervals and **F-values** for comparison of weaning masses

	Weaning mass	Hereford 180,8	Bonsmara 199,7	Nguni 175,2
Bonsmara	199,7	**10,71*****	—	
Nguni	175,2	**2,88**	**19,57****	—
Nguni controls	186,5	**1,41**	**7,17****	**2,01**

** = significant difference at 5 %

*** = significant difference at 1 %

from the undipped Nguni group, but this difference was not significant.

When all the animals were dipped during the 1984/85 season there were no significant differences between the weaning masses of calves from the Nguni and Hereford cows (Table 5). The Bonsmara cows, however, weaned calves with a significantly greater body mass than calves from the other 2 breeds.

Tick infestation had only a minor effect on the productivity of Nguni cows as measured by the weaning masses of their calves (Table 4 and 5). The effect of tick infestation on the productivity of Hereford cows seems to be much more severe, whilst the effect on Bonsmara cows seems to be intermediate. Furthermore, the information in Tables 4 and 5 can be used to quantify the effect of tick infestation on the productivity of cows of these 3 breeds.

The weaning masses summarized in Table 5, compared to those in Table 4, are not only influenced by dipping, but also by the season and the fact that the cows were a year older. These season and age effects could not be separated and they were treated together as a "season-age" effect. The weaning masses of calves from the Nguni control group were used to estimate a correction factor for the "season-age" effect. Since calves from this group had a weaning mass of 171,9 kg in the first "season-age" combination (Table 4) and 186,5 kg (Table 5) in the second, the effect of the second "season-age" was estimated to be 7,8 % [(1–171,9/186,5) × 100]. The weaning masses of calves from the 1984/85 season were therefore reduced by 7,8 %, which implies a multiplicative correction for the "season-age" effect.

A comparison between the weaning masses of the 1983/84 season (no dipping) and the "season-age" corrected weaning masses of the 1984/85 season (dipping every three weeks) is presented in Table 6. Dipping resulted in a significant increase in the weaning mass of calves from the Hereford (29,5 kg) and Bonsmara (17,6 kg) cows, whilst there was no

TABLE 6 Comparison between the weaning masses (kg) of calves in a non dipping situation and when dipped every three weeks

Breed	No dipping	Dipping	Difference
Hereford	137,2	166,7	+ 29,5**
Bonsmara	166,5	184,1	+ 17,6*
Nguni	164,7	169,1[a]	+ 4,4

Difference calculated as dipping—no dipping

** = significant difference at 5 % level

* = significant difference at 10 % level

a = calculated from weaning masses of both the Nguni experimental and control groups since the treatment was the same

significant effect on the weaning mass of calves from the Nguni cows.

The number of successful female ticks on each breed during the period of lactation were estimated as follows:

mean number of ticks per count × 205 days

The results are presented in Table 7

During the 205 days of lactation it was estimated that 3 136,5 one-host female ticks and 164 multi-host female ticks engorged on the Hereford cows, whilst corresponding numbers were 2 029,5 and 164 on the Bonsmara cows.

With one-host ticks being predominant and it not being possible to distinguish between the effects of the different tick species, it was estimated that each engorged female tick caused a reduction of 8,9 g [29,5 kg/(3 136,5 + 164 ticks)] in the weaning mass of calves from Hereford and 8,0 g in that of calves from Bonsmara cows (Table 7).

TABLE 7 Estimated number of engorged female ticks on each breed during lactation, and the effect of each engorged female tick on the weaning mass of calves

Breed	Number of one-host ticks	Number of multi-host ticks	Effect of one engorged female tick[a]
Hereford	3 136,5	164	8,9 g
Bonsmara	2 029,5	164	8,0 g
Nguni	430,5	82	8,6 g

[a] was calculated as follows: loss in weaning mass (Table 6)/(number of one-host ticks + number of multi-host ticks)

Although dipping had no significant effect on the weaning masses of calves from Nguni cows, the magnitude of the effect of tick infestation was similary estimated (Table 7). With 430,5 one-host and 82 multi-host female ticks engorging on the Nguni cows, the negative effect of each engorged female on the weaning mass of a calf was estimated to be 8,6 g.

In Australia the direct effect of the one-host *B. microplus* (pantropical blue tick), was found to be a loss of 0,6–1,5 g in body mass for each engorged female (Sutherst *et al.*, 1983). The present study indicates a loss in weaning mass of calves from cows infested predominantly with one-host ticks *(B. decoloratus)* to be much higher and in the region of 8,0–9,0 g for each engorged female.

Although only preliminary, these results suggest that the effect of tick infestation may be more severe on the suckling calf of a cow which is infested than on the adult animal itself. Another possibility is that the effect of *B. decoloratus* may be more severe than that of *B. microplus*, corresponding more to that of *A. hebraeum* (bont tick), which causes a loss of about 10 g in body mass for each engorged female

(Norval *et al.*, 1988b). The latter possibility, however, seems to be highly unlikely.

CONCLUSION

That the Nguni breed is more tick resistant than the Hereford and Bonsmara breeds, with Herefords being most susceptible to tick infestation is confirmed. Ticks seem to have a marked influence on the productivity of cows, as measured by the weaning mass of their calves. The effect on Nguni cows was not significant because a very small number of ticks were able to engorge on these animals. However, each tick that did engorge caused a comparable loss in productivity to that noted on the other breeds. This result is in agreement with that of Norval *et al.* (1988a).

Frequent dipping is essential to avoid drastic losses in productivity when exotic breeds, with a high susceptibility to tick infestation, are utilized in farming areas with a high tick incidence.

The use of indigenous breeds that possess a very high resistance to tick infestation may be a solution to the dilemma of infestation and frequent dipping in the undeveloped parts of Africa, as pointed out by Norval *et al.* (1988a). This may be accompanied by strategic dipping e.g. dipping every 3 weeks during the wet season and only when necessary in the dry season. To a large extent this strategy will prevent the loss of endemic stability.

The level of nutrition in large parts of Africa is such that it simply cannot provide for the higher demands of exotic breeds or their crossbred progeny (Scholtz, 1988). The standard of husbandry and management is such that productivity is often low, and no increase is possible through the introduction of exotic breeds or their crossbreds (Scholtz, Roux & Lombard, 1990). Thus, the elimination of exotic breeds from large parts of Africa will not lead to a decrease in production. It may even increase, while input costs are reduced.

ACKNOWLEDGEMENTS

The expert assistance of Mr D. S. de Bruin, Mr D. de Klerk and Mrs Marga Odendaal is appreciated.

REFERENCES

ACOCKS, J. P. H., 1975. Veld types of South Africa. Memoirs of the Botanical Survey of South Africa, No. 40. Department of Agricultural Technical Services, South Africa. 128 pp.

BONSMA, J. C., 1981. Breeding tick repellant cattle. *In:* WHITEHEAD, G. B. & GIBSON, J. D. (eds). *Proceedings of an International Conference on Tick Biology and Control,* 27–29 January 1981, Rhodes University, Grahamstown, South Africa, 67–77.

HARVEY, W. R., 1988. User's guide for LSMLMW PC-1 version. Iowa State University Press. Iowa.

HEWETSON, R. W., 1981. Resuls of selection for cattle tick resistance in cattle. *In:* WHITEHEAD, G. B. & GIBSON, J. C. (eds). *Proceedings of an International Conference on Tick Biology and Control,* 27–29 January 1981, Rhodes University, Grahamstown, South Africa, 91–97.

LENG, R. A. & BRUMBY, P., 1985. Cattle production in the tropics. *In:* TAYLOR, T. G. & JENKINS, N. K. (eds). *Proceedings of the 13th International Congress on Nutrition,* 18–23 August 1985, Brighton, United Kingdom, 884–887.

MEYER, E. H. H., 1984. Chromosomal and biochemical genetic markers of cattle breeds in southern Africa. *In:* HOFMEYR, J. H. & MEYER, E. H. H. (eds). *Proceedings of the 2nd World Congress on Sheep and Beef Cattle Breeding,* 16–19 April 1984, Pretoria, South Africa, 328–339.

NORVAL, R. A. I., 1981. A reassessment of the role of dipping in the control of tick-borne diseases in Zimbabwe. *In:* WHITEHEAD, G. B. & GIBSON, J. D. (eds). *Proceedings of an International Conference on Tick Biology and Control,* 27–29 January 1981, Rhodes University, Grahamstown, South Africa, 87–90.

NORVAL, R. A. I., SUTHERST, R. W., KURKI, J., GIBSON, J. D. & KERR, J. D., 1988a. The effect of the brown ear-tick *Rhipicephalus appendiculatus* on the growth of Sanga and European breed cattle. *Veterinary Parasitology,* 30, 149–164.

NORVAL, R. A. I., SUTHERST, R. W., JORGENSON, O., GIBSON, J. D. & KERR, J. D., 1988b. The effect of the bont tick *(Amblyomma hebraeum)* on the growth of Africander steers. *Veterinary Parasitology,* 33, 329–341.

RECHAV, Y., DAUTH, J. & ELS, D. A., 1990. Resistance of Brahman and Simmentaler cattle to southern African ticks. *Onderstepoort Journal of Veterinary Research,* 57, 7–12.

SCHOLTZ, M. M., 1988. Selection possibilities of hardy beef breeds in Africa: The Nguni example. *Proceedings of 3rd World Congress on Sheep and Beef Cattle Breeding,* 19–23 June 1988, INRA, Paris, 2, 303–319.

SCHOLTZ, M. M., LOMBARD, P. E., DE BRUIN, D. S., ENSLIN, C. B. & SPICKETT, A. M., 1989. Eenvoudige metode vir die beraming van bosluisbestandheid by beeste. *South African Journal of Animal Science,* 19, 121–124.

SCHOLTZ, M. M., ROUX, C. Z. & LOMBARD, P. E., 1990. Breeding strategies for beef cattle in the subtropics and tropics: Terminal crossbreeding. *In:* HILL, W. G., THOMPSON, R. & WOOLLIAMS, J. A. (eds). *Proceedings of the 4th World Congress on Genetics Applied to Livestock Production,* 23–27 July 1990, Edinburgh, Scotland, 15, 361–364.

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,* 56, 245–250.

SULLIVAN, G. M., 1990. World trends and future markets for beef. *Proceedings of the 5th Santa Gertrudis World Congress,* 15–24 April 1990, Johannesburg, South Africa, 7–16.

SUTHERST, R. W., 1981. Is the Australian pest management approach to tick control relevant to Africa? *In:* WHITEHEAD, G. B. & GIBSON, J. D. (eds). *Proceedings of an International Conference on Tick Biology and Control,* 27–29 January 1981, Rhodes University, Grahamstown, South Africa, 79–85.

SUTHERST, R. W., MAYWALD, G. F., KERR, J. D. & STEGEMAN, D. A., 1983. The effect of cattle tick *(Boophilus microplus)* on the growth of *Bos indicus* × *Bos taurus* steers. *Australian Journal of Agricultural Research,* 34, 317–327.

TATCHELL, R. J., 1981. Current methods of tick control with special reference to Theileriosis. *In:* IRVIN, A. D., CUNNINGHAM, M. P. & YOUNG, A. S. (eds). *Advances in the control of Theileriosis.* The Hague, Holland, 148–159.

WHARTON, R. H., 1976. Tick-borne livestock diseases and their vectors. 5. Acaricide resistance and alternative methods of tick control. *World Animal Review,* 20, 8–15.

Printed by the Government Printer, Private Bag X85, Pretoria, 0001