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Tick resistance of two breeds of cattle in Wolaita Zone, Southern Ethiopia

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The objective of this study was to evaluate total tick burden and resistance differences of local indigenous breeds and Holstein-crosses (50%). Longitudinal study method was employed to assess the mean monthly half-body regions of total tick burdens. The mean monthly half body regions of total tick count on local indigenous cattle and Holstein-crosses (50%) were 75.2 and 201.7, respectively. The monthly mean half-body region of total tick count on the Holstein-crosses (50%) was significantly (p<0.05) higher than that of the indigenous breed throughout the study months. From 4425 collected adult ticks, *Boophilus decoloratus* (47.50%), *Amblyomma gemma* (21.06%), *Amblyomma variegatum* (18.31%), *Amblyomma cohaerens* (4.97%), *Amblyomma lepidum* (3.75%), *Rhipicephalus evertsi evertsi* (2.87%), *Rhipicephalus muhsamae* (0.79%) and *Rhipicephalus guilhoni* (0.75%) were the tick species identified in descending order. Among the tick species identified, seasonal variation was observed in four species, namely: *A. variegatum*, *A. gemma*, *A. lepidum* and *R. evertsi evertsi*. Animal health extension especially on tick control strategy should be in place in order to improve animal productivity.

Key words: Burden, Holstein-cross (50%), indigenous, resistance tick, Ethiopia.

INTRODUCTION

Ticks are globally important in livestock production, because of their economic and health implications (Jongejan and Uilenberg, 2004). It has been estimated that about 80% of world's cattle are infested with ticks (Minjauw and McLeod, 2003). According to CSA (2010), there are about 723,343 heads of cattle in Wolaita of which 3825 are Holstein-crosses. The total cattle population of Wolaita accounts for 7.46% of the Southern Region. Crossbred cattle are being introduced into Wolaita during the working phase of Wolaita Agricultural Development Unit project as a means of milk production to satisfy the protein demand of the human population. Resistance of cattle to tick infestation was reported to consist of innate and acquired components (Wikel and Whelen, 1986).

According to Utech et al. (1978) high levels of host resistance to ticks are primarily associated with zebu cattle, but a proportion of resistant individuals can occur in all breeds. Hence the objective of this study was to assess total tick burden difference, which is one of an indicator for tick resistance differences, of indigenous and Holstein-crosses (50%) in Kokatie, area.

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MATERIALS AND METHODS

Study area

The study was carried out in Kokatie PA of Sodo-Zuria district, (Figure 1) which is 2083 to 2213 m above sea level, and located between 6°52'01.9" to 6°52'42.6" N and 37°47'06.9" to 37°48'55.3" E. The vegetation of the study area is predominantly eucalyptus tree, natural grasses, tuft of grasses and some bushes. The area is characterized by bimodal rainfall, long rainy period (June to October) and short rainy period (March and April). Moreover, it is one of the areas that are densely populated.

Experimental animals

The experimental animals were selected from two breeds of cattle that were kept under backyard and/or traditional management system. From these, thirty two animals, sixteen indigenous and sixteen Holstein-crosses (50%), were selected through purposively sampling method for this field experimental study. Then the selected animals were grouped into two according to their breed types: Group I indigenous cattle and Group II Holstein-crosses (50%). The study animals were not treated with acaricide throughout the study periods and for about two months before the start of the study.

Study design and methodology

A longitudinal study method was employed in which monthly half-body regions total tick burden were taken regularly for eight consecutive months, August to March. During these eight study months, adult ticks were collected from the animals into universal sample bottles containing 70% ethanol following the procedure described by Okello-Onen et al. (1999). Then samples were transported to Hawassa University Veterinary Medicine Parasitology Laboratory and identified following the standard identification procedures described by Hoogstraal (1956), Okello-Onen et al. (1999) and Walker,(2003). Rainfall, humidity and temperature data of the study months were taken from Sodo meteorological station. The study considered 95% level of significance and 5% desired absolute precision.

Data analysis

The data collected were analyzed by descriptive statistics; and log transformed data were analyzed with t-test and repeated measure of variance using SPSS 16.5 software.

RESULTS

Tick burden

The overall mean half body regions of total tick count on the indigenous and Holstein-crosses (50%) were 75.2 and 201.7, respectively. The trend of mean monthly half-body regions total tick count of the indigenous and Holstein-crosses (50%) are shown on Figure 2. Repeated measure of collected data analysis showed that, there was a significant ($p<0.05$) variation in the mean monthly half-body region of tick burdens between the two breeds of cattle, indigenous and Holstein-crosses (50%) (F= 370.61, P> 0.000, Partial η squared= 0.925; 95% CI=1.766 to 1.833 for indigenous breed and 2.209 to 2.275 for Holstein-crosses 50%). Within the breeds there was significant ($p<0.05$) variation in the mean monthly tick burden of half-body regions in both breed (F= 4.585, P< 0.001 and Partial η squared = 0.132), due to the interaction of breeds with months. The seasonal tick burden of half body region on both breeds is shown in Figure 3. The analysis for presence or absence variation in the two breeds of cattle half-body region tick burden is shown in Table 2. Humidity and rainfall had positively influenced (t = 10.28, P = 0.000; t = 9.71, P = 0.000) on the half-body regions total tick burden of both breeds (Figure 4), while the temperature had negatively affected (t = -9.74, P = 0.000) the half-body regions total tick burden of both breeds as shown in figure 5. That is why about 80.76% of the overall total tick burden differences were observed between the study months (F = 125.95, P = 0.000 and partial η squared = 0.8076).

Tick species identification

A total of 4425 adult ticks were collected from half body regions of the study animals, and a total of three genera of ticks were identified. From the identified genera, a total of eight species of ticks were identified, namely: *B. decoloratus* (47.5%), *A. gemma* (21.1%), *A. variegatum* (18.3%), *A. cohaerens* (5.0%), *A. lepidum* (3.8%), *R. evertsi evertsi* (2.9%), *R. muhsamae* (0.8%) and *R. guilhoni* (0.8%). Among these eight tick species six of them were identified as the major tick species in the study area: *A. variegatum*, *A. gemma*, *A. cohaerens*, *A. lepidum*, *B. decoloratus* and *R. evertsi evertsi* (Table 1).

DISCUSSION

The mean monthly half-body region of total tick count on the Holstein-crosses (50%) was significantly ($p<0.05$) higher than that of the indigenous breed throughout the study months (F= 370.61, P= 0.000, Partial η squared= 0.925). This variation is clearly shown in Figure 2 that showed the trends of half body region of total tick counts. This finding agreed with Ali and de Castro (1993) who reported that Horro breed carried fewer total tick burdens than Horro X Holstein. Aragaw (1994), Yohualashet et al. (1995) and Solomon and Kaaya (1996) also reported better control of tick burdens in the local zebu than Holstein crosses.

At Abernossa ranch, Arsi breed was found to be highly tick resistant, followed by Boran breed, but Boran X Holstein was the least resistant (Solomon and Kaaya, 1996). Moran et al. (1996) also observed that pure Ankole cattle of Burundi were more resistant than Ankole X Holstein. In this study, mean monthly Log_{10} (x+1) of total tick burden was statistically significant and observed

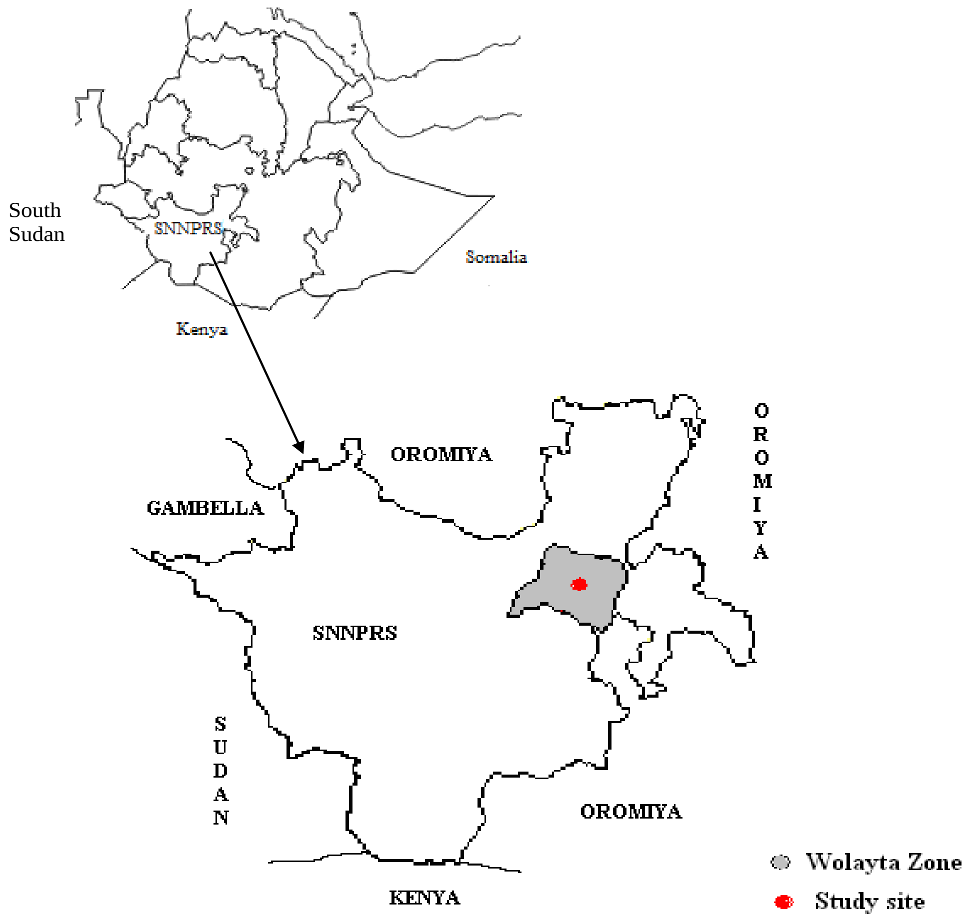

Figure 1. Map of SNNPRS to show the study site

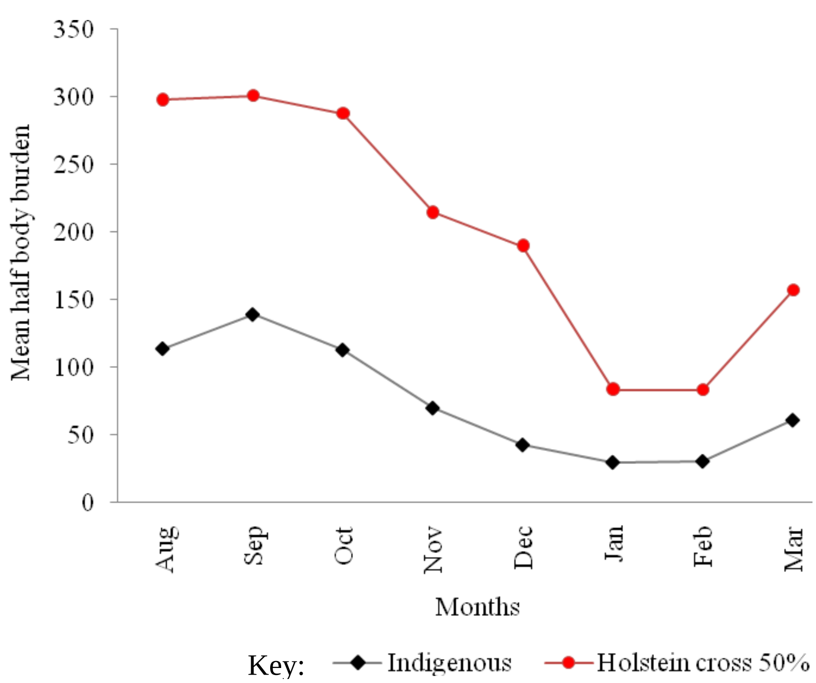

Figure 2. Pattern of mean monthly half-body tick burden of the Indigenous and Holstein crosses 50%.

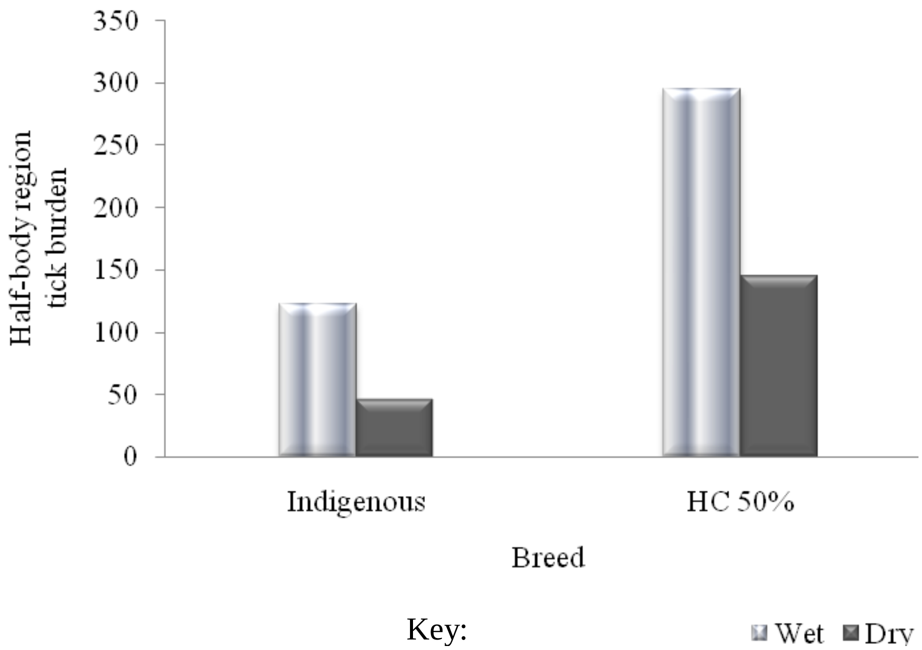

Figure 3. Wet and dry periods mean half-body regions total tick burden of indigenous and Holstein-cross (50%) cattle breed.

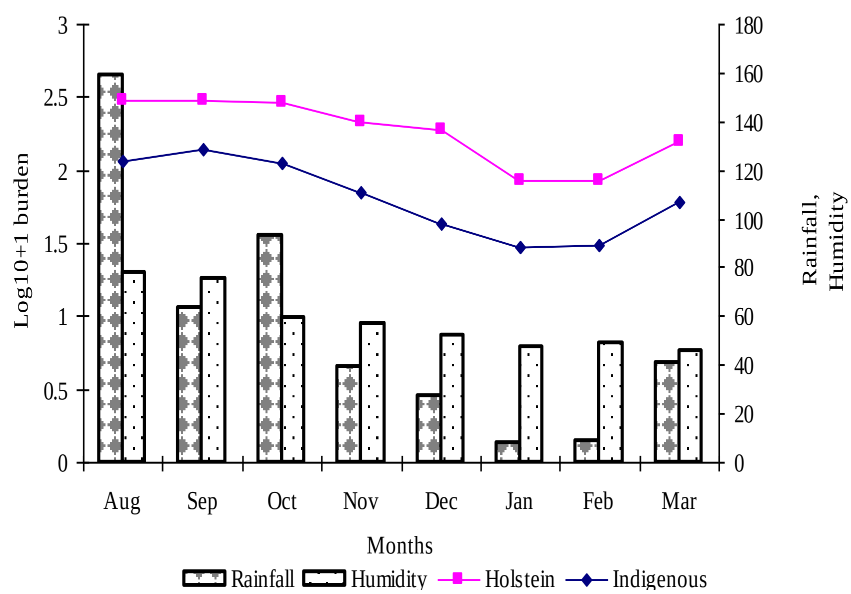

Figure 4. Trends of mean $log_{10}(X+1)$ half body tick burden of the breeds, rainfall and humidity.

higher in Holstein-crosses (50%) than on the indigenous breed throughout the study months. Even with the various temperatures, rainfall and humidity had no change in the mean half body region tick burden. Gene expression studies strongly indicated that both immune and non-immune mechanisms are associated with tick resistance in cattle (Porto et al., 2011).

Tick counts positively correlated to coat characteristics in cattle (Marufu, et al., 2011; Verissimo et al., 2002); and also it was observed that cattle with shorter and smoother coats carried lower tick counts (Marufu, et al., 2011). Generally it is believed that cattle breeds with short hairs exposed the ticks to harmful climatic conditions and to predators like birds (Tatchell, 1987; Taylor, 2006;

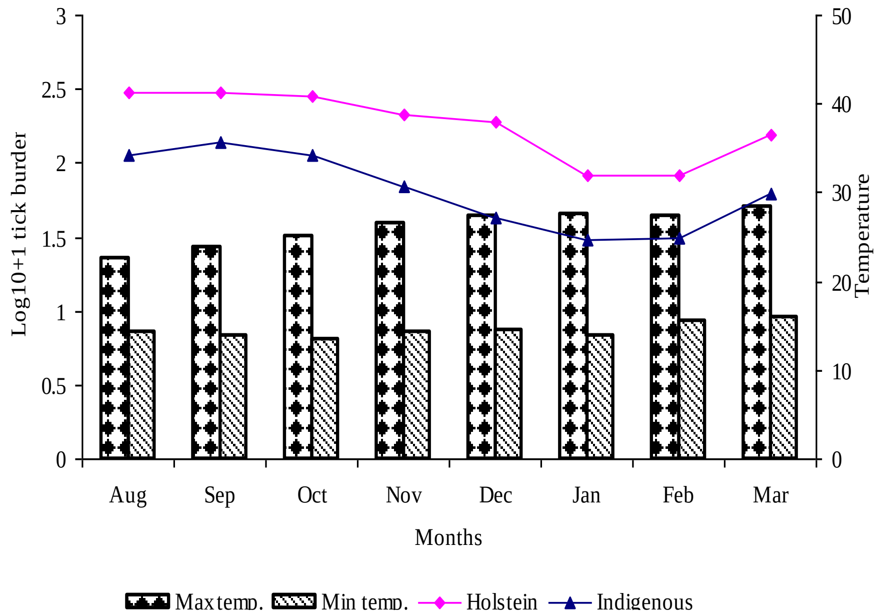

Figure 5. Trends of mean $log_{10}(X+1)$ tick burden of the breeds and temperature.

Table 1. Comparison of the two breeds of cattle half-body regions tick burden [$Log_{(X+1)}$]

Breed	Log transformed mean of half-body tick burden (Mean count)	Std. Err	95% CI	t-value	P-value
Indigenous	2.78 (601.8)	0.015	2.74-2.81	17.66	0.000
HC 50%	3.20 (1613.4)	0.019	3.16-3.24		
Total	2.99 (1107.6)				

Table 2. Seasonal variation of the major tick species identified during the study period ($Log_{10}(X+1)$

Tick spp.	Season	Mean	Std. Error	t – value	P > |t|	[95% CI]	Significance
AV	Wet	4.304	0.594	4.3993	0.000	3.130 - 5.478	* * *
	Dry	1.565	0.187			1.195 - 1.936	
AG	Wet	2.261	0.173	-5.7173	0.000	1.919 - 2.603	* * *
	Dry	4.493	0.350			3.801 - 5.185	
AC	Wet	0.667	0.141	-1.2189	0.224	0.388 - 0.946	NS
	Dry	0.928	0.161			0.609 - 1.246	
AL	Wet	0.377	0.090	-2.3018	0.022	0.198 - 0.556	* *
	Dry	0.826	0.173			0.484 - 1.168	
BD	Wet	7.884	0.319	1.0566	0.292	7.253 - 8.516	NS
	Dry	7.348	0.394			6.568 - 8.128	
RhE	Wet	0.725	0.115	4.1495	0.000	0.497 - 0.953	* * *
	Dry	0.196	0.054			0.088 - 0.303	

NB. Equal variances assumed. (AV =*A. variegatum*, AG =*A. gemma*, AC = *A. cohaerens*, AL = *A. lepidum*, BD = *B. decoloratus*, RhE = *Rh. evertsi evertsi* NS = Not significant). * * * = Highly significant and * * = Significant)

Marufa et al., 2011). According to de Castro (1991) observation *Bos indicus* naturally self-groom and groom each other frequently and thoroughly. It is already known that grooming is a means by which the host can express resistance; fewer ticks were seen on those animals that were able to groom (Minjauw and de Castro, 2000; Brossard, 1998).

Tropical cattle breeds are known to possess short hair to overcome heat stress. And those animals with shorter hairs tend to have lower tick counts compared to those with longer hairs, since long hairs create favourable conditions for tick survival (Taylor et al., 1995; Marufa et al., 2011). Moreover, longer coat hairs may protect ticks from the animal's self-grooming that enables them to remove ticks attached to the coat (Machado et al., 2010). *B. indicus* were reported to be more innately resistant to *B*. *microplus* infestation (Wikel and Whelen, 1986).

Among the tick species identified seasonal variation was observed in four species, namely: *A. variegatum*, *A. gemma*, *A. lepidum* and *R. evertsi evertsi* (Table 2). This result is in a general agreement with observation of Kaiser et al. (1991) who reported that all stages of *Rh. evertsi evertsi* were less active during dry season. There was a significant seasonal variation of *A. variegatum* ($t = 10.2719$, $P = 0.05$ at $\alpha = 0.05$) in the study area, which was with highest mean count during wet period.

This finding is in agreement with that of Gebre et al. (2000) and Solomon (1993) observations at Sebeta and Abernossa, respectively. They recorded highest counts of *A. variegatum* in July and April, which coincide with the rainy months for the areas. Moreover, Hoogstraal (1956), Morel (1980), Petney et al. (1987), Yohualashet et al. (1995), Mattioli et al. (1997), Bekele (2002) and Assefa (2004) observed the seasonal fluctuation of this tick species with a relative rise in numbers during the short and long rains. The life-cycle of this tick species is most closely linked to rainfall. The adults were aroused by rain in the rainy months, in which by that time most had apparently found a host (Kaiser et al., 1988). In Ethiopia Pegram et al. (1981) observed that the onset of feeding activity of adult coincides with the start of wet season. From de Castro (1994) survey in western Ethiopia females, *A*. *variegatum* were mostly present in rainy time during collections of tick species.

The mean distribution of *A. gemma* ($t= 5.7173$, $P< 0.05$) and *A. lepidum* ($t= 2.3018$, $P< 0.05$) were significantly and seasonally varied. These ticks were highly prevalent during dry period, and they are xerophilous African species of *Amblyomma* (Morel, 1980). This finding is in a general agreement with Petney et al. (1987). There was a significant seasonal variation of *Rh*. *e*. *evertsi* ($t = 4.1495$, $P= 0.000$) with the highest collection of the adult in wet period (95% CI 0.497 to 0.953 and 0.088 to 0.303 during wet and dry periods, respectively). This finding is in line with Kaiser et al. (1991) who showed that all stages of this tick were less active during dry season. In fact according to Pegram et al. (1981), de Castro (1994) and Bekele (2002) it appears to occupy a wide range of climatic and ecological conditions with rain occurring in most of the year, and throughout the year.

CONCLUSION AND RECOMMENDATION

Ticks burden of Holstein-crosses (50%) was significantly higher than the local indigenous breed in all the seasons. So to increase cattle productivity in the study area and elsewhere in the country, consideration of the breed type would be helpful. But for this purpose, animal health extension work, especially on breed use for strategic tick control could be important.

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CONFLICT INTERESTS

The author has not declared any conflict of interests.

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