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Host Preference and Seasonal Variation of Tick (*Amblyomma cohaerens* Donitz, 1909) on Naturally Infested Cattle in Jimma Zone, Southwestern Ethiopia

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Abstract

The seasonal dynamics of tick *Amblyomma cohaerens* on naturally infested cattle in Jimma Zone was studied from September 1998 to September 2000 using fifty cattles in five Localities. Monthly tick counts were made for two consecutive years. Although, *Amblyomma cohaerens* infestation occurred throughout the year, it was greater at the beginning and end of the rainy season. High humidity and temperature were the factors that influence the seasonal variation. The study on the host preference of different blood groups showed that host selection and specificity correlate with the abundance and distribution of the tick. These have been reflected by the presence of more tick in highbred cattle than the indigenous *Zebu*.

Keywords: *Amblyomma cohaerens*, breed preference, cattle tick, Ethiopia, seasonal variation

1 Introduction

The bites of *Amblyomma* ticks are severe. They may result in septic wounds and abscesses, inflammation of the teats of cows and considerable damage to hides and skins. The tick *Amblyomma cohaerens* is the main vector of *Cowdria ruminantum* and *Dermatophilus congolensis* in southwestern parts of Ethiopia. In the western Ethiopia, acute dermatophylosis is the major cause of economic loss resulting from the tick. The epidemiological and ecological aspects of *Amblyomma cohaerens* have received considerable study (Morel, 1980; Lalle, 1981; Castro, 1994; Mekonnen, 1996). Limited field data on its seasonal activity and development are available (Castro, 1994).

Amblyomma cohaerens is the most abundant tick species that is followed by *Boophilus decoloratus* in the southwestern Ethiopia (Pegram *et al.*, 1981; Castro, 1994). It is considered to be one of the principal ectoparasite of cattle in the region. The economic loss resulting directly or indirectly from tick infestation may be considered as an important factor that impedes the development of exotic cattle in these regions.

The *Amblyomma* ticks are ornate, large and broad. They have a long gnathosoma with basis capituli rectangular dorsally. Eyes and festoons are present. Coxae 1 are usually

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with two spurs. Spiracles are triangular. Male is without ventral plates, but small chitinous plaques may be present close to the festoons. Anal groove surrounds the anus posteriorly. They are usually ornate, so the *Amblyomma* ticks are frequently called the bont ticks. Bont is the African word referring to the presence of brightly colored patterns on their backs and their brown and white-banded legs (BARNARD, 1984; SOLOMON and KAAYA, 1998).
Two different types of *A. cohaerens* have been observed in Ethiopia. A larger type believed to be associated to wild hosts, particularly African Buffalo and a smaller one from cattle. My collection showed only the second type. Previous records from the western zone, A. cohaerens have been found between 1200-1800 mm rainfall in both rainfall types. It was collected from areas of broad-leaved forest (PEGRAM *et al.*, 1981).

In the present survey, *Amblyomma cohaerens* was recorded from all altitude zones but it predominated between 1600-2400m. It was recorded between 800 and over 2600 mm rainfall although it was absent from the rainfall zone between 1000-1200 mm, probably due to chance. This observation support previous findings that *A. cohaerens* is the most abundant tick in Jimma zone (ABEBAW, 1996; PEGRAM *et al.*, 1981; CASTRO, 1994).

Seasonality: In those localities with rainfall most of the year, *A. cohaerens* females were mostly collected between January and September before and during the rainfall peak and less collected between October and December after the rainfall peak. Nymphs were mostly collected between January and April just before the rainfall peak and were less common between June and during the rains. Larvae were most between March and April before the rains. In localities with summer rains none of the instars showed a trend in regard to abundance of collections (PUNYUA *et al.*, 1991; CASTRO, 1994).

2 Materials and Methods

The study was carried out in five localities of Jimma zone (Jiren, Bore, Blida, Merewa and Jimma University, College of Agriculture dairy farm). These areas were selected on the basis of location, altitude and cattle population. The collection have been done from fifty cattle thirty five indigenous zebu and fifteen Zebu crosses with Friesian having different blood level from ten to thirty six months of age representing different management systems, sex and weight groups. These cattle have been selected from herds of the study area based on an initial tick count. Ten cattle from each locality with high infestation in the initial tick count were selected and ear tagged.

The selected cattle were hand sprayed with *Norotraz* 12.5% (from Norbrook Laboratory Limited, Newry, North Ireland) to standardize tick burdens at the beginning and then left in their respective herd for a month until sampling commences. Monthly whole bodies collections of tick have been accompanied by general check up of health status. There was no acaricide treatment during the whole study period. The collection was done on the selected cattle from September 1998 to August 2000. In the course of the two years seven cattle have been replaced because five died and two were sold.
Every 27-30 days the animals were put in crash or restrained to allow whole body collection of ticks according to the method of LONDT *et al.* (1979). Collected samples have been placed in sample vials containing 6% formalin with glycerin. The samples

were labeled immediately after the collection from each animal body was finished. The label contains the locality, animal identification number, date and month of collection. The samples then were counted and identified in the laboratory using hand lens and stereomicroscope on the same day or on the next day. Identification was done based on morphological and structural differences of the species and different instars. The grouping to their genus and species was made according to the methods developed by HOOGSTRAAL (1956) and KEIRANS and ROBBINS (1999). Other species of ticks were discarded after the identification. Along these, ecology, metrological data and environment of the region were taken in to consideration.

The association of the tick count with the metrological data and the trend of development have been statistically analyzed. The statistical analysis was done using correlation between the tick count, temperature and relative humidity and also the association between the larval, nymph + adult stage of the tick. The monthly variations of tick count by instars have been analyzed by analyses of variance (ANOVA). The relationships between the minimum temperature, relative humidity and maximum temperature with the number of ticks and their instars have been analyzed by correlation of variables. The dependent variables of interest were Larvae, Adult +Nymph and total Boophilus decoloratus population (count). Data were analyzed using the General Linear Model (GLM) procedures of SAS (1996) by fitting a fixed effect model with the effects of Year, Site (Locality) and Month. The Tukey's studentized range test was used to separate means with significant variation. Correlations between the dependent variables and relative humidity, minimum and maximum temperature were computed using PROC CORR of SAS (SAS, 1996). Least squares means obtained from the analyses of the model described were used to prepare graphs to illustrate the relationships between the dependent variables (Larvae, Adult + Nymph and total populations) with month.

3 Results

Results of overall means, least squares means (and S.e.), Cv. (%) and F-test of effects of year and site for larva, adult + nymph and total *Amblyomma cohaerens* are summarized in table 1. There were no significant differences in the infestation (total tick count) between the years. However, significant differences were observed in total tick count between months and the sites. There was considerable variation between JCA farm tick count and other localities. This suggests that JCA farm cattle were more susceptible to tick infestation than the others. This difference observed was based on the breed difference, while cattle of JCA farm was a mainly exotic breed. In the study conducted in a different location on different tick species, cattle with exotic blood had higher mean infestation rate than the local *Zebu* cattle. Thus, local cattle resist tick infestation better than the exotic one.

The result on the effect of environment on tick population indicate that *Amblyomma cohaerens* is highly dependent on moist microenvironments because of its great susceptibility to percentage losses of total body water, and drop in hemolymph volume at low humidity. This study illustrates that *Amblyomma cohaerens* perish rapidly when the humid protection is disrupted. Seasonal activity began in March when larvae exhibited

Table 1: Overall means, Least squares means, Cv. (%) and F-test of effects of year and site for larva, adult+nymph and total *Amblyomma cohaerens*

Effect and level	*Larva*	*Adult + Nymph*	*Total*
Overall	38.5	41.2	79.7
C.V.	26.8	29.3	24.2
Year	Ns	Ns	Ns
1998/99	37.3	42.5	79.8
1999/2000	39.7	39.9	79.6
Site	**	**	**
Blida	28.0 ^{b}	31.5 ^{b}	59.6 ^{b}
Bore	33.8 ^{b}	35.8 ^{b}	69.5 ^{b}
JCA	69.8 ^{a}	74.5 ^{a}	144.3 ^{a}
Jiren	28.3 ^{b}	27.6 ^{b}	55.9 ^{b}
Merewa	32.5 ^{b}	36.5 ^{b}	69.0 ^{b}

** $\widehat{=}$ sigificant at $P \leq 0.01$; NS $\widehat{=}$ not significant

host-seeking behavior on the ground. Ticks began to come up to the top of vegetations in April and early May, and a peak in the percentage of ascending tick reached in late May, June and beginning of July. The percentage ascending remained constant until mid July when ticks began to go down to the root of vegetations in association with higher humidity and lower temperature. Thus climatic factors seemed to greatly influence cattle tick infestation.

Amblyomma cohaerens had two peaks of activity, in September and October (moderate) and in May, June and July (maximum). No significant increase in tick population was observed during the short rains. There was, however, a greater buildup coincidence with the main rainy season. There was a direct relationship between population and minimum temperatures, whereas maximum temperature seemed to have no such relationship. The Patterns of seasonal activity for *Amblyomma cohaerens* on cattle in Jimma zone is shown in (Fig.1)

There were substantial variations in the total tick count and developmental stages between months as indicated the Table 2.

Table 3 shows the correlation coefficient between larva, adult+nymph and total *Amblyomma cohaerens* and minimum temperature, maximum temperature and relative humidity. All correlations are significantly different from zero ($P < 0.01$). Tick count and maximum temperature were negatively correlated. Tick count was positively correlated with minimum temperature and relative humidity.

Figure 1: Seasonal variation of the population of total, adult and larvae of *Amblyomma cohaerens*.

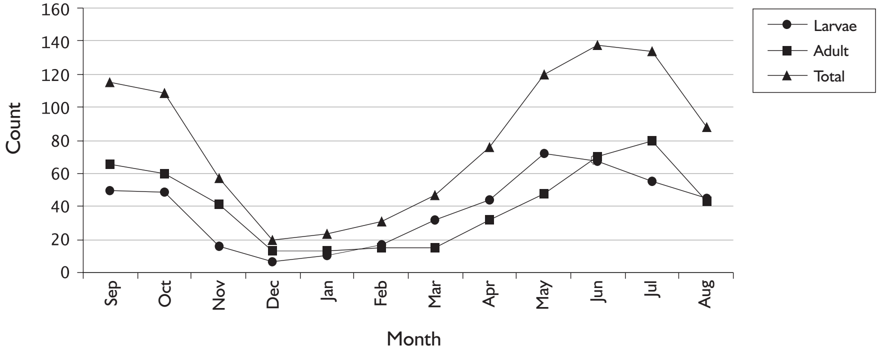

Table 2: Least squares means for larva, adult+nymph and total *Amblyomma cohaerens* in different months for the years 1998/99 and 1999/2000

Month	*Larva*	*Adult + Nymph*	*Total*
September	49.6	65.2	114.8
October	48.5	59.6	108.1
November	15.6	41.2	56.8
December	6.6	13.5	20.1
January	10	13.4	23.4
February	16.4	14.7	31.1
March	31.5	14.9	46.4
April	44.1	31.7	75.8
May	72.3	47.3	119.6
June	67.2	70.6	137.8
July	54.8	79.2	134
August	45	43	88

The growth and multiplication of all instars of *Amblyomma cohaerens* were correlated with mean air temperature. The habitat most favorable for it was also most moderate in terms of temperature and relative humidity. Consequently, the environmental conditions created within a vegetation, specifically temperature and relative humidity, are more important for the survival of *Amblyomma cohaerens* than plant species comprising that area.

Thus, when temperature is low and relatively humidity high in May, June and July, the population of *Amblyomma cohaerens* ascends vegetation and awaits a host. When temperature is high and relative humidity low from November to March, ticks descend the vegetation and seek shelter in the soil and leaf litter. *Amblyomma cohaerens* seek

Table 3: Correlation coefficient between larva, adult + nymph and total *Amblyomma cohaerens* and minimum temperature, maximum temperature and relative humidity.

	Min. Temp.	*Max. Temp.*	*R. Humidity*
Larva	0.47 (**)	- 0.46 (**)	0.48 (**)
Adult+Nymph	0.44 (**)	- 0.51 (**)	0.50 (**)
Total	0.47 (**)	- 0.51 (**)	0.51 (**)

All correlations are significantly different from zero at $P \leq 0.01$

hosts by moving across the ground in March and April and by ascending vegetation in May, June and July. The earliest significant activity of *Amblyomma cohaerens* begins in May when the average ambient temperatures are 19-21 °C. Of course, soil surface temperatures may rise significantly above this. Peak populations occur in May, June to mid July, from mid July to August short decline and another peak in September then further decline until almost non-observed in late December and January. This phenomenon was also observed during other years.

Temperature and humidity measurement in the zone indicated very high day temperatures and low humidity and considerable cooling and a raise in relative humidity during the night. High summer temperatures influence the behavior of ticks in all habitat types. This condition probably results in shorter longevity in certain habitats. As a behavioral response to rising temperatures during November to April, ticks migrate down the vegetation to the soil.

Rainfall and the directly related relative humidity are the main climatic factors influencing tick distribution and activity. A peak of activity for most species was detected at the beginning of the heavy rain (June-July). Due to the extreme difference in rainfall and relative humidity during the year tick numbers during the dry season are low with a marked increase coinciding with the start of the rains. Relatively high tick burdens last throughout the rainy season.

The result from the analysis of variance for larva, adult+nymph and total *Amblyomma cohaerens* in table 4 indicate that site and month had a significant ($P < 0.01$) effect on infestation.

4 Discussion

The ticks were found on the cattle during every month of the year, but there was a reduction in the number of ticks per animal during the dry season. Rainfall was the climatic factor that most affected the seasonal variation in the tick infestations (Pegram *et al.*, 1984). The present result was consistent with those of (Asres and Gebre-Ab, 1991) who studied the tick fauna and seasonal dynamics at Abernosa ranch they found out that minimum temperature had higher effect than maximum temperature.

Table 4: Analysis of variance for larva, adult and total *Amblyomma cohaerens*.

Source	*Larva*		*Adult+Nymph*		*Total*	
	DF	*F-value*	*DF*	*F-value*	*DF*	*F-value*
Year	1	1.67 ^{NS}	1	1.41 ^{NS}	1	0.00 ^{NS}
Site	4	70.58 **	4	59.15 **	4	86.17 **
Month	11	46.29 **	11	39.28 **	11	50.60 **

** $\hat{=}$ $P < 0.01$; NS $\hat{=}$ Not significant

Although ticks were present on the animals during each month of the experimental period, two peaks of infestation could be distinguished between September 1998 and August 2000, each of which probably corresponded to a new generation of ticks. These data are in agreement with the observations of Solomon and Kaaya (1998) who studied the development reproductive capacity and survival of *Amblyomma variegatum* and *Boophilus decoloratus* in relation to climatic factor and host resistance under field condition and noted the occurrence of two generations of the tick per year.

The degree of infestation of the animals with larvae is related to the influence of climatic factors on the production and survival of the non-parasitic stages. Hence the seasonal variation of ticks on the animals presented a direct association with the availability of larvae in the pastures, i.e. during the months of low infestation the population of larvae available in the pastures is relatively low (Sutherst, 1989). Rainfall appeared to be the climatic factor that most influenced the seasonal variation in the intensity of infestations of *Amblyomma cohaerens* in the study area during the experimental period.

Peaks in the number of ticks were preceded by rainfall, as observed by Wilkinson (1982). In South Africa, Robertson (1981) found out that a monthly rainfall of 100 mm/month or lower created unfavorable conditions, resulting in a gradual fall in the numbers of available larvae. In the present study, it was found out that only monthly rainfall in excess of 250 mm produced a reduction in *Amblyomma cohaerens* infestations.

An increase was observed in the number of ticks in May to July 1999 and 2000, immediately following the beginning of the rainy season. During the dry season (November to April), when rainfall and humidity were lower, there was a sharp reduction in *Amblyomma cohaerens* infestations, producing the lowest counts in the observation period. A small peak occurred in September to October 1998 and 1999 that can probably be related to the increase of temperature and reduction of rainfall that occurred in these months. These data confirm the observation of Gray and Potgieter (1982). The onset of the rainy season (May-June) produced a rise in infestation levels, which then remained relatively high until July, when there was a reduction that was probably due to excessive rain. No correlations were observed between maximum temperature and the seasonal variation of *Amblyomma cohaerens*.

The fluctuations in infestation levels showed the same pattern during both years of the study although the peaks were of different intensities. Lower infestations were observed during the second year of the study, when the animals were getting older and developed acquired resistance. ABEBAW (1996) observed that heifers and young bulls of highbred cattle presented higher burdens of *Amblyomma cohaerens* than did adults and calves, although TEEL *et al.* (1988) did not find any age-related effect on resistance to the tick.

In the present study, both the climatic differences between the two years and the cattle-raising techniques used by the farmers where the study was carried out could have contributed to the lower infestations seen in the adult animals. The calves up to six months of age were maintained apart from adult animals at low population densities and were thus exposed to lower parasite burdens on the pasture.

During the study period, it was observed that fifteen of the animals (30%) maintained 50% of the total parasite load of the group that are mainly exotic breeds, which agrees with the findings of CASTRO (1994). Identification of the most susceptible animals within a group is an important prerequisite for the adoption of measures to reduce parasitic burden (CLAXTON and LEPERRE, 1991). These may involve removing susceptible animals from the herd or using them to remove larvae from the pastures and submitting them to more frequent acaricidal dips (SUTHERST, 1989).

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