



Epidemiology and seasonal dynamics of Ixodid ticks of dairy animals of Punjab state, India*

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ABSTRACT

Cattle (890) and buffaloes (636) were examined from 8 districts of Punjab state, India with an overall prevalence of 85.28 and 57.10% *Rhipicephalus (Boophilus) microplus*, 20.45 and 52.20% *Hyalomma anatolicum anatolicum* and 5.73 and 9.90% mixed infestation in cattle and buffalo population, respectively. *R. microplus* was the predominant tick in cattle population (85.28%), whereas in buffalo population *R. microplus* and *H. a. anatolicum* were almost evenly distributed. Among the different agro-climatic zones a significantly higher prevalence of *H. a. anatolicum* was recorded in both cattle and buffalo population of Western Plain and Western regions with comparison to other regions i.e. Central Plain and Undulating Plains of the state. *H. a. anatolicum* was recorded more in summer (23.1%) and monsoon (21.0%) seasons compared to winter (6.10%). In cattle, the tick infestation was similar in both the sexes whereas in buffalo, *R. microplus* was predominating in males and *H. a. anatolicum* was predominating in females. In organized dairy farms, the prevalence of *H. a. anatolicum* was very low (3.74%) but was and higher (45.31%) in unorganized sector.

Key words: Buffalo, Cattle, Epidemiology, *Hyalomma anatolicum anatolicum*, Punjab, *Rhipicephalus (Boophilus) microplus*

Ticks rank first as arthropod vectors of protozoa, rickettsiae, bacteria and viruses, causing diseases in nonhuman vertebrates, and rank second only to mosquitoes as vectors of pathogens to humans (Zhou *et al.* 2009). India accounts for a significant share of the world's livestock resources with nearly 56.63% of world's buffaloes and 12.48% cattle (FAO 2009). Minjauw and McLeod (2003) showed that the cost of management of ticks and tick borne diseases (TTBDs) in livestock of India is as high as US\$ 498.7 million per annum. The most common combined effect of TTBDs in Indian dairy system is reduction in milk yield i.e. (loss of 14% of the lactation) (McLeod and Kristjanson 1999) and quality of hides for leather industry (Biswas 2003).

Punjab is having 10% of India's cattle population (20,38,543 approx.) and contributes a significant percentage

(6.5) of India's buffalo population (59,94,535 approx.) (Indiastat 2008). The state contributes nearly 9% to the Indian milk production. The state is situated at the North West frontier of India and the tropical climatic condition of the state is highly conducive for growth and development of ticks and tick-borne diseases (Haque *et al.* 2010). A number of hard tick species were reported from Punjab, viz. *Amblyomma javanense*, *A. leave*, *A. nitidum*, *A. testudinarium*, *Rhipicephalus (Boophilus) microplus*, *Dermacentor auratus*, *Haemaphysalis bispinosa*, *H. canestrinii*, *H. doenitzi*, *H. intermedia*, *H. montgomeryi*, *H. sulcata*, *Hyalomma anatolicum anatolicum*, *H. brevipunctata*, *H. detritum*, *H. dromedarii*, *H. issaci*, *H. hussaini*, *H. kumari*, *Rhipicephalus haemaphysaloides* and *R. sanguineus* (Ghosh *et al.* 2007). However, *R. microplus* and *H. a. anatolicum* infestation is most common and considered as economically important tick species. Control of ticks is largely dependant on application of chemical acaricides leading to many problems. Development of alternative measures focused on infestation pattern is the need of the hour. The present study has been conducted to determine the infestation pattern of economically important tick species on cattle and buffaloes.

MATERIALS AND METHODS

Geographical information: The state of Punjab extends

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from the latitudes 29.30° N to 32.32° N and longitudes 73.55° E to 76.50° E. It covers a geographical area of 50,362 km² which is 1.54% of country's total geographical area. The plain lands lie between altitudes 180 meters and 300 meters above sea level. The three major seasons are summer (April to June; average rainfall 51.6 mm), monsoon (July to September; average rainfall 395.2 mm) and winter (October to March; average rainfall 119.1 mm). The climate of the plains is excessively hot and dry between April and August, with temperatures as high as 45°C. Winters are cool with some frosts. The average temperature in January is 13°C, whereas, in June is 34°C occasionally climbing as high as 45°C. Average rainfall is 565.9 mm. More than 70% of the annual rainfall occurs during the monsoon season from July to September (<http://punjabonline.in/Profile/Geography/climate.asp>).

On the basis of annual rainfall pattern and altitude the state is divided into 6 agroclimatic zones. Among the selected 4 zones, western region and western plain region are most hot and dry zones whereas, undulating plain and central plain zone receive maximum rainfall with humid climate.

Collection of ticks: Ticks from cattle and buffaloes were collected during August 2008 to May 2009, from different villages covered under the 8 different districts of Punjab. For epidemiological study a questionnaire comprising details about the animals (age, sex, species and breed), managemental practices and socio-economic conditions of owners was formulated. Cattle and buffaloes of both sexes and all age groups were examined to record the prevalence of Ixodid ticks in different organized and unorganized dairy farms. Each animal examined for tick infestation was considered as one sample. Ticks were searched by passing hands through the animal's coat and collected manually without damaging their mouthparts. The collected tick samples were then transferred to plastic tubes marked with permanent marker in accordance with the serial number of the questionnaire containing the detail information about the source of the samples collected. The samples were brought to the laboratory and were transferred to dessicator in which

80–85% relative humidity was maintained using 10% KOH (Solomon 1951) and were kept in incubator at a constant temperature at 28 °C. Collected ticks were morphologically identified according to keys given by Miranpuri (1979).

Statistical analysis: Statistical analysis was performed on data by SPSS 13.0 software by applying Chi Square test and statistical differences ($P \leq 0.01$ and $P \leq 0.05$) between various groups were calculated.

RESULTS AND DISCUSSION

Ticks collected from cattle and buffaloes were identified as *Rhipicephalus (Boophilus) microplus* and *Hyalomma anatolicum anatolicum*.

Distribution pattern of *R. microplus* and *H. a. anatolicum* in cattle and buffaloes: Out of 890 cattle screened an overall 85.3% animals were infested with *R. microplus*, 20.5% with *H. a. anatolicum* and 5.7% with mixed infestations (Table 1). The prevalence of *R. microplus* was more or less comparable in all the districts except in Sangrur, where the prevalence was lower (60.0%) than other districts. Similarly, the prevalence of *H. a. anatolicum* was comparable in all the districts except Sangrur and Bathinda, where the prevalence was high (i.e. 40.0% and 32.4% respectively). Interestingly, a comparatively higher percentage of mixed infestations were recorded from Bathinda district.

Similarly, out of 636 buffaloes screened an overall prevalence of *R. microplus*, *H. a. anatolicum* and mixed infestations was 57.7%, 52.2% and 9.9% respectively. The highest prevalence of *R. microplus* was seen in Patiala (94.6%) and the lowest was recorded from Sangrur district (31.3%) whereas, the prevalence of *H. a. anatolicum* was highest in Sangrur district (79.4%) and lowest in Patiala (16.2%) district. Mixed infestations were recorded from all the districts except Kapurthala and Hoshiarpur where 82.5% animals were infested with *R. microplus* (Kapurthala) and 17.5% animals were infested with *H. a. anatolicum* (Hoshiarpur). Lowest prevalence of mixed infestations was observed in Ludhiana (1.9%).

Distribution of *R. microplus* and *H. a. anatolicum* in

Table 1. Epidemiology of ixodid ticks of cattle and buffalo in different agro-climatic zones of Punjab percentage of infestation in parentheses

Agro climatic zones	Cattle				Buffalo			
	Examined	+ for <i>R. microplus</i>	+ for <i>H. a. anatolicum</i>	Mixed infestat- ions	Examined	+ for <i>R. microplus</i>	+ for <i>H. a. anatolicum</i>	Mixed infestat- ions
Central Plain Region	509	443 (87.0)	93 (18.3)	27 (5.3)	308	211 (68.5)	120 (38.9)	23 (7.5)
Undulating Plain Region	95	88 (92.6)	10 (10.5)	3 (3.2)	40	30 (75.0)	10 (25.0)	0
Western Region	108	93 (86.1)	35 (32.4)	20 (18.5)	36	24 (66.7)	21 (58.3)	9 (25.0)
Western Plain Region	178	135 (75.8)	44 (24.7)	1 (0.6)	252	102 (40.5)	181 (71.8)	31 (12.3)
Total	890	759 (85.3)	182 (20.4)	51 (5.7)	636	367 (57.7)	332 (52.2)	63 (9.9)
χ^2 value	-	18.03**	18.72**	42.83**	-	51.46**	72.94**	17.26*

* $P \leq 0.05$, ** $P \leq 0.01$; figures in parenthesis are the % prevalence of infested ticks.

different agro-climatic zones: Among the cattle population of various agro-climatic zones highest prevalence rate (92.6%) of *R. microplus* was recorded in undulating plain region and lowest (75.8%) was recorded in western plain region. While highest prevalence (32.4%) of *H. a. anatolicum* was recorded in western plain region and lowest (10.5%) in undulating plain region.

Likewise, among the buffaloes highest (75.0%) prevalence of *R. microplus* was recorded in undulating plain region and lowest (40.5%) in western plain region. Highest prevalence (71.8%) of *H. a. anatolicum* was recorded in western plain region and lowest (25.0%) in undulating plain region (Table 1).

Age and sex wise prevalence of R. microplus and H. a. anatolicum: No marked variation in the prevalence of *R. microplus* and *H. a. anatolicum* was observed in two age groups of cattle and buffalo population of Punjab. Similarly, sex wise no marked variation was recorded in the prevalence of *R. microplus* and *H. a. anatolicum* in both cattle and buffaloes.

Seasonal dynamics of R. microplus and H. a. anatolicum in different districts of Punjab: In monsoon season among the cattle screened 83.9% were positive for *R. microplus*, 21.0% for *H. a. anatolicum* and 4.9% were having mixed infestations of both *R. microplus* and *H. a. anatolicum* ticks. Likewise, in winter 97.7, 6.1 and 3.8% were found positive for *R. microplus*, *H. a. anatolicum* and mixed infestations, respectively. Similarly, in summer, out of total screened cattle 83.1% were positive for *R. microplus*, 23.1% for *H. a. anatolicum* and 6.2% were found to have mixed infestations of both the ticks.

In buffaloes, in monsoon season 37.8% were found positive for *R. microplus* and 62.2% were positive for *H. a. anatolicum*. In winter, 81.9%, 20.1% and 2.1% buffaloes were positive for *R. microplus*, *H. a. anatolicum* and mixed infestations, respectively whereas, in the summer season 51.6%, 61.5% and 13.2% were positive for *R. microplus*, *H. a. anatolicum* and mixed infestations, respectively.

Distribution of R. microplus and H. a. anatolicum in organized and unorganized dairy farms: Overall, in organized dairy farms, the prevalence of *H. a. anatolicum* was very low (3.74%) and higher (45.31%) in unorganized sector. However, among the cattle screened from organized dairy farms it was found that 98.1% were positive for *R. microplus* and 1.9% for *H. a. anatolicum*. Whereas, in organized buffalo farms, among the buffaloes screened, 90.4% were positive for *R. microplus* and 9.6% for *H. a. anatolicum*. While, in cattle population screened under unorganized dairy farm, 77.9% were positive for *R. microplus*, 31.1% for *H. a. anatolicum* and 9.0% were having mixed infestations of both the ticks. In buffalo population under unorganized dairy farm, 51.3% were positive for *R. microplus*, 60.5% for *H. a. anatolicum* and 11.8% were harbouring mixed infestations.

The prevalence of *R. microplus* and *H. a. anatolicum* ticks

in different districts of Punjab, showed a significant variation ($P < 0.01$). *R. microplus* was found to be the predominant tick of cattle in the state. This may be due to change in climatic conditions, exponential rise of exotic and cross bred cattle in Punjab or adaptation of enhanced managemental system which is detrimental for the survival of multi-host ticks (Gill and Gill 1977). Whereas, in buffalo population *R. microplus* and *H. a. anatolicum* were almost evenly distributed as buffaloes are less susceptible to brevirostrate tick *R. microplus* due to less dense hair coat, thickness of hide and wallowing habit in mud (Khan 1986).

The distribution of *R. microplus* and *H. a. anatolicum* in different agro-climatic zone showed a significant association ($P < 0.01$). Maximum prevalence of *R. microplus* both in cattle and buffalo was recorded in central plain and undulating plain region where greater annual rainfall associated with high soil moisture content is evident (Raizada and Nagar 1979, Rajagopalan and Sreenivasan 1981, Chhabra 1992, Shahardar *et al.* 1998, Ghai *et al.* 2008). A hike in the prevalence of *H. a. anatolicum* in western and western plain region suggested that relatively higher temperature and lower rainfall favours the development of *H. a. anatolicum* (Estrada 2008, Ghai *et al.* 2008).

As reported by Manan *et al.* (2007) age of animals has role on the infestation pattern of tick species. However, the findings of the present study are mainly attributed to the fact that the animals of all age groups are maintained in close proximity to each other and thus uniformly sharing the tick population. Similarly, no marked difference was recorded in tick infestation pattern amongst males and females although Sutherst *et al.* (1983) reported that the milch animals are more susceptible to tick infestations because of hormonal stress.

Although variation was observed in *R. microplus* population in different seasons, the result indicates that it is the predominant tick in all seasons in cattle population of Punjab state. *H. a. anatolicum* ticks in cattle population showed a significant variation ($P < 0.01$) with the change of season and were found minimum in winter season whereas an increase in population was observed in the summer season. At the advent of monsoon season, the tick population showed a slightly decrease which declined further in the winter season. This population dynamic pattern clearly attribute to the fact that hot and dry weather is conducive for the development of *H. a. anatolicum* tick as reported earlier (Bouattour *et al.* 1996, Maske 1996, Estrada 2008).

The results revealed that the farming system (organized and unorganized) have a significant influence ($P < 0.01$) on the prevalence of *R. microplus* and *H. a. anatolicum* ticks. In organized dairy farm, *R. microplus* was found to be the predominating tick species in both cattle and buffaloes. Similar dominance of *R. microplus* in organized farms has been earlier reported by Vatsya *et al.* (2007). But in the unorganized sector it was interesting to record an entirely

different scenario as *R. microplus* remains predominant in cattle but the prevalence of *H. a. anatolicum* was found to be significantly higher (31.0%). Contrary to the organized sector, buffaloes of unorganized dairy farm showed a higher prevalence of *H. a. anatolicum* as compared to *R. microplus*.

Hence it is concluded that *R. microplus* is emerging as the main tick of the organized dairy farms with permanent structure, like pakka and open shed and good drainage facility to ensure proper ventilation and low humidity which is proving detrimental for the success of multi-host ticks. One host ticks or *R. microplus* remains predominant as its survival is much easier and its whole life cycle can be spent on the same host. As there was a progressive decline in the prevalence of *H. a. anatolicum* in organized dairy farms. Contrary to this, in unorganized sector the managerial practices favour the survival of all type of tick population. Lack of proper drainage and ventilation leads to high humidity in the sheds and provides an ideal condition for the development of ticks. Also the presence of cracks and crevices along with kaccha floor provides excellent hiding and breeding places for the dropped engorged females and also larvae and nymphs of multi-host ticks. Thus the survival of multi host ticks is favoured which accounts for the comparable prevalence of *R. microplus* and *H. a. anatolicum* in the unorganized dairy farm of Punjab.

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