

EPIDEMIOLOGY OF IXODID TICKS IN BUFFALOES (*BUBALUS BUBALIS*) OF PUNJAB, INDIA

N.K. Singh* and S.S. Rath

ABSTRACT

A total of 3590 buffaloes of all age groups and sex were examined from various districts of Punjab state, India. The association between age, sex of host, season and the prevalence of ixodid ticks on animal level were investigated by multivariate logistic regression. The overall prevalence of ixodid ticks, *Rhipicephalus (Boophilus) microplus*, *Hyalomma anatolicum anatolicum* and mixed infestations were 57.68, 31.83, 19.08 and 6.76%, respectively. The results of multivariate analysis showed that the prevalence was associated with season ($P<0.001$; OR: 3.153; CI 95%: 2.69-3.69), host age ($P<0.001$; OR: 2.13; CI 95%: 1.67-2.73) and sex ($P<0.001$; OR: 0.416; CI 95%: 0.24-0.71).

The prevalence of ixodid ticks were highest in monsoon season (74.48%) whereas, maximum prevalence of *R. (B.) microplus* and *H. a. anatolicum* were recorded in monsoon (44.73%) and summer (23.32%), respectively and the seasonal variation was significant ($P<0.001$). Further, higher tick infestation was recorded in calves <6 months of age and also in males. The findings of the current study would provide a basis for evolving effective control strategy for the management of ticks in buffalo population of the region.

Keywords: buffalo, epidemiology, *Hyalomma anatolicum anatolicum*, *Rhipicephalus (Boophilus)*

microplus

INTRODUCTION

Ticks and the diseases they transmit are widely distributed throughout the world, particularly in tropical and subtropical regions. Losses attributable to ticks are caused either directly through tick worry, blood loss, damage to hides and udders and the injection of toxins, or indirectly through mortality or debility caused by the diseases transmitted by or associated with the ticks. The global economic loss due to tick infestation has been estimated as US\$ 14000 to 18000 million annually and the cost of management of tick and tick borne diseases (TTBDs) in livestock of India is as high as US\$ 498.7 million per annum (Minjauw and McLeod, 2003). 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 a significant percentage of India's buffalo heads and contributes nearly 9% to the Indian milk production. The state is situated at the North West frontier of India and the climatic condition of the state is highly conducive for growth and development of ticks. In past, several sporadic reports on tick infestation patterns of dairy

animals from Punjab had been published (Gill and Gill, 1977; Singh and Singh, 1999; Ghai *et al.*, 2008; Haque *et al.*, 2011) but a comprehensive epidemiological study covering whole of the state has not been explored so far. Therefore, the present study was undertaken to determine the epidemiological patterns of the ixodid tick in buffaloes of Punjab state, India.

MATERIALS AND METHODS

Location, geography and climate of study area

The state of Punjab extends from the latitudes 29.30°N to 32.32°N and longitudes 73.55°E to 76.50°E in the northwest region of India. It covers a geographical area of 50,362 km² and lie between altitudes 180 meters and 300 meters above sea level. The three major seasons in Punjab 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 in summers and winters are cool with some frosts. Average rainfall in Punjab is 565.9 mm and ranges from about 915 mm in north to 102 mm in south. (<http://punjabonline.in/Profile/Geography/climate.asp>).

Collection of ticks

Ticks were collected during February, 2010 to August, 2011 from 3590 buffaloes of different villages covered under the eighteen districts. Animals of both sexes and all age groups were examined and each animal examined 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 and were brought to the laboratory and separately stored in 70% ethanol. Adult ticks were identified under a stereomicroscope, according to general identification keys (Estrada-Pena *et al.*, 2004).

Statistical analysis

All data analyses were performed by using statistical software program (SPSS for Windows, Version 19.0, USA). Association between the prevalence of ixodid tick infestation and various factors was carried out by Chi square (χ^2 -test). Variables with significant association at $P < 0.05$ (two-sided) were subjected to the multivariate logistic regression model. The results were each expressed as P value and odds ratio (OR) with a 95% confidence interval (CI 95%).

RESULTS AND DISCUSSION

Ticks collected from the buffalo population of Punjab state were identified as *Rhipicephalus (Boophilus) microplus* and *Hyalomma anatolicum anatolicum*. The prevalence of ixodid ticks, *R. (B.) microplus*, and *H. a. anatolicum* were 57.68%, 31.83% and 19.08%, respectively. Most infestations were pure with single species as mixed infestations of both genera occurred less frequently (6.76%). These ticks were present on all over the body but *R. (B.) microplus* showed preference for the areas with softer skin viz. groin, insides of shoulder and thighs, around the anus and external genitalia, base of tail etc. Whereas, *H. a. anatolicum* were found to be evenly distributed through out the body and in some animals an atypical circular infestation pattern by the nymphal stages was documented (Figure 1).

Results of the current study reveal that *R.*

(B.) microplus and *H. a. anatolicum* are the ixodid ticks infesting buffaloes of Punjab state, India. In contrast, much earlier reports from the region document a large number of ixodid tick species parasitizing buffaloes from the same geographical area (Gill and Gill, 1977; Miranpuri, 1988). The change in the tick population in form of reduced number of species may be related to the adaptation of better animal husbandry practices in the last two to three decades. Newer tick control measures and availability of effective acaricides proved to be detrimental particularly for the survival of ticks other than the two species reported in the study mainly due to their initial low frequencies in the population (Gill and Gill, 1977). Similar to the findings of the current study, recent studies on the tick population of dairy animals from the region also report *R. (B.) microplus* and *H. a. anatolicum* as the only tick species infesting dairy animals (Singh and Singh, 1999; Sangwan *et al.*, 2000; Ghai *et al.*, 2008; Haque *et al.*, 2011).

Seasonal dynamics of ixodid ticks

The current study indicates that season plays a very important role in population dynamics

of ticks and *R. (B.) microplus* was recorded as the predominant tick in all seasons of Punjab state. Significant association between prevalence of infestation with ixodid ticks in buffaloes and the season was observed ($P < 0.001$; OR: 3.153; CI 95%: 2.69-3.69). The β value of -0.725 was recorded between the prevalence of ticks and the various seasons (summer followed by monsoon and winter) thus indicating a decrease in tick prevalence with decrease in ambient temperature (Table 1). Several studies are on record with regard to seasonal dynamics of ticks in India (Rajagopalan and Sreenivasan, 1981; Das, 1994; Vatsya *et al.*, 2008).

The highest infestation rate was recorded in monsoon season (74.48%), followed by summer (66.64%) and least in winter (38.78%) with a significant variation ($P < 0.001$) (Table 2) in seasonal distribution as the hot and humid environmental conditions in the monsoon is most conducive for the development of various developmental stages of ticks. Whereas, the cold and dry conditions of the winters are unfavourable for its survival and tick passes the winter as engorged females, nymphs, larvae and unfed adults by hiding into



Figure 1. Atypical circular infestation pattern of *Hyalomma a. anatolicum* in buffalo.

the cracks and crevices (Chaudhuri, 1969) thus leading to low infestation levels. The trend was similar for the distribution of *R. (B.) microplus* with significant statistical variation ($P<0.01$) among seasons whereas; seasonal prevalence of *H. a. anatolicum* showed entirely different trend with maximum prevalence in drier months with significant variation ($P<0.001$) as hot and dry weather is conducive for its development and similar trend has been reported earlier (Bouattour *et al.*, 1996; Estrada Pena, 2008). An earlier study also revealed the gradual overpowering of *R. (B.) microplus* on *H. a. anatolicum* in the winter season and is because of its wide distribution and prevalence (Haque *et al.*, 2011).

Prevalence of ixodid ticks in various age groups of buffaloes

Animal age significantly affected the prevalence of infestation by ixodid ticks ($P<0.001$; OR: 2.13; CI 95%: 1.67-2.73) but had a negative correlation ($\beta=-2.61$). Thus, among the different age group of buffaloes screened maximum tick infestation was recorded in calves <6 months of age (72.73%), followed by 6 months to 1 year age group (61.30%) and least in >1 year age group (55.53%). Similarly, significant difference ($P<0.001$) was recorded in the prevalence of *R. (B.) microplus* among different age groups with highest prevalence in calves <6 months of age, whereas, prevalence of mixed infestations was higher in older animals (Table 2). The age of the host animal plays a significant role on the infestation pattern of tick species (Manan *et al.*, 2007). Younger animals are more prone to tick infestations and can be correlated with the fact that the adult or the productive animals are given utmost care with better animal husbandry practices whereas the younger animals are least attended

with limited use of acaricides leading to higher tick infestations. Also, low tick infestation on adult cattle is probably due to resistance acquired following repeated exposure from early life (Das, 1994). Further, similar infestation pattern of ticks had been reported in past (Nagar *et al.*, 1978; Manan *et al.*, 2007).

Sex wise prevalence of ixodid ticks

The effect of sex of host on the prevalence of ixodid tick infestations was significant ($P<0.01$; OR: 0.416; CI 95%: 0.24-0.71) with positive correlation ($\beta=4.42$) and higher prevalence in males. The prevalence of *R. (B.) microplus*, *H. a. anatolicum* and mixed infestation in both sexes were significantly variable ($P<0.001$) (Table 2). Although, Sutherst *et al.* (1983) reported that the milch animals because of the hormonal stress carry more ticks but in the current study a higher tick infestation was encountered in males and can be attributed to the fact that male animals in this part of the country are neglected and least care is provided with occasional use of acaricides. This is due to the reason that males are now considered useless by the farmers after the popularization of artificial insemination and use to motorized power for farm usage as informed by the owners through the questionnaire.

It can hence be concluded that *R. (B.) microplus* and *H. a. anatolicum* are the ixodid ticks of buffaloes of Punjab state and the former being the predominant one. Further, as the tick population peaks at the monsoon followed by summer season the control measures should be adopted accordingly to minimize the losses attributed to ticks and thus increase the productivity of the animals.

Table 1. Final logistic regression model for factors associated with ixodid ticks infestation in buffaloes on animal levels.

Variables	Regression coefficient (β)	Standard Error (SE)	P value	Odds	Confidence Interval (CI 95%)
Season	-0.725	0.06	0.000	3.153	2.69-3.69
Age	-2.61	0.106	0.000	2.135	1.67-2.73
Sex	4.42	0.237	0.000	0.416	0.24-0.71

Table 2. Epidemiology of ixodid ticks in buffaloes of Punjab state, India.

Groups		Examined	Positive	+ve for Mixed infestation	+ve for <i>R. (B.) microplus</i>	+ve for <i>H. a. anatolicum</i>
Season	Summer	1256	837 (66.64)	143 (11.38)	401 (31.92)	293 (23.32)
	Monsoon	921	686 (74.48)	85 (9.22)	412 (44.73)	189 (20.52)
	Winter	1413	548 (38.78)	15 (1.06)	330 (23.35)	203 (14.36)
	χ^2 value	-	358.9*	101.4*	10.40**	27.9*
Age	<6 mon	352	256 (72.73)	16 (4.54)	167 (47.44)	73 (20.73)
	6 mon – 1 yr	292	179 (61.30)	20 (6.84)	93 (31.84)	66 (22.60)
	> 1 yr	2946	1636 (55.53)	207 (7.02)	883 (29.97)	546 (18.53)
	χ^2 value	-	41.49*	294.1*	999.3*	663.0*
Sex	Female	3514	2013 (57.29)	238 (6.77)	1115 (31.73)	660 (18.78)
	Male	76	58 (76.32)	5 (6.57)	28 (36.84)	25 (32.89)
	χ^2 value	-	11.80**	223.4*	1034*	588.6*
	Total	3590	2071 (57.68)	243 (6.76)	1143 (31.83)	685 (19.08)

Figures in parenthesis are the % prevalence of infested ticks; *P<0.001, **P<0.01

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