Original Article
Buffalo Bulletin (October-December 2024) Vol.43 No.4
https://doi.org/10.56825/bufbu.2024.4343819

REVALENCE OF IXODID TICKS IN BUFFALOES OF INDORE DISTRICT, MADHYA PRADESH, INDIA

Umesh Kumar Mandloi, Anantrao Kashiram Jayraw*, Gaya Prasad Jatav, Mukesh Shakya, Vivek Agrawal and Nirmala Jamra

Received: 06 August 2020
Accepted: 20 December 2024

ABSTRACT

Ticks which are highly prevalent in tropical and subtropical regions, top the list as arthropod vectors amongst microbial diseases in non-human vertebrates and are major constraint in achieving maximum production from buffaloes which are commonly called as 'Black Diamond' owing to their versatile role in the socioeconomic upliftment. Although voluminous literature is available pertaining to prevalence of ticks in cattle, but when it comes to buffaloes, very scanty literature is available about buffalo ticks. Therefore, an investigation was carried out to assess the prevalence of ixodid ticks in buffaloes of Indore district. Every month, ticks were collected from a total of 9922 buffaloes belonging to randomly selected 5 villages of each tehsil of Indore district, *viz.* Indore, Mhow, Depalpur, Sanwer and Hatod. The current study revealed an overall tick prevalence of 42.49% with significantly high prevalence of *Rhipicephalus microplus* (29.83%) than *Hyalomma anatolicum* (10.14%) and mixed infestation (2.52%). Month-wise, the tick prevalence was significantly high in the month of September (48.41%) while it was significantly lowt in the month of January (30.04%). Season-wise, the prevalence of ticks was highest in monsoon (48.41%) than summer (42.55%) and winter (40.75%). Amongst the various age groups, significantly high tick infestation was evident in 1–3-year-old (71.35%) than <1 year-old (49.29%) and >3-year-old (37.47%) animals. Significantly high prevalence was recorded in males (59.47%) than that of females (41.09%). Significantly higher rate of occurrence was noted in Mhow tehsil (50.49%) as compared to Depalpur (43.76%), Indore (43.35%), Sanwer (38.42%) and Hatod (36.53%) tehsils of Indore district.

Keywords: *Bubalus bubalis*, buffaloes, *Hyalomma anatolicum*, India, Indore, Madhya Pradesh, *Rhipicephalus microplus*

INTRODUCTION

Ticks are the most important ectoparasites causing colossal monetary losses to the livestock industry in tropical, subtropical and temperate areas of the globe. Their occurrence and seasonal dynamics are greatly influenced by varying climatological patterns. A single female engorged tick causes a daily loss of 0.5 to 2 ml of blood, 8.9 ml of milk and 1 g of body weight. Apart from this,

Department of Veterinary Parasitology, College of Veterinary Science and Animal Husbandry, Nanaji Deshmukh Veterinary Science University, Mhow, India, *E-mail: jayrawanant@gmail.com

they are also responsible for skin damage (Biswas, 2003; Jongejan and Uilenberg, 2004), blood loss, toxicity from the bites, reduced animal weight gain and milk production (Sutherst, 1983; Sajid *et al*., 2007) along with transmission of tick-borne diseases like babesiosis and anaplasmosis (Rodríguez-Vivas *et al*., 1998 and 2004). Approximately, a total of 106 species of ticks have been documented in India (Geevarghese *et al*., 1997) amongst which *Boophilus microplus*, which is presently known as *Rhipicephalus microplus* (CFSPH, 2007) and *Hyalomma anatolicum* are widely prevalent and are considered as economically important ticks of dairy animals in India (Ghosh *et al*., 2007). In India, Minjauw and Mc Leod (2003) estimated the control cost of ticks and tick-borne diseases (TTBDs) in animals to the tune of US$ 498.7 million per year. Several factors, *viz.* species, age, sex, season, breed, photoperiod and management influence the susceptibility and resistance of animals to the tick infestation. Application of chemical acaricides is still the most widely used method of control, although Sagar *et al.* (2020); Shakya *et al.* (2021); Mandloi *et al.* (2022) reported the resistance against various chemical acaricides in ticks of Indore district. Presently, the researchers are aiming to decrease the tick population to acceptable levels, to minimize the production losses and to minimize the dependence on chemical acaricides by adopting alternative methods of tick control (Ghosh *et al*., 2007). Although Katuri *et al.* (2013) documented the prevalence of ixodid ticks from Jabalpur district of Madhya Pradesh, however, the information regarding the prevalence of ixodid ticks in buffaloes of Malwa region is not available, hence, it becomes mandatory to develop data on prevalence of ixodid ticks in buffaloes for the execution of future control measures against the ticks.

MATERIALS AND METHODS

Buffalo ticks were collected from 5 tehsils of Indore district, *viz*. Indore, Mhow, Depalpur, Sanwer and Hatod during the period from September 2014 to May 2015. A questionnaire was prepared to record the age and sex of the animal. Buffalo of both the sexes and of different age groups, *viz*. <1 year, 1 to 3 years and >3 years were examined for the presence of ticks and each tick infested animal was considered as one sample. Ixodid ticks were gently plucked up from the body of the host while avoiding the damage of their mouth parts. Collected ticks were transferred to the separate collection vials which were numbered as per the serial no. of the questionnaire, as the questionnaire had the detailed information about the source of the collected sample. For passing the air in the test tube, mouth of each tube was closed by muslin cloth and was tied with the rubber band and these samples were carried to the Department of Veterinary Parasitology, College of Veterinary Science and Animal Husbandry, Mhow for their correct identification as per the standard keys provided by Soulsby (1982).

RESULTS AND DISCUSSIONS

The ticks collected from 9922 buffaloes of Indore district were identified as *Rhipicephalus microplus* and *Hyalomma anatolicum.* The overall prevalence of ticks during the period of study was noted as 42.49%. The *R. microplus* was found to be the predominant tick species with an overall prevalence of 29.83% than that of *H. anatolicum* (10.14%) and mixed infestation (2.52%). As per the observations of the current survey, the *R. microplus* was found to be the predominant tick species when

compared with *H. anatolicum* in buffaloes which is attributed to its easier survival as the whole life is being spent on the body of the same host being a one host tick. These observations are in line with the findings of Shahardar *et al.* (1998); Rajendran and Hafeez (2003). Further, Sangwan *et al.* (2000) also evidenced a similar pattern and opined that one host tick, the *R. microplus* is replacing its three-host tick counterpart, the *H. anatolicum* in large ruminants of Haryana. Similar trend with high infestation of *R. microplus* than *H. anatolicum* was also evidenced by Vatsya *et al.* (2008) in large ruminants of Uttarakhand. The present observations are also in conformity with the observations of Manan *et al.* (2007); Haque *et al.* (2011); Singh and Rath (2013); Asmaa *et al.* (2014); Eyo *et al.* (2014); Mandloi *et al.* (2016).

Month-wise, the prevalence of ticks (Table 1) was highest during the month of September (48.41%) while it was lowest during the month of January (30.04%), which is in accordance with the observations of Atif *et al.* (2012) who reported highest tick infestation in rainy season. Patel *et al.* (2015) also described similar trends in buffaloes from Mathura. Highest infestation in the month of September (monsoon) which is attributable to increased hotness and dampness in the environment. Season-wise, significantly high tick prevalence was noticed in monsoon season (48.41%) than summer (42.55%) and winter (40.75%) season (Table 2). Which agrees with the study of Singh *et al.* (2007) from Manipur, Thakur *et al.* (2007) from Marathwada region of Maharashtra, Vatsya *et al.* (2007 and 2008) from Uttarakhand, Haque *et al.* (2011) from Punjab, Moges *et al.* (2012) from Ethiopia, Singh and Rath (2013) from Punjab, Chhillar *et al.* (2014) from Haryana, Khajuria *et al.* (2015) from Jammu and Patel *et al.* (2015) from Mathura. On the contrary, Rajendran and Hafeez (2003) reported highest prevalence in summer followed by monsoon and winter seasons from Tirupati, Andhra Pradesh. Further, Manan *et al.* (2007) also witnessed higher tick infestation in late summer while lowest

As regards to age-wise prevalence, significantly high prevalence was noted in animals of 1 to 3 year-age (71.35%) group followed by <1 year (49.29%) and >3 year-age (37.47%) group indicating overall high prevalence in young animals than that of their adult counterparts (Table 2). Vatsya *et al.* (2007) also documented similar findings with high infestation in <1 year-old than grown up and adult cattle and buffaloes of Uttaranchal. Higher susceptibility of young ones than adults was also documented by Kabir *et al.* (2011); Patel *et al.* (2015) who recorded higher tick infestation in young ones than grown up and adult animals. Synonymously, Singh and Rath (2013) also evidenced maximum tick infestation in young ones than that of adults. Eyo *et al.* (2014) also witnessed a high prevalence in young ones than adults.

According to Manan *et al.* (2007), age of the animal is crucial as regards to the pattern of tick infestation is concerned and accordingly findings of the present survey indicated that, younger animals were more prone to tick infestation than their adult counterparts, which might be due to the fact that, the utmost care of adult animals is being taken with better animal husbandry practices owing to their productivity as compared to their younger counterparts and animal owners are least bothered about them with rare use of acaricides resulting into higher rate of tick infestation in young ones. Further, the low tick infestation in adult animals is attributed to the fact that the resistance being acquired due to repeated exposure from the early life (Misra, 1984; Das, 1994). On the other hand,

Table 1. Month-wise prevalence of ixodid ticks in buffaloes of Indore district.

Months	Examined	Positive	+ ve for *R. microplus*	+ ve for *H. anatolicum*	+ ve for mixed infestation
September	1129	595 (48.41)	471 (38.32)	113 (9.19)	11 (0.89)
October	1152	517 (44.88)	385 (32.42)	116 (10.07)	16 (1.39)
November	989	393 (39.74)	287 (29.02)	103 (10.41)	3 (0.30)
December	1086	523 (48.16)	279 (25.69)	184 (16.94)	60 (5.52)
January	1102	331 (30.04)	184 (16.70)	116 (10.53)	31 (2.81)
February	1153	396 (34.34)	284 (24.63)	89 (7.72)	23 (1.99)
March	1164	541 (46.48)	374 (32.13)	117 (10.05)	50 (4.29)
April	1029	488 (47.42)	337 (32.75)	117 (11.37)	34 (3.30)
May	1018	432 (42.44)	359 (35.26)	51 (5.10)	22 (2.16)
Total	9922	4216 (42.49)	2960 (29.83)	1006 (10.14)	250 (2.52)
$\chi 2$ value	-	156.756**	185.839**	95.181**	98.651**

NS- Non significant, **<0.01; Figures in parentheses are percentage of positive animals.

Table 2. Prevalence of ixodid ticks in buffaloes of Indore district.

Groups mixed		Examined	Positive	+ ve for *R. microplus*	+ ve for *H. anatolicum*	+ ve for infestation
Season	Monsoon	1129	595 (48.41)	471 (38.32)	113 (9.19)	11 (0.89)
	Winter	4329	1764 (40.75)	1135 (26.22)	519 (11.99)	110 (2.54)
	Summer	4364	1857 (42.55)	1354 (31.03)	374 (8.57)	129 (2.96)
	$\chi 2$ value	-	23.026**	72.316**	29.253**	16.598**
Age	< 1 year	1130	557 (49.29)	425 (37.61)	103 (9.11)	29 (2.57)
	1-3 years	1075	767 (71.35)	549 (51.07)	153 (14.23)	65 (6.05)
	> 3 year	7717	2892 (37.47)	1986 (25.73)	750 (9.72)	156 (2.02)
	$\chi 2$ value	-	467.178**	326.164**	22.567**	62.248**
Sex	Male	755	449 (59.47)	304 (40.26)	110 (14.57)	35 (4.63)
	Female	9167	3767 (41.09)	2656 (28.97)	896 (9.77)	215 (2.34)
	$\chi 2$ value	-	96.404**	42.486**	17.605**	14.898**
Tehsils	Mhow	1935	977 (50.49)	743 (38.39)	190 (9.82)	44 (2.27)
	Indore	1973	855 (43.35)	576 (29.19)	227 (11.50)	52 (2.63)
	Depalpur	2075	908 (43.76)	625 (30.12)	238 (11.47)	45 (2.17)
	Hatod	1990	727 (36.53)	513 (25.78)	159 (7.99)	55 (2.76)
	Sanwer	1949	749 (38.42)	503 (25.81)	192 (9.85)	54 (2.77)
	$\chi 2$ value	-	94.684**	98.986**	18.558**	2.607NS
	Total	9922	4216 (42.49)	2960 (29.83)	1006 (10.14)	250 (2.52)

NS- Non significant, **<0.01; Figures in parentheses are percentage of positive animals.

higher prevalence in adult animals than young ones were reported by Thakur *et al*. (2007); Bilkis *et al.* (2011); Asmaa *et al*. (2014); Werede and Afera (2014) from Maharashtra, Bangladesh, Egypt and Ethiopia, respectively.

The overall prevalence of ixodid ticks in male and female buffalo was 59.47% and 41.09%, respectively indicating significantly high tick infestation in male animals than their female counterparts. Similarly, high tick intensity in male buffaloes than their female counterparts was noted by Thakur *et al*. (2007). Further, Singh and Rath (2013); Eyo *et al.* (2014); Tasawar *et al.* (2014); Werede and Afera (2014); Khajuria *et al*. (2015) also recorded similar trend in animals of Punjab, Nigeria, Pakistan, Ethiopia and Jammu, respectively. Current study emanated the high prevalence of ticks in male animals than their female counterparts which might be due to the fact that, owing to the productivity of milch animals, their proper care is being taken while the proper care of their male counterparts is not taken hence the frequency of application of acaricides is very less in case of male animals. This is being practiced owing to the fact that, males are becoming less useful now-a-days owing to artificial insemination and use of motorized power for farm usage. On the contrary, Bilkis *et al.* (2011); Kabir *et al.* (2011) documented higher prevalence in case of females than that of males, which is attributable to hormonal stress in case of milch animals resulting in high tick infestation (Sutherst *et al*., 1983).

Tehsil-wise, maximum prevalence was reported in Mhow tehsil (50.49%) followed by Depalpur (43.76%), Indore (43.35%), Sanwer (38.42%) and least was in Hatod tehsil (36.53%). Overall tick infestation was maximum in Mhow tehsil while minimum in Hatod tehsil of Indore district. The highest prevalence in Mhow tehsil is attributable to poor managmental conditions and poor health status of animals owing to overcrowding. The tehsil-wise variation evidenced in the present investigation is in line with the observations of Haque *et al*. (2011); Singh and Rath (2013) who also recorded place-to-place variation in different regions of Punjab. As per Singh and Rath (2013) the prevalence of ticks in an area is influenced by its macro and micro-climate which might be responsible for place-to-place variation. Further the tick distribution pattern is also dependent on soil moisture content of the locality (Raizada and Nagar (1979); Rajagopalan and Sreenivasan (1981); Chhabra (1992).

ACKNOWLEDGEMENTS

Necessary facilities provided by the Dean, College of Veterinary Science and Animal Husbandry, Mhow to carry out the research work are thankfully acknowledged.

REFERENCES

Asmaa, N.M., M.A. Elbably and K.A. Shokier. 2014. Studies on prevalence, risk indicators and control options for tick infestation in ruminants. *Beni-Suef University Journal of Basic and Applied Sciences*, **3**(1): 68-73. DOI: 10.1016/j.bjbas.2014.02.009

Atif, F.A, M.S. Khan, H.J. Iqbal, Z. Ali and S. Ullah. 2012. Prevalence of cattle tick infestation in three districts of the Punjab, Pakistan. *Pakistan Journal of Science*, **64**(1): 49-53.

Bilkis, M.F., M.M.H. Mondal, S. Rony, M.A. Islam and N. Begum. 2011. Host determinant based prevalence of ticks and lice in cattle (*Bos*

indicus) at Bogra district of Bangladesh. *Progressive Agriculture*, **22**(1&2): 65-73. DOI: 10.3329/pa.v22i1-2.16468

Biswas, S. 2003. Role of veterinarians in the care and management during harvest of skin in livestock species. *In Proceedings of National Seminar on Leather Industry in Today's Perspective*, Kolkata, India, p. 62-64.

Centre for Food Security and Public Health (CFSPH). 2007. *Rhipicephalus* (*Boophilus*) *Microplus*: *Southern Cattle Tick, Cattle Tick*. Iowa State University, Iowa, USA. p. 1-3.

Chhabra, M.B. 1992. Tick infestations of livestock in India and their control. *Insect. Sci. Appl.*, **13**(Sppl 4): 649-655. DOI: 10.1017/S1742758400016258

Chhillar, S., J.S. Chhilar and H. Kaur. 2014. Investigations on some hard ticks (Acari: Ixodidae) infesting domestic buffalo and cattle from Haryana, India. *Journal of entomology and zoology studies*, **2**(4): 99-104.

Das, S.S. 1994. Prevalence of ixodid tick infestation on farm animals in Pantnagar, Tarai of Uttar Pradesh. *Agricultural and Food Sciences, Environmental Science*, **3**: 71-73.

Eyo, J.E., F.N. Ekel, N. Ivoke, C.I. Atama, I.E. Onah, N.E. Ezenwali and C.B. Ikele. 2014. Survey of tick infestation of cattle at four selected grazing sites in the tropics. *Global Veterinaria*, **12**(4): 479-486. DOI: 10.5829/idosi.gv.2014.12.04.8325

Geevarghese, G., S. Fernandes and S.M. Kulkarni. 1997. A checklist of Indian ticks (Acari: Ixodidae). *Indian J. Anim. Sci*., **67**: 566-574.

Ghosh, S., G.C. Bansal, S.C. Gupta, D.D. Ray, M.Q. Khan, H. Irshad, Md. U. Shahiduzzaman Seitzer and J.S. Ahmed. 2007. Status of tick distribution in Bangladesh, India and Pakistan. *Parasitol. Research*, **101**(Sppl. 2): S207-S216. DOI: 10.1007/s00436-007-0684-7

Haque, M., Jyoti, N.K. Singh, S.S. Rath and S. Ghosh. 2011. Epidemiology and seasonal dynamics of ixodid ticks of dairy animals of Punjab state, India. *Indian J. Anim. Sci*., **81**(7): 661-664.

Jongejan, F. and G. Uilenberg. 2004. The global importance of ticks. *Parasitol*., **129**: S3-S14. DOI: 10.1017/s0031182004005967

Kabir, M.H.B., M.M.H. Mondal, M. Eliyas, M.A. Mannan, M.A. Hashem, N.C. Dabnath, O.F. Miazii, C. Mohiuddin, M.A. Kashem, M.R. Islam and M.F. Elahi. 2011. An epidemiological survey on investigation of tick infestation in cattle at Chittagong district, Bangladesh. *Afr. J. Microbiol. Res*., **5**(4): 346-352. Available on: https://www.internationalscholarsjournals.com/articles/an-epidemiological-survey-on-investigation-of-tick-infestation-in-cattle-at-chittagong-district-bangladesh.pdf

Katuri, R.N., G. Das, S.K Chalhotra and A.K. Singh. 2013. Analysis of site of predilection for the ticks of family Ixodidae. *International Journal of Food, Agriculture and Veterinary Sciences*, **3**(2): 42-46. Available on: https://www.cibtech.org/J-FOOD-AGRI-VETERINARY-SCIENCES/PUBLICATIONS/2013/Vol_3_No_2/JFAV...06-009...Katuri...Analysis...Ixodidae.pdf

Khajuria, V., R. Godara, A. Yadav and R. Katoch. 2015. Prevalence of ixodid ticks in dairy animals of Jammu region. *Journal of Parasitic Diseases*, **39**(3): 418-421. DOI:

10.1007/s12639-013-0354-x

Manan, A., Z. Khan and B. Ahmad. 2007. Prevalance and identification of ixodid tick genera in frontier region, Peshawar. *Journal of Agriculture and Biological Sciences*, **2**(1): 21-25.

Mandloi, U.K., A.K. Jayraw, M. Haque and N. Jamra. 2016. Prevalence of ixodid ticks in cattle population of Indore, Madhya Pradesh. *Indian Journal of Veterinary Sciences and Biotechnology*, **12**(2): 62-65. DOI: 10.21887/ijvsbt.v12i2.3740

Mandloi, U.K., A.K. Jayraw, M. Haque, M. Shakya, G.P. Jatav, N.K. Singh, V. Agrawal and N. Jamra. 2022. Resistance status of synthetic pyrethroids in *Rhipicephalus microplus* of Indore district, Madhya Pradesh, India. *Int. J. Trop. Insect Sc*., **42**: 1197-1203. DOI: 10.1007/s42690-021-00638-w

Minjauw, B. and A. McLeod. 2003. Tick-borne diseases and poverty. The impact of ticks and tick-borne diseases on the livelihood of small scale and marginal livestock owners in India and eastern and southern Africa. *Research Report*, DFID Animal Health Programme, Centre for Tropical Veterinary Medicine, University of Edinburgh, UK. p. 59-60.

Misra, S.C. 1984. A note on the incidence and control of ixodid ticks at Bhubaneswer. *Cheiron*, **13**(1): 5-8.

Moges, N., B. Bogale and T. Fentahun. 2012. Hard ticks (Ixodidae): Species composition, seasonal dynamics and body site distribution on cattle in Chilga district, Northwest Ethiopia. *Asian Journal of Agricultural Sciences*, **4**(5): 341-345.

Patel, G., D. Shanker, A.K. Jaiswal, V. Sudan and S.K. Verma. 2015. Prevalence and seasonal variation in ixodid ticks on buffaloes of Mathura district, Uttar Pradesh. *Buffalo Bull*., **34**(1): 21-28. Available on: https://kukrdb.lib.ku.ac.th/journal/BuffaloBulletin/search_detail/result/288687

Raizada, R.N. and S.K. Nagar. 1979. Observations on the environmental stress on distribution and abundance of *Boophilus microplus* and its preference for host and feeding sites in Uttar Pradesh. *Indian J. Anim. Sci*., **49**(8): 622-628.

Rajagopalan, P.K. and M.A. Sreenivasan. 1981. Ixodid ticks on cattle and buffaloes in the Kyasanur forest disease area of Karnataka state. *Indian Vet. J*., **65**: 18-22.

Rajendran, C. and M. Hafeez. 2003. Prevalence of ixodid ticks on crossbred cattle in and around Tirupati. *J. Vet. Parasitol.,* **17**(2): 147-149.

Rodríguez-Vivas, R.I., Y. Mata-Mendez, E. Pérez-Gutierrez and G. Wagner. 1998. The effect of management factors on the *Boophilus microplus* engorged females naturally infected in the Mexican tropics. *Vet. Parasitol*., **78**: 253-257.

Rodríguez-Vivas, R.I., Y. Mata-Mendez, E. Pérez-Gutierrez and G. Wagner. 2004. The effect of management factors on the seroprevalence of *Anaplasma marginale* in *Bos indicus* cattle in the Mexican tropics. *Trop. Anim. Health Pro*., **36**: 135-143.

Sagar, S.V., K. Saini, A.K. Sharma, S. Kumar, R. Kumar, A. Fular, M. Shakya, D. Upadhaya, G. Nagar, C. Shanmuganath, S. Samanta, S. Kumar and S. Ghosh. 2020. Acaricide resistance in *Rhipicephalus microplus* collected from selected districts of Madhya Pradesh, Uttar Pradesh and Punjab states of

India. *Trop. Anim. Health. Prod*., **52**(2): 611-618. DOI: 10.1007/s11250-019-02048-0

Sajid, M.S., Z. Iqbal, M.N. Khan, G. Muhammad and M.U. Iqbal. 2007. Effect of *Hyalomma* ticks (Acari: Ixodidae) on milk production of dairy buffaloes (*Bos bubalus bubalis*) of Punjab (Pakistan). *Ital. J. Anim. Sci*., **6**(Suppl 2): 939-941. DOI: 10.4081/ijas.2007.s2.939

Sangwan, A.K., N. Sangwan and M.C. Goel. 2000. Progressive displacement of *Hyalomma* ticks by *Boophilus microplus* in Haryana. *Journal of Parasitic Diseases*, **24**: 95-96.

Shahardar, R.A., S.M. Niphadkar, V.S. Narsapur and M.L. Gatne. 1998. Ixodid ticks of cattle and buffaloes in coastal districts (Konkan region) of Maharashtra state. *Indian Vet. J*., **75**: 503-506.

Shakya, M., M. Singh, S. Kumar, A.K. Jayraw, G.P. Jatav, V. Agrawal and N. Jamra. 2021. Efficacy of commercially available chemical compound used against management of tick infestation in Mhow, Madhya Pradesh. *Int. J. Trop. Insect Sci*., **41**(01): 1-7.

Singh, N.K. and S.S. Rath. 2013. Prevalence of ixodid ticks in buffaloes (*Bubalus bubalis*) *of* various agro-climatic zones of Punjab state, India. *J. Vet. Parasitol*., **27**(2): 105-109.

Soulsby, E.J.L. 1982. *Helminths, Arthropods and Protozoa of Domesticated Animals*, 7th ed. Bailliere Tindall, London, UK. p. 458-471.

Sutherst, R.W. 1983. Management of arthropod parasitism in livestock. *World Association for the Advancement of Veterinary Parasitology*, Dansmore, Australia.

Sutherst, R.W., J.D. Kerr, G.F. Maywald and D.A. Stegeman. 1983. The effect of season and nutrition on the resistance of cattle to the tick *Boophilus microplus*. *Aus. J. Agr. Res*., **34**(3): 329-339.

Tasawar, Z., S. Nasim and M.H. Lashari. 2014. The prevalence of ixodid ticks on buffaloes at private animal farm Bibipur, Multan. *Global Veterinaria*, **12**(2): 154-157. DOI: 10.5829/idosi.gv.2014.12.02.81198

Thakur, G.T., P.M. Shirsikar, G.M. Chigure, B.W. Narladkar, B.S. Khillare and A.K. Jayraw. 2007. Epidemiological survey of ruminant ticks from Marathwada region of Maharashtra state. *Royal Veterinary Journal of India*, **3**(2): 147-150.

Vatsya, S., C.L. Yadav, R.R. Kumar and R. Garg. 2007. Seasonal activity of *Boophilus microplus* on large ruminants at an organized livestock farm. *J. Vet. Parasitol*., **21**(2): 125-128.

Vatsya, S., C.L. Yadav, R.R. Kumar and R. Garg. 2008. Prevalence of ixodid ticks on bovines in foothills of Uttarkhand state: A preliminary report, India. *Indian J. Anim. Sci*., **78**(1): 40-42.

Werede, H. and B. Afera. 2014. Prevalence of ixodid ticks on bovine of Werieleke Wereda, Tigray. *Acta Parasitol. Globalis*, **5**(2): 146-150. DOI: 10.5829/idosi.apg.2014.5.2.8541