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## Investigations on Some Hard Ticks (Acari: Ixodidae) Infesting Domestic Buffalo and Cattle from Haryana, India.

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### ABSTRACT

A cross-sectional study was conducted to determine the diversity and intensity of hard tick species infesting domestic buffalo and cattle from Haryana, India. A total of 17 collections were performed from 10 allopatric populations during the study period of August 2011 to January 2013. Out of a total number of 662 animals surveyed, 309 animals were found infested with ticks from three different genera of family Ixodidae and a total of 867 ticks were collected and identified. The genera recorded were *Hyalomma* Koch, 1844, *Rhipicephalus* Koch, 1844 and *Dermacentor* Koch, 1844. Tick species identified of the three genera were *Hyalomma anatolicum anatolicum* Koch, 1844, *Hyalomma anatolicum excavatum* Koch, 1844, *Rhipicephalus sanguineus* (Latreille, 1806), *Rhipicephalus (Boophilus) microplus* (Canestrini, 1888), *Rhipicephalus (Boophilus) decoloratus* (Koch, 1844) and *Dermacentor* spp. The present study revealed that *Hyalomma anatolicum anatolicum* and *Rhipicephalus (Boophilus) microplus* are the most common vector species infesting buffalo and cattle in this state. The level of infestation, the seasonal epidemiology of ticks and the associated management practices to adopt are discussed.

**Keywords:** Buffalo, Cattle, Haryana, Taxonomy, Hard ticks

### 1. Introduction

In the developing world domestic animals play a major role as source of energy, food, raw material and manure for the primarily rural farmers [1]. India is home to the largest livestock population in the world accounting for about 57 per cent of the world's buffalo population and about 15 per cent of the world's cattle population and as a result is the largest milk producer in the world. The majority of these livestock (about 88%) are owned by marginal, small and semi-medium farmers (with operational holding area less than 4 ha) [2].

Ticks belonging to family Ixodidae (Acari: Ixodida) are obligate haematophagous ectoparasites of humans and their cultivated animals and their parasitization of livestock results in reduced milk production, reduced weight, and transmission of pathogens like parasitic protozoa - *Babesia*, *Theileria*, *Anaplasma*, Rickettsia bacteria like *Ehrlichia* and arboviruses thus acting as an impediment to the growth of the livestock industry [3, 4, 5]. Perry *et al.* [6] ranks prominent the burden of tick and tick borne diseases (TTBD's) for the continued subsistence of rural agricultural communities. In India alone TTBD's have been implicated to cause projected loss of about \$500 million annually [6, 7, 8, 9, 10, 11]. The larger fraction of domestic animals is formed by the cattle and buffaloes that are raised together as an amalgamated group in the Indian livestock production, therefore having a realistic chance of horizontal and vertical transmission of tick-borne pathogens [12, 13].

A review of literature reveals that India is home to ~109 tick species belonging to 12 genera, out of which ~36 species of ticks from 9 genera have been reported to infest cattle from different Northwestern Indian states [7, 9, 10, 12, 14, 15, 16].

Considering the lack of information on ticks infesting domestic animals from the state of Haryana, India and due to the importance of cattle wealth in the economy of the state the present study was planned with the objective of determining common hard tick species infesting buffalo and cattle in the state. Further, host specificity, preferred site of predilection on the host and their possible role in disease transmission were also studied. The level of infestation, the seasonal epidemiology of ticks and the associated management practices to adopt are discussed in this study.

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## 2. Material and Methods

Ticks were collected from buffaloes and cattle kept at different government and private dairy farms from different places in the state of Haryana (Table 1). A total of 17 collections were performed from 10 allopatric populations during the study period of August 2011 to January 2013. Out of a total number of 662 animals surveyed, 309 animals were found infested with ticks from three different genera of family Ixodidae and a total of 867 ticks were collected and identified (Table 1, Fig 1). The collections were done in tick containers from buffalo and cattle according to

preferred sites of attachment like ears, anal and peri-anal, abdomen, tail etc. of animals. The collections were segregated and encoded based on the host and site predilection. Some of the engorged females were transferred to the humid dark egg-laying containers lined with sterile wet filter papers which were kept in a BOD incubator till egg laying (2-7 days) after which the eggs were photographed and stored in 70% ethanol. All the other specimens collected were identified on the basis of morpho-taxonomic features by following the standard dichotomous keys available for the same [17, 18, 19, 20, 21, 22, 23].

**Table 1:** Details of Tick Collection Done from Buffalo and Cattle during the Present Study from Haryana, India.

S. No	Place of collection	Latitude Longitude	Date of collection	No Of Ticks	Tick Details FE- Female Engorged, FN- Female Normal, M- Male, NN- Nymph Normal, NE- Nymph Engorged	Species Identified
1.	Cattle yard, NDRI, Karnal	29.703504 76.983218	20/09/2012	149	123FE, 5FN, 21M	RBM, RBD
			12/2012	20	8M, 12F, 3FE	HAA
			01/2013	35	19N (9E), 15FE	HAA
2.	Chopra colony, Rohtak road, Gohana	29.127408 76.698571	20/08/2011	56	18FE, 5FN, 21N, 12M	RBD, HAA, DS
			26/08/2011	26	10FE, 13N, 2NE, 1M	RBM, RBD, HAA
3.	Village Nuran Khera, Jind road, Gohana	29.203916 76.581767	26/9/2012	14	1FE, 6F, 7M	HAA, HAE
			28/09/2012	256	63M, 80F, 7NE, 106FE	HAA, RBM
4.	Gautam nagar, Meham road, Gohana	29.128930 76.686523	3/09/2012	27	5F, 12M, 5M	HAA, RS
			22/9/2012	31	7FE, 8F, 16M	HAE, HAA
5.	Hansi road, Karnal	29.687237 76.974474	20/03/2012	45	9M, 1NE, 2F, 1NN, 18FE, 16NF	RBM, RBD, HAE, HAA,
6.	Village Mahra, Rohtak road, Gohana	29.095420 76.688218	08/2011	27	1FE, 8M, 18F	RS
			09/2011	17	5M, 12F	RS
7.	Ashok vihar, Sonapat	28.995288 77.006662	2/10/2012	23	23M	HAE
8.	Garhi brahmanan, Sonapat	28.994380 76.994348	2/10/2012	86	41M, 6FE, 39FN	HAA, HAE
			3/11/2012	25	7M, 2FE, 16F	HAE
9.	Village Gangana, Jind road, Gohana	29.236950 76.614468	26/09/2012	23	6FE, 3N, 11M, 3F	HAA, HAE
10.	Village Katwal, Gohana	29.040534 76.757162	15/5/2012	7	2M, 5F	HAA, HAE

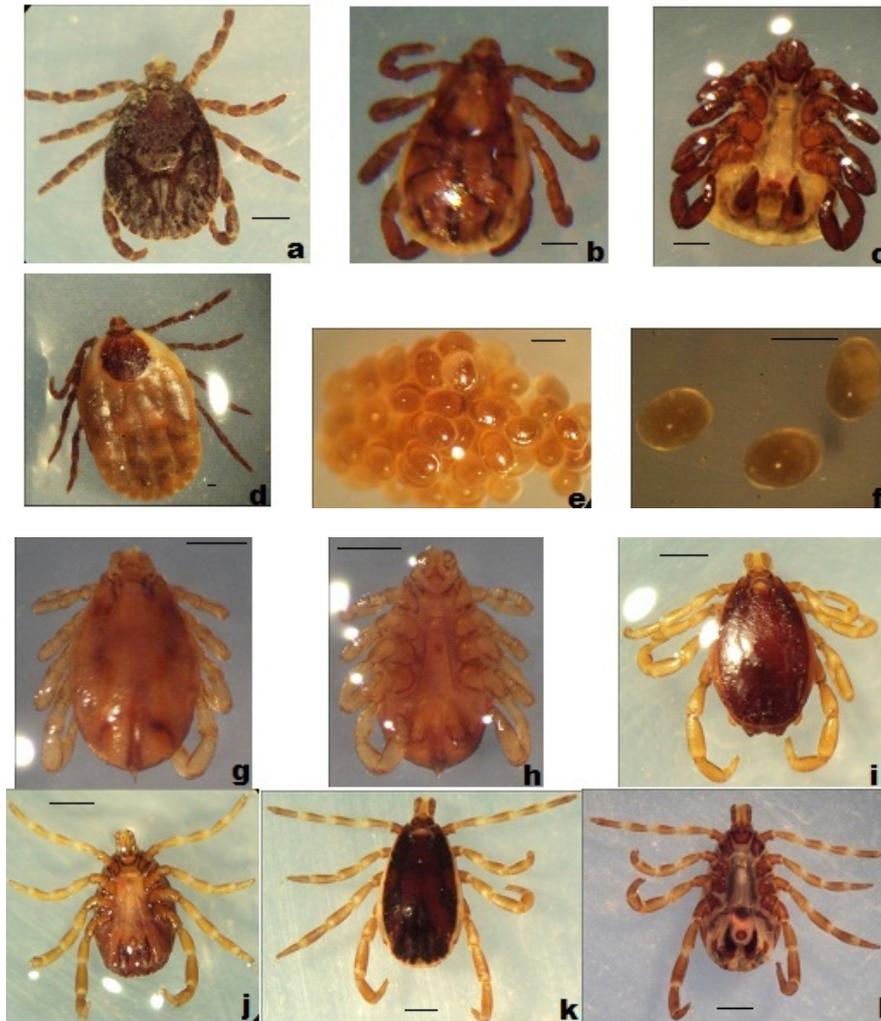
HAA – *Hyalomma anatolicum anatolicum* Koch, 1844; HAE – *Hyalomma anatolicum excavatum* Koch, 1844; RBM – *Rhipicephalus (Boophilus) microplus* (Canestrini, 1888); RBD – *Rhipicephalus (Boophilus) decoloratus* (Koch, 1844); RS – *Rhipicephalus sanguineus* (Latreille, 1806)  
Ds – *Dermacentor* spp.

For identification, the ticks were studied under stereo-zoom microscope and photographed using a digital camera. Further, to store as voucher specimens, ticks were mounted on slides. For this they were subjected to boiling treatment in 10% sodium hydroxide solution to render the non-chitinous portions transparent. Treated ticks were thoroughly washed with water and dehydrated in ascending grades of alcohol and cleared in a mixture of absolute alcohol and clove oil. Cleared ticks were mounted on glass slides in Canada balsam. The identified ticks were segregated according to the genus and stored in well labeled cryo-tubes in a -20 °C deep freezer.

## 3. Results

After detailed microscopic examination and comparison of photographs with the identification keys available for the purpose [17, 18, 19, 20, 21, 22, 23] three genera of hard ticks were recorded from the

state of Haryana during the present study viz. *Hyalomma* Koch, 1844, *Rhipicephalus* Koch, 1844 and *Dermacentor* Koch, 1844. Tick species identified of the three genera are *Hyalomma anatolicum anatolicum* Koch, 1844, *Hyalomma anatolicum excavatum* Koch, 1844, *Rhipicephalus sanguineus* (Latreille, 1806), *Rhipicephalus (Boophilus) microplus* (Canestrini, 1888), *Rhipicephalus (Boophilus) decoloratus* (Koch, 1844) and *Dermacentor* spp. (Table 1, 3; Fig. 1). The present study revealed that *Hy. a. anatolicum* and *Rh. (B.) microplus* are the most common vector species infesting buffalo and cattle in this state. *Hy. a. excavatum* Koch, 1844, *Rh. (B.) decoloratus* (Koch, 1844) and *Dermacentor* spp. are being reported for the first time from Haryana, India. Mixed infestations of *Hy. a. anatolicum* with *Hy. a. excavatum* and *Rh. (B.) microplus* with *Rh. (B.) decoloratus* are not uncommon.



**Fig 1:** Photomicrographs of Some of the Species Collected During the Present Study – a) *Dermacentor* spp. ♂ dorsal, b) *Rh. sanguineus* ♂ dorsal, c) *Rh. sanguineus* ♂ ventral, d) *Rh. sanguineus* ♀ engorged, e) egg mass of *Rh. sanguineus*, f) isolated magnified eggs of *Rh. sanguineus*, g) *Rh. (B.) microplus* ♂ dorsal, h) *Rh. (B.) microplus* ♂ ventral, i) *Hy. a. anatolicum* ♂ dorsal, j) *Hy. a. anatolicum* ♂ ventral, k) *Hy. a. excavatum* ♂ dorsal, and l) *Hy. a. excavatum* ♂ ventral (bar = 1mm)

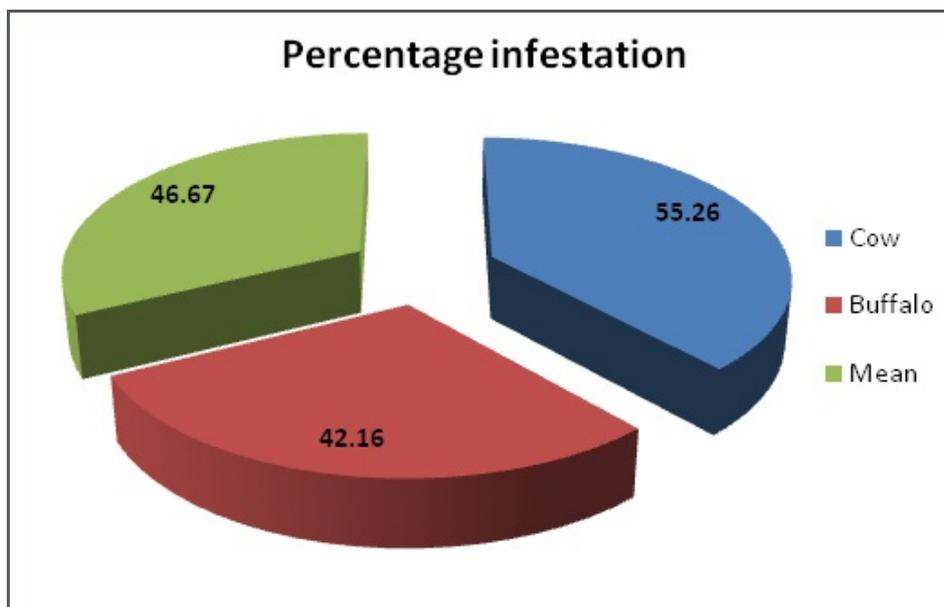
The highest month-wise prevalence was during the post rainy season of July to September, and the lowest prevalence was recorded in the months of December and January, respectively (Table 3). When host preference was studied female and young cattle were found to be heavily infested than males and older individuals. Cattle were heavily loaded with engorged females especially of *Rh. (B.) microplus* and *Rh. sanguineus* while both sexes were observed on buffaloes. The preferred sites of attachment of these species on cattle were inside and outside of the ear for larvae while nymphs and adults preferred croup, udder-scrotum, anno-vulva and tail (Table 3). Heavily infested cattle were weak, showed hair loss, scar marks and skin nodulations. The milk yield was reported to be low by farmers. The young ones of cattle and buffalo were preferred by larvae and nymph around neck and ear edges. They also showed similar symptoms and reduced growth.

As for the host preference and intensity of infestation are concerned, cattle was the preferred choice for most of the hard tick species which were collected during the present study with about

55% of the cattle found infested with ticks as compared to about 42% of the buffaloes (Table 2, Fig. 2). In farms of progressive farmers (who use modern control methods like periodic vaccination) very few tick specimens were recorded as most of the buffalo and cattle were uninfested. It was observed that tick infestation and density varied with management practice and use of different control measures and variation in the degree of infestation from one animal to another and one farm to another was observed.

**Table 2:** Total Rate of the Tick Infestation on Buffalo and Cattle.

Name of the host	Total no of host	
	Observed	Infested
Cow	228	126
Buffalo	434	183
Total	662	309



**Fig 2:** Pie chart showing host specific percentage infestation observed during the present study from Haryana, India.

**Table 3:** Site Predilection and Seasonal Epidemiology of Various Tick Species Infesting Buffalo and Cattle Observed During the Present Study from Haryana, India.

Genus	Species	Stage	Site Predilection	Seasonal occurrence
<i>Hyalomma</i>	<i>anatolicum</i> <i>anatolicum</i>	Adults	Axilla, groin, genital areas, perineum, udder	Throughout the year, reduced in winters
	<i>anatolicum</i> <i>excavatum</i>	Adults	Hindquarters, perineum and udder	Post rainy season
<i>Rhipicephalus</i>	<i>sanguineus</i>	Adults	Ears, neck, shoulder, belly and flanks	Throughout the year, reduced in winters
	<i>Boophilus</i> <i>microplus</i>	Adults	Belly, dewlap, udder and axilla.	Throughout the year, reduced in winters
	( <i>Boophilus</i> ) <i>decoloratus</i>	Adults	Back, upper legs, neck, shoulders, dewlap and belly	Post rainy season, spring season
<i>Dermacentor</i>	<i>Spp.</i>	Adults	Belly	Post rainy season

#### 4. Discussion

India is predominantly an agricultural country with about 70% of its population dependent on income from agriculture. Haryana is a landlocked state in northern India. It is located between 27°39' to 30°35' N latitude and between 74°28' and 77°36' E longitude while its altitude varies from 700 to 3600 ft above sea level. The populations reported in the present study are from the Yamuna-Ghaggar plain that forms the largest part of the state. This state is undergoing rapid ecological changes due to economic development and its consequential urbanization. Earlier studies by Geevarghese *et al.* [7] and Ghosh *et al.* [9, 10] have reported that out of a total of 109 species of ticks present in India 88 belong to family Ixodidae of hard ticks. Chhabra [4] had reported 46 tick species of family Ixodidae infesting livestock in India of which 13 were reported to commonly infest buffalo while 36 of them were reported to infest cattle. Geevarghese *et al.* [7] have reported that about 10 species of hard ticks might be prevalent in Haryana infesting various livestock and wild animals by compiling data of ticks reported in the literature, (though no state specific study is reported in the literature to infer the tick diversity of this northwestern Indian state of Haryana). Geevarghese *et al.* [7] stated that a large number of the

species infesting livestock have been recorded as vectors of various pathogens. According to them, further research in lesser surveyed states of India is bound to yield several new species and requires deeper insight into tick systematics.

In this context, the present study has resulted in identification of 6 species from 3 genera of hard ticks belonging to family Ixodidae, reporting for the first time presence of *Hyalomma anatolicum excavatum*, *Rhipicephalus (Boophilus) decoloratus* and *Dermacentor* spp. from this state. The reason behind this identification of new species can be import of tick species from other places carried along on their hosts; as there is frequent import of new buffalo and cattle from other countries as well as neighboring/other Indian states, due to the importance of buffalo and cattle in the economy of the state of Haryana. This coupled with lack of proper quarantine measures at some stage during the import might have resulted in the influx of these new species into the state. Another reason might be that these species were infesting wild populations and remained unreported but have now transferred to the domesticated varieties of buffalo and cattle due to ecological changes. An additional reason can be that the new

species might have accompanied the wandering cattle arriving from neighboring state of Rajasthan that are brought in to the state every year for grazing by nomadic herdsmen.

Species diversity and distribution pattern of different species varied with collection sites and the species showed site predilections even though found distributed on the entire body surface of the hosts. Similar to the observations of the Prakasan and Ramani [13], the more prevalence of *Rhipicephalus (Boophilus)* species on cattle might be attributed to their being brevirostrate thus preferring thin skinned and more hairy hosts while the longirostrate ticks like *Hyalomma* prefer thick skinned and less hairy hosts. Previously, Miranpuri [12] had reported that out of about ~10000 ticks infesting buffalo collected from Northwestern India, *Hyalomma anatolicum anatolicum*, *Hyalomma marginatum issaci* and *Rhipicephalus (Boophilus) microplus* comprised 80% of all ticks collected by them but similar to the present study mixed infestations of *Hyalomma anatolicum anatolicum* and *Rhipicephalus (Boophilus) microplus* were uncommon. Analogous studies from other parts of India have also reported *Hyalomma anatolicum anatolicum* and *Rhipicephalus (Boophilus) microplus* as the predominant species infesting buffalo and cattle [4, 12, 13, 24]. Geevarghese and Dhanda [14] reported an infestation rate of 42.6% and 75.5% for buffalo and cattle respectively while during the present study it was 42.16% and 55.26% for buffalo and cattle respectively. The lesser infestation on cattle during the present study might be due to more cleanliness and application of control measures. Another reason why the infestation rate was less could be that large numbers of the cattle studied were from cattle yard of the National Dairy Research Institute at Karnal, where periodic vaccination of cattle is employed to control TTBD's. Vathsala *et al.* [24] have reported *Hyalomma anatolicum anatolicum* and *Hyalomma marginatum issaci* to infest even sheep and goat from Tamil Nadu.

Haryana is a rapidly developing state of India that is experiencing large scale urbanization and changes in urbanization pattern have been reported to affect the ecological distribution of tick species [25]. In this context, there are possible odds of alteration in the tick diversity and thus pragmatic chances of horizontal and vertical transmission of pathogens to veterinary and human hosts. Climatic conditions dictate the dynamics of tick borne diseases by affecting the distribution of ticks, seasonal occurrence, survival, and host ecology and abundance [16]. Ecological changes in modern society and formation of new interfaces due to changes in agriculture and forest land use have been implicated in triggering the multiplication of tick vectors sometimes even resulting in outbreak of TTBD's.

In the order of preponderance, the ecology and disease relationship of the economically important ticks infesting buffalo and cattle from Haryana are discussed hereunder:

*Hyalomma anatolicum anatolicum* Koch, 1844: It is a very common two-host hard tick species abundant in the North India, including Haryana showing maximum activity during the summer and post rainy season months of April to September. Both fed and unfed stages were frequently found infesting buffalo and cattle. Site predilections on cattle are perineum, hind legs, axial, tail for adults and ear pinna for nymphs. It has been reported to be the principal vector of *Theileria annulata* causing bovine tropical theileriosis and is also incriminated for transmission of equine babesiosis and at least four arboviruses [23].

*Rhipicephalus (Boophilus) microplus* (Canestrini, 1888): It is a one-host hard tick that is considered to be the most important tick parasite of livestock in the world. It has been reported to infest many hosts including cattle, buffalo, horses, donkeys, goats, sheep, deer, pigs, dogs and some wild animals and is incriminated in transmission of protozoan parasites *Babesia bigemina* and *B. bovis* causing babesiosis and *Anaplasma marginale* causing anaplasmosis

[23]. During the present study it was found throughout the year infesting cattle and buffalo, but preferring exotic and crossbred cattle. Preferred sites of predilections are neck dewlap and forequarters.

*Rhipicephalus sanguineus* Latreille, 1806: It is a three-host tick that prefers to feed on dogs in all stages, so called the brown dog tick. However, it has been reported to feed on other mammals, including domestic animals and humans. In parts of Europe, Asia and Africa it is a reported vector of *Rickettsia conorii*, known locally as Mediterranean spotted fever, boutonneuse fever, or tick typhus and it is also incriminated to cause ehrlichiosis and babesiosis [23, 26, 27]. During the present study it was collected from only a few places probably because buffalo and cattle are preferred by this tick as secondary hosts only in absence of dogs.

*Hyalomma anatolicum excavatum* Koch, 1844: It is a two-host or occasional three-host tick which is very similar to *Hy. a. anatolicum* but is slightly robust and dark colored with ringed legs. It is important to compare the males for differentiating the two species. The most important characters are - presence of a pale central festoon, paracentral festoons joined anteriorly and the adanal plates having squarish ends. The disease relationship is uncertain as it has been reported for the first time from the state. Its distribution overlaps with that of *Hy. a. anatolicum* and mixed infestations were also seen.

*Rhipicephalus (Boophilus) decoloratus* Koch, 1844: It is a one-host tick, also known as the blue tick, which is tough to differentiate from similar looking *Rh. (B.) microplus* as the color of engorged females and dentition is the only parameter to differentiate between females. Hence, males have to be compared where the differences from *Rh. (B.) microplus* are distinct ventral adanal and accessory adanal plate spurs that are even visible dorsally. It was found to be infesting cattle preferring the upper body for attachment especially the hind quarters. It is incriminated in transmission of *Babesia bigemina* and *Anaplasma marginale* [23].

*Dermacentor* spp.: Only one male specimen was identified to belong to *Dermacentor* spp. from the state. This is the first report of this genus from this state. Preliminary investigations revealed that it did not match with other three *Dermacentor* species reported from India viz. *Dermacentor auratus*, *D. atrosignatus* and *D. raskemensis* [7]. Unfortunately, the specimen was lost due to mishandling by a lab staff. New collections are planned for acquiring some fresh specimens so that detailed identification up to the species level can be made.

Tick control strategies should aim at keeping the populations in check at regular intervals during the specific tick season. Proper and timely identification of ticks and selection and encouragement of tick resistant cattle breeds would be an admirable guiding principle. Majority of tick species collected during the present study are known vectors of various pathogens incriminated in causing diseases of livestock especially in buffalo and cattle. Different control programs should be adopted during the lean and heavy infestation periods of winter and rainy seasons respectively.

In conclusion, the present study discusses the result of first survey carried out for having an insight of the species diversity of the hard ticks infesting buffalo and cattle from the state of Haryana, India. This indicates the fact that tick infestation forms a major, but ignored constraint for the proper development and well being of the buffalo and cattle wealth of Haryana. More such studies targeting hard ticks from a wider geographical area are required to have a better insight of their phylogenetic relationships, disease epidemiology, and to prepare a checklist of hard ticks infesting buffalo and cattle in the state of Haryana, India.

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