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Research Article

Diversity and Seasonal Distribution of Hard Ticks in Livestock Animal Population from Western part of Uttar Pradesh in India

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Abstract

The present study was conducted for epidemiological examination of seasonal tick infesting on livestock animals (cattle and buffalo). The investigation was carried out from March 2019 to February 2020 period at different districts of western regions of Uttar Pradesh. The western regions comprise of Amroha (AMR), Moradabad (MBD), Rampur (RMP), Bareilly (BLY), Bijnor (BJN), Chandousi (CHD), Hapur (HPU), Bhagpat (BGT), Baraut (BRT), Ghziabad (GZB), Muzaffarnagar (MZN) and Shaharnpur (SHN). The region is located between 26°251 N to 300 251 N and 770101 E to 800 251E. The selected districts were investigate carefully for the presence of ticks and in positive cases ticks were collected manually and identified on the basis of morphological characters. The total numbers of animals (5696) were examined on the basis of random collection in throughout the year. The total number of cattle (1792) was infested out of 3250 cattle and the total number of buffalo (805) was infested out of 2446 buffalo animals, respectively. The large number of animals was suffered to tick infestation in BLY, MZ, BJN, MBD and RMP. The highest tick infection was recorded in BJN (48.8 ± 10.7) and MZN (48.8 ± 14.0) and the minimum was in AMR district (39.0 ± 13.6). The periodic examination highest tick infestation was observed in rainy season (68.5%), followed by summer (48.3%) while lowest in the winter (22.9%). The large number of positive case was reported in cattle (1792) followed by buffalo (805). The high rate of tick infection was recorded in cattle (55.0%) while the lowest was in Buffalo (33.0%). During the study, rainy season were found highly significant ($p<0.001$) in cattle comparing with results in summer and winter seasons. The inverted distance weighted (IDW) uses the measured values surrounding the prediction location. The measured value closest to the prediction location have more influence on the predicted value than those farther away. On the basis of morphological studies, two species of ticks were identified namely *Rhipicephalus microplus* and *Hyalomma anatolicum*. The commonly suckle sites for adult ticks were neck, axilla, belly, groin, udder, perineal regions and tail. The present study revealed that widespread distribution of major tick infestation in cattle and bovine in targeted areas. It is concluded that ticks infestation are most prevalent in the cattle and buffalo.

Keywords: *Rhipicephalus Microplus; Hyalomma anatolicum*; Cattle; Buffalo; Infestation

Introduction

India is largest producer of milk and ranks first in milk production in world. The total milk production in India is 146.3 million tonnes and per capita availability is 322 gm per day in the year 2014-15 (NDDB). Livestock sector contributes 3.9 percent in national GDP [2]. In India, Uttar Pradesh is the leading state in terms of milk production and annual production of milk more than 20 million tonnes. Almost 17% of total milk production in India is contributed by Uttar Pradesh. It is also having highest number of cows and buffaloes are more than 1.8 crore within the state [1]. India having total buffalos' population of 105 million and 26.1% of the population in Uttar Pradesh state. India also has 09 well-recognized breeds based on their genotypic characteristics (Nili Ravi, Murrah, Surti, Jaffarabadi, Bhadawari, Nagori, Mehsana, Toda and Pandarpuri), distributed over several agro-climatic zones [3]. The total livestock population of Uttar Pradesh, India is 68 million including cross-breed, exotic, indigenous cattle, and buffaloes [4]**.** During 2015–2016, in Uttar Pradesh state's milk production was around 32.95 million tons (Source: India Brand Equity Foundation report, February 2017) and is recognized as a large milk-producing state in the country, accounting for approximate 20.5% share in total milk production. The climatic conditions of the state are highly favorable for tick activities and more than 60% of animals were reported to be infested with ticks [5,6] and tick management is considered as one of the major activities of animal management during the tick active period. The milk yield per cow was 1.83 litres and that of buffalo 3.15 litres per day was also more than the national average for the country as a whole [7]. The per capita availability of milk in the state was 318 gm per day in 2013- 14, as against 307 gm for the country (NDDB).

Ectoparasites, mainly ticks, play an important role in all species of domestic animals and pose greater health concerns and about 80% of world's cattle population is exposed to tick infestation [8]. Ticks and tick-borne diseases (TTBDs) are a major problem to livestock health in the world and its severity depends on region, species involved, host population, socioeconomic and technological advances in control measures. Ticks either cause direct losses through tick worry, blood loss, damage to hides and udders, toxin production and body weight loss [9-12] or indirectly through transmission of bacterial, viral and protozoan infections, predisposing for secondary disease condition such as screw-worm myiasis and dermatophytosis [13] reduction in milk yield and stunted growth [14]. A single female engorged tick is imposes a daily loss of 0.5-2 ml of blood, 8.9 ml of milk and 1 g of body weight [13,15]. The global economic losses due to tick infestation have been estimated as US $14,000-18,000 million annually and in India it causes annual loss of US $498.7 million [15]. Ticks are mainly control by conventional acaricides. But these acaricides have undesirable effects on host organisms and the environment. Problems like environmental contamination, residues in food and feed, high costs, residual in milk and meat, development of acaricide resistance in tick [16]. The current tick control strategies aim to reduce ticks numbers to acceptable levels, to prevent production loss, minimize chemical residue risks, and reduce the reliance on chemicals by utilizing control with alternative treatments for different herd group's [17].

Babesiosis and thelieriosis is one of the most formidable and serious heamoprotozoan diseases of livestock in India. The treatment of these heamoprotozoan diseases is not affordable to every farmer of the country. The control of these diseases primarily depends on management of vectors, which is itself complex due to a number of tick species (108 sp) and the wild animal that act as reservoir of these arthropods. The epidemiological determinants like high temperature, humidity, moderate rainfall, adequate water sources aggravate the surplus tick population. Meteorological factors affect tick population dynamics via faster developmental rates with increasing humidity, and lower survival with extreme temperatures and low moisture and by negatively affecting individual reproductive behaviours. Meteorological factors might affect insect tick populations directly, through influences on reproductive and mortality ratios, and indirectly, through influences on their natural enemies. Seasonal variation in weather variables, such as rainfall and temperature maxima and minima, might be the most important causes of dramatic changes in tick abundance, especially in temperate ecosystems. Although the climate of tropical forest ecosystems is moderately constant (e.g., minimal variation in monthly average temperatures), marked local variation in temperature and precipitation might occur due to changes in topography, and such variation might affect tick population dynamics. The relationship between climate variables and tick abundance can provide important information to determine parasite activity levels and, therefore, disease risk. Exact information on the seasonal prevalence of tick fauna in a region is essential for the development of efficient vector control programs. But there were few published data on the seasonal abundance of ticks in India. Therefore, the present study

was undertaken to know the prevalence of ticks in relation to the different month of the year, different seasons of the year, age of the animals, sites of their attachment and identification of ticks up to species level.

Material and Methods

Geography of study area

The state of Uttar Pradesh extends from the latitudes 26.85° N and longitudes 80.90° E. It covers a geographical area of 243,290 km^2. The climate of Uttar Pradesh is mostly subtropical. However weather conditions change a lot depending on where one lives and the season. The three major seasons in Uttar Pradesh are summer (March to June; temperatures rise to 45 °C, sometimes 47-48 °C), rainy (July to September; 85% of average annual rainfall of 990 mm) and winter (October to February). The climate of the plains is excessively hot and dry in summers and winters are cool with some frosts. The rain in U.P. can vary from an annual average of 170 cm in hilly areas to 84 cm in Western U.P. The figure of Inverse Distance Weighted (IDS) generated map collected of tick sample from Uttar Pradesh (Figure 1).

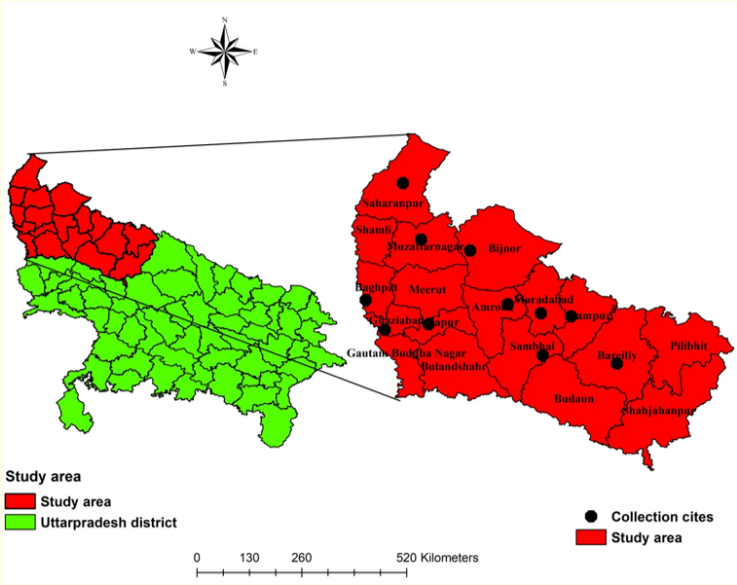

Figure 1: Inverse Distance Weighted targeted map for collected area of tick samples.

Area of study

Systematic survey on *R. microplus* ticks of cattle was undertaken at various locations of the Upper Gangetic Plains region i.e central and western parts of Uttar Pradesh during the period from May 2019 to April 2020. The different regions of Upper Gangetic Plains selected were- AMR (Amroha), MBD (Moradabad), RMP (Rampur), BLY (Bareilly), BJR (Bijnor), CHD (Chandoushi), HPU (Hapur), BGT (Bagpat), BRD (Baroad), GZB (Gaziabad), MZN (Muzafernagar) and SRE (Saharanpur).The selected areas were visited once a week to determine the seasonal pattern of tick infestation and to observe variation in prevalence of tick infestation across different seasons.

Sampling and design of survey

Randomly sampling was performed for this study. Cattle and Buffaloes were examined for ecto-parasites from 10-12 villages of Upper Gangetic Plains region. The investigation was carried out in several visits on three seasons (summer: March- June; Rainy: July-September and winter: October-February).

Identification of tick samples

The adult male and female ticks (unengorged and engorged) were gently plucked up from the body of the host by hand manipulation or with the aid of blunt pointed forceps without damaging

their mouth parts. The specimens were kept in separate plastic containers with ventilated cap according to host-wise and according to the sites of attachment. Information about the date, host, age, locality and site of collection were entered on the label of each container. These ticks were identified using standard keys under a stereomicroscope [13,18]. 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.

Statistical analysis

All the data were statistically analyzed for the mean value along with standard error (SE) by One way ANOVA and the significance p value was recorded at 5% level ($p < 0.05$) and 1% level ($p < 0.01$). The complete statistical analysis was made by Graphpad Prism Version-5.0. Inverse distance weighted (IDW) interpolation explicitly makes the assumption that things that are close to one another are more alike than those that are farther apart. To predict a value for any unmeasured location.

Results

Overall abundance of tick infestation in cattle and buffalo

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 (Figure 2).

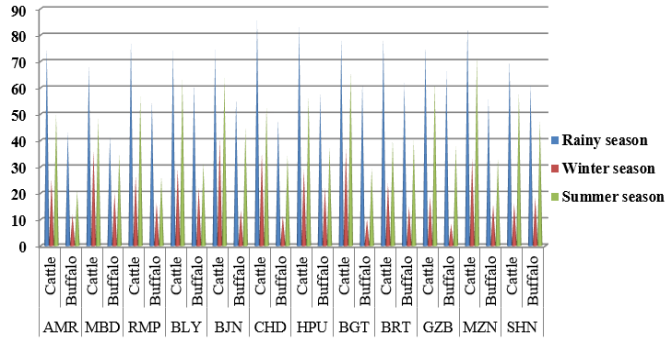

Figure 2: Species wise seasonal variation of tick infestation on cattle and buffalo.

The large number of animals was suffered to tick infestation in BLY, MZ, BJN, MBD and RMP. The highest tick infestation was recorded in BJN (48.8 ± 10.7) and MZN (48.8 ± 14.0) and the minimum was in AMR district (37.0 ± 12.4) Tabel-1 and (Figure 3).

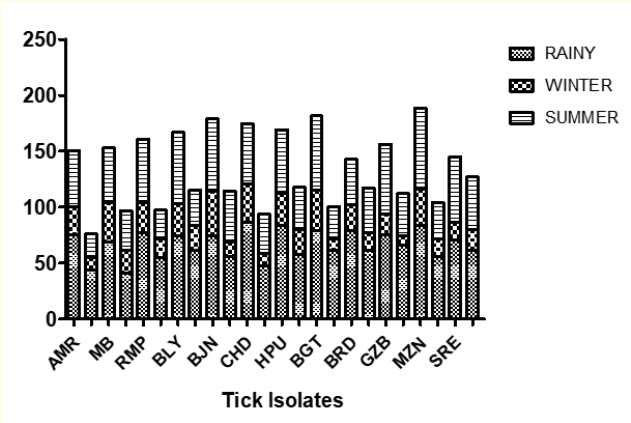

Figure 3: Districts wise seasonal variation of tick infestation on cattle and buffalo.

The current study revealed that the cattle and buffalo were susceptible to seasonally tick infestations. The tick infestation was recorded in 2597 out 5696 animals**.** The overall prevalence of tick infestations was (2597/5696 = 45.5%) in cattle and buffalo. The prevalence of tick infestation (1792/3250 = 55.1%) was in cattle and in buffalo (805/2446 = 32.9%) was recorded. On the basis of morphological studies, two species of ticks were identified namely *R. microplus* and *H. anatolicum*. The most ticks were found to attach on whole body area predominantly on ear, neck, tail, abdomen and udder region. Mixed infection with more than one species of ticks was also recorded in cattle and buffalo in study areas. The highest overall prevalence of tick infestation was observed in female sex compare to male animals. The district wise comparison of seasonal tick infestation graph was showed in figure 3. The prevalence of tick infestation on cattle and buffalo were presented in graph (Figure 4,5).

Tick infestation in rainy season

A total number of animals were examined 1869 and infestation was recorded in 1282. The highest infestation was recorded (70.8 ± 12.8) in HPU tick isolated and lowest was recorded in MBD (55.0 ± 13.4) tick isolates in rainy season. The minimum and maximum range of infestation was found in AMR to CHD (43.3-86.0) tick iso-

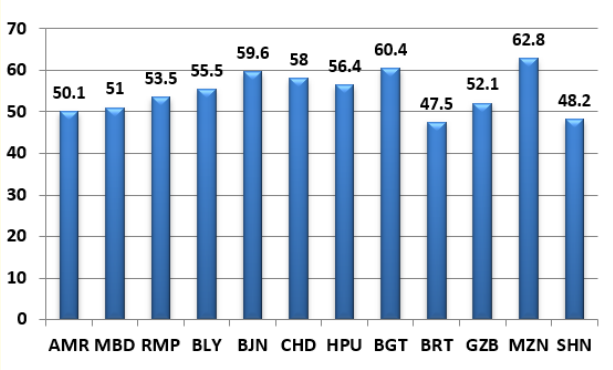

Figure 4: The district wise prevalence and infestation of *R. microplus* on cattle.

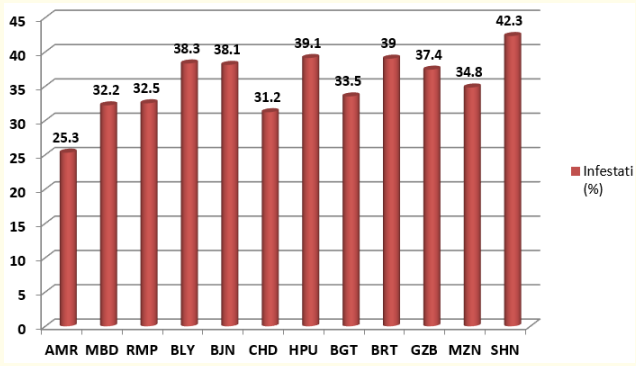

Figure 5: The district wise prevalence of R. microplus tick infestation on buffalo.

lates collected from field. During the study, the highest rate of tick infestation was recorded in cattle while the lowest was in Buffalo (Table 1,2) and the comparatively seasonally tick infestation on cattle and buffalo were showed in (Figure 6,7).

Collection sites	Animals	No. of Animal Examined	No. of Infested Animal	Average Seasonal infestation (%)			Individual Infestation (%)	Mean of infestation (Mean± SE)	*R. microplus*
				Rainy	Winter	Summer			
AMR	Cattle	270	134	78.7	25.5	53.3	52.5	39.0±13.6	+
	Buffalo	270	71	43.4	11.7	21.0	25.3		+
MBD	Cattle	180	95	68.5	36.0	48.3	51.0	41.6±9.4	+
	Buffalo	160	47	41.6	20.0	35.0	32.2		+
RMP	Cattle	360	193	77.5	26.6	56.6	53.5	43.0±10.5	+
	Buffalo	250	72	55.0	16.3	26.2	32.5		+
BLY	Cattle	398	223	74.2	32.9	67.0	58.0	48.1±9.8	+
	Buffalo	180	73	61.4	22.0	31.6	38.3		+
BJN	Cattle	370	219	74.1	40.7	64.1	59.6	48.8±10.7	+
	Buffalo	150	54	56.0	13.3	45.0	38.1		+
CHD	Cattle	277	162	86.0	35.2	53.0	58.0	46.1±12.0	+
	Buffalo	161	50	48.0	11.2	43.5	34.2		+
HPU	Cattle	280	150	83.7	29.0	56.6	56.4	47.7±8.6	+
	Buffalo	140	55	58.0	22.0	37.5	39.1		+
BGT	Cattle	205	128	78.7	36.6	66.1	60.4	47.0±13.4	+
	Buffalo	198	67	61.4	10.0	29.3	33.5		+
BRD	Cattle	230	118	79.0	23.7	40.0	47.5	43.2±4.2	+
	Buffalo	170	63	62.0	15.0	40.0	39.0		+
GZB	Cattle	184	96	75.7	18.7	62.0	52.1	44.7±7.3	+
	Buffalo	314	102	66.2	8.2	38.0	37.4		+
MZN	Cattle	320	191	83.5	33.0	72.0	62.8	48.8±14.0	+
	Buffalo	310	94	55.7	15.7	33.0	34.8		+
SHN	Cattle	165	83	70.7	16.0	58.0	48.2	45.2±3.0	+
	Buffalo	144	57	61.3	18.3	47.5	42.3		+

Table 1: Seasonal variation of cattle tick *Rhipicephalus microplus* infestation in dairy animals of different districts of Uttar Pradesh.

Collection sites	Animals	No. of Animal Examined	No. of Infested Animal	Infestation Range	% Infestation (Mean ± SE)
AMR	Cattle	80	63	43.3-48.7	61.05 ± 17.6
	Buffalo	99	43		
MBD	Cattle	70	48	41.6-68.5	55.0 ± 13.4
	Buffalo	60	25		
RMP	Cattle	120	93	55.0-77.5	66.2 ± 11.2
	Buffalo	60	33		
BLY	Cattle	144	104	61.4-74.2	67.8 ± 6.4
	Buffalo	70	43		
BJN	Cattle	120	89	56.0-74.1	65.05 ± 9.0
	Buffalo	50	28		
CHD	Cattle	90	78	48.0-86.0	67.0 ± 19.0
	Buffalo	50	24		
HPU	Cattle	80	67	58.0-83.7	70.8 ± 12.8
	Buffalo	50	29		
BGT	Cattle	80	63	61.4-78.7	70.0 ± 8.6
	Buffalo	70	43		
BRD	Cattle	100	79	62.0-79.0	70.5 ± 8.5
	Buffalo	50	31		
GZB	Cattle	70	53	66.2-75.7	71.0 ± 4.7
	Buffalo	80	53		
MZN	Cattle	97	81	55.7-83.5	69.6 ± 13.9
	Buffalo	70	39		
SHN	Cattle	65	46	61.3-70.7	66.0 ± 4.7
	Buffalo	44	27		

Table 2: The tick infestation rate (%) in examined across rainy season the year.

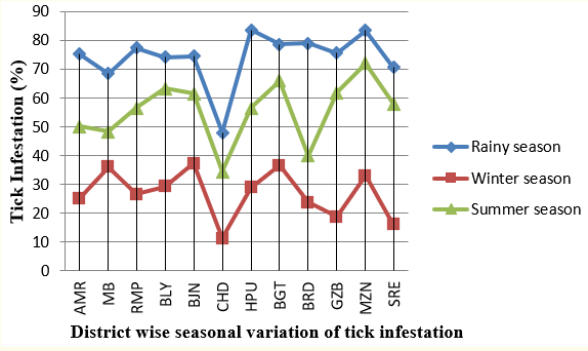

Figure 6: The graph showing comparatively seasonally tick infestation on cattle.

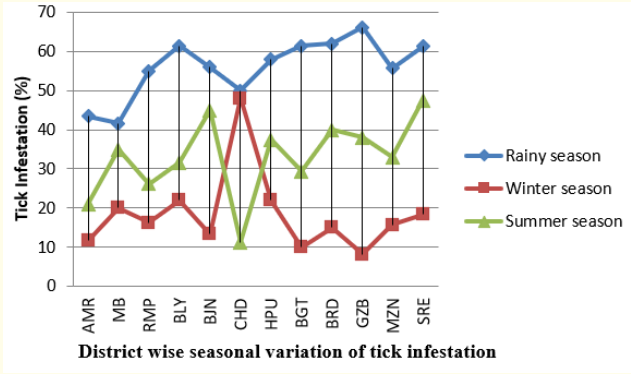

Figure 7: The graph showing comparatively seasonally tick infestation on buffalo.

Tick infestation in winter season

The tick infestation was recorded lowest in the winter season (483/2106 = 22.9%). The large number of positive case was reported in cattle (1792) followed by buffalo (805) in table 3. The lowest tick infestation was recorded in GZB isolates (13.4 ± 5.2) and highest was recorded in MBD (28.0 ± 8.0) tick isolates. The minimum to maximum was recorded in GZB to BJN (8.2-40.7).

Collection sites	Animals	No. of Animal Examined	No. of Infested Animal	Infestation Range	% Infestation (Mean ± SE)
AMR	Cattle	97	23	11.7-25.5	18.6 ± 6.9
	Buffalo	85	10		
MBD	Cattle	50	18	20.0-36.0	28.0 ± 8.0
	Buffalo	60	08		
RMP	Cattle	120	32	16.3-26.6	21.40 ± 5.1
	Buffalo	110	18		
BLY	Cattle	158	52	22.0-33.0	27.4 ± 5.4
	Buffalo	50	11		
BJN	Cattle	130	53	13.3-40.7	27.0 ± 13.7
	Buffalo	60	08		
CHD	Cattle	87	31	11.2-35.2	23.2 ± 12.0
	Buffalo	71	09		
HPU	Cattle	110	32	22.0-29.0	25.5 ± 3.5
	Buffalo	50	11		
BGT	Cattle	60	22	10.0-36.6	23.3 ± 13.3
	Buffalo	70	07		
BRD	Cattle	80	19	15.0-23.7	19.3 ± 4.3
	Buffalo	80	12		
GZB	Cattle	64	12	8.2-18.7	13.4 ± 5.2
	Buffalo	134	11		
MZN	Cattle	130	43	15.7-33.0	24.3 ± 8.6
	Buffalo	140	22		
SHN	Cattle	50	08	16.0-18.3	17.1 ± 1.15
	Buffalo	60	11		

Table 3: The tick infestation rate (%) in examined across winter season of the year.

Tick infestation in summer season

The tick infestation was observed second highest in summer season (832/1721 = 48.3%). The tick infestation was range minimum (AMR = 21.0) and maximum (MZN = 72.0). The highest mean infestation was recorded in BJN (54.5 ± 9.5) and lowest mean infestation was in SHN (52.7 ± 19.5) in table 4,5. During the study, the animal mortality was recorded due to tick and tick borne diseases and young animals were found more susceptible than large animals to tick infestation. The tick infestation was more prevalent on cattle than buffalo (Figure 8). IDW uses the measured values surrounding the prediction location. The rate of risk infection area of cattle and buffalo were showed (Figure 9) and district wise rate of tick infection (%) in cattle and buffalo (Figure 10). The measured values closest to the prediction location have more influence on the predicted value than those farther away. IDW assumes that each measured point has a local influence that diminishes with distance. It gives greater weights to points closest to the prediction location,

Collection sites	Animals	No. of Animal Examined	No. of Infested Animal	Infestation Range	% Infestation (Mean ± SE)
AMR	Cattle	90	48	21.0-53.3	37.1 ± 16.1
	Buffalo	86	18		
MBD	Cattle	60	29	35.0-48.3	41.6 ± 6.6
	Buffalo	40	14		
RMP	Cattle	120	68	26.2-56.6	41.4 ± 15.2
	Buffalo	80	21		
BLY	Cattle	100	67	31.6-67.0	49.3 ± 17.7
	Buffalo	60	19		
BJN	Cattle	130	77	45.0-64.1	54.5 ± 9.5
	Buffalo	40	18		
CHD	Cattle	100	53	43.5-53.0	48.2 ± 4.7
	Buffalo	39	17		
HPU	Cattle	90	51	37.5-56.6	47.0 ± 9.5
	Buffalo	40	15		
BGT	Cattle	65	43	29.3-66.1	47.0 ± 18.0
	Buffalo	58	17		
BRD	Cattle	50	20	30.0-50.0	47.0 ± 10.0
	Buffalo	40	20		
GZB	Cattle	50	31	38.0-62.0	50.0 ± 12.0
	Buffalo	100	38		
MZN	Cattle	93	67	33.0-72.0	52.5 ± 5.2
	Buffalo	100	33		
SHN	Cattle	50	29	47.5-58.0	52.7 ± 19.5
	Buffalo	40	19		

Table 4: The tick infestation rate (%) in examined across summer season of the year.

Tukey's Multiple Comparison Test	Mean Diff.	q	P value	95% CI of diff
Rainy vs Winter	33.29	8.351	P < 0.001	19.77 to 46.82
Rainy vs Summer	18.75	4.703	P < 0.01	5.226 to 32.27
Summer vs Winter	-14.54	3.648	P < 0.05	-28.07 to -1.017

Table 5: One-way ANOVA analysis of animal infestation.

and the weights diminish as a function of distance, hence the name inverse distance weighted. The larger the power coefficient, the stronger the weight of nearby points as can be gleaned from the following equation that estimates the value z at an unsampled location:

^Zj = ∑iZi/dnij∑i1/dnij

Tick control practice in study area

Chemical control

Most of the formers and dairy owners were depends largely on the use of different chemicals (deltamethrin, cypermethrin, amitraz and ivermectin) for the control of tick infestation. The development of resistance against commonly using chemical acaricides

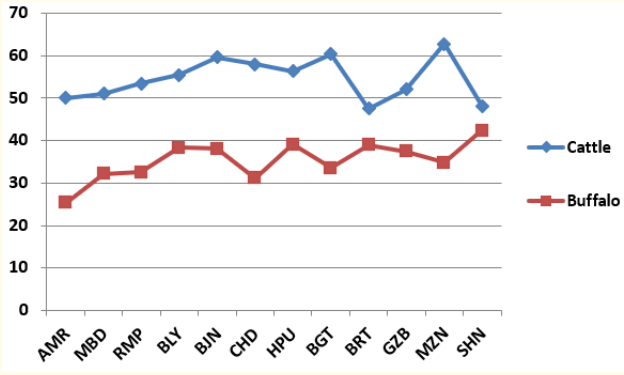

Figure 8: The graph showing comparatively tick infestation between cattle and buffalo.

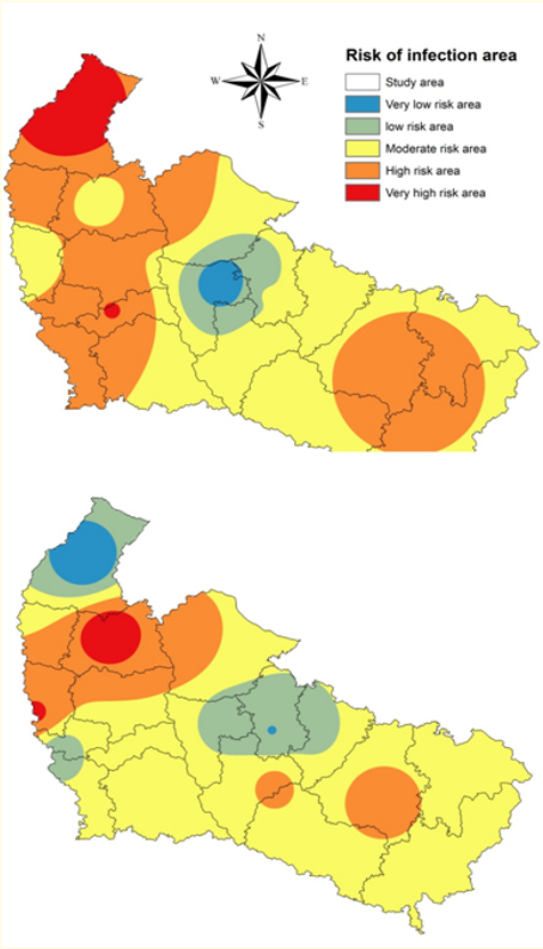

Figure 8: The rate of risk infection area of cattle and buffalo.

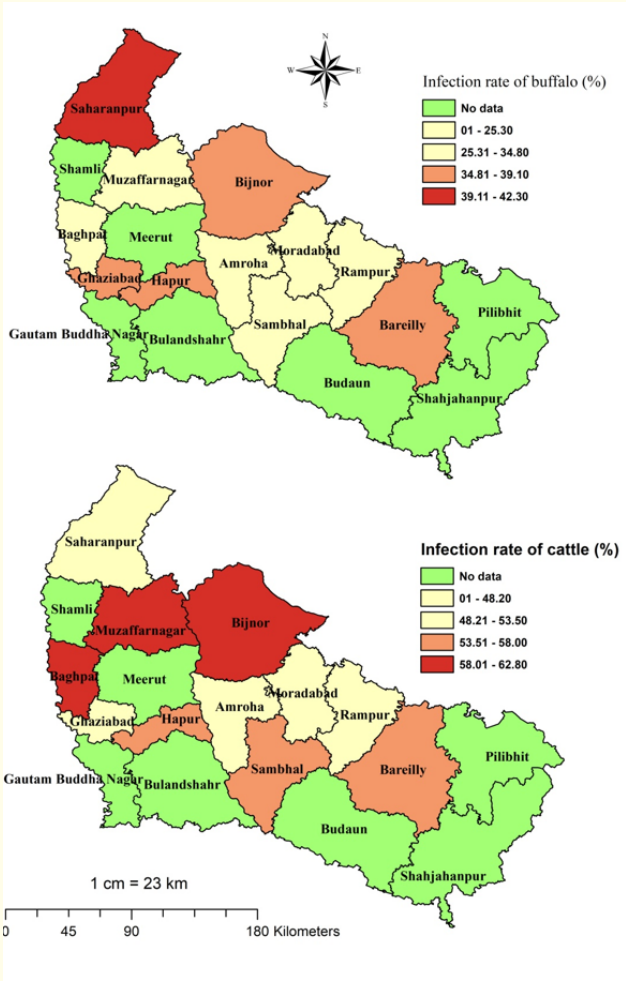

Figure 10: The figure indicates district wise rate of tick infection (%) in cattle and buffalo.

has increased problem in this regard and animal population is becoming susceptible to both the ticks and diseases they transmit, with disastrous outcomes.

Biological tick control

The biological agents, which potentially include predators like rodents, birds, ants, spiders, lizards and beetles as well as Prasitoids (destroy the host: the wasp lay the eggs in the engorged ticks and larvae eats the tick and emerges as adult to attack another tick) and parasites (Nematodes and fungus) attack soil living stages of the ticks are effective and depending on the conditions, these

predators can consume a large number of ticks (Figure 11). Yet, having such effective importance the development of a biological tick control methods has been neglected as compared to the control of plant pests or dipterous insects harmful to men and animals.

Figure 11: Tick control management by poultry.

Vector borne disease

The vector-borne disease refers to any of a broad array of infectious diseases caused by pathogens that are transmitted by arthropods or other biologic intermediaries. During the study, theileriosis, heartwater, babesiosis, animal mortality due to heavy tick infestation and anaplasmosis are recorded the most important tick-borne diseases of animals in Uttar Pradesh.

Discussion

The purpose of this study was to monitor prevalence of tick infestation of *R. microplus* and *H. anatolicum* on animals collected from western part of Uttar Pradesh. During study period, a total of 5696 cattle and buffalo were examined from different district of western Uttar Pradesh for tick prevalence study and found that highest prevalence prevalence of ticks was 68.5% in rainy season. The tick infestation was recorded in 2597 out 5696 animals. The overall prevalence of tick infestations was (2597/5696 = 45.5%) in cattle and buffalo. The prevalence of tick infestation (1792/3250 = 55.1%) was in cattle and in buffalo (805/2446 = 32.9%) was recorded. Similar finding have been reported by [19,20]. In the current research study, *R. microplus* was found to be the most predominant tick of cattle and buffalo. *R. microplus* has been reported as the most predominant tick in cattle from different states of country viz. Uttar Pradesh [21], Uttarakhand [19], Maharastra [38], Punjab [22-24] Karnataka [25,26], Andhra Pradesh [27], Andamans [28], West Bengal [29].

Season plays a very important role in tick population and significance difference was observed in population of ticks in different seansons. The present research work revealed a significantly ($p < 0.001$) higher rate of tick infestation occurs in the rainy season followed by summer and winter seasons (Figure 6 and 7). Similar findings were also reported by [6,5,29,37], where highest prevalence was recorded in rainy season followed by summer and winter. The current study indicates that *R. microplus* species was the predominant tick in all seasons in cattle and buffalo of western part of Uttar Pradesh. The highest prevalence of tick infestation in rainy season suggests that the humidity seems to be macroclimatic condition influencing infestation rate of ticks [19]. Whereas, the cold and dryness conditions of the winters are unfavorable for the survival of tick passes the winter as engorged female tick, nymphs, unfed larvae and unfed adults by hiding into the cracks of wall and crevices thus leading to low infestation rate of tick [24]. [31] also reported higher tick infestation rate in rainy season. While studying the effect of the age of the animal on the infestation rate of ticks it was recorded that young animal were more susceptible for tick infestation as compared to the adult animals. Low tick infestation on adults is probably due to resistance acquired following repeated infestations from very early life [32,33]. Similar findings were reported by a large number of workers [5,6,19,29,34,35].

The *R. microplus* tick infestation is more prevalent on cattle because of preference of denser hair coat by the tick. Conversely, buffaloes have smooth skin and less dense hair coat and have access to mud for wallowing that might attribute to dropping of ticks and hence less infested with *R. microplus* [28]. [26] also recorded higher prevalence R. *microplus* tick infestation on cattle as compared to the buffaloes. [36] also observed higher prevalence of R. *microplus* on cattle in Mathura district and adjoining regions.

The prevalence of tick was higher in rainy season than in hot and dry season. Lower body weight cattle calves were more susceptible to tick infestation than higher body weight cattle. The cattle inner tigh and neck region was heavily infested by ticks followed by armpit and the least tick load was observed in vulva. Tick

infestation may lead to decline in meat, milk and skin production. Regular survey of cattle for ticks along with using chemical acaricide is recommended for inclusion into routine tick management of cattle in the targeted districts.

Conclusion

It can be concluded that *R. microplus* and *H. anatolicum* are the predominant tick of cattle and buffalo population of western part of Uttar Pradesh in India. In the current research, the highest prevalence of rainy season tick infestation on cattle and buffaloes. It was found that the cattle and bovine population in western part of Uttar Pradesh are considerably burdened with tick infestation leading to a risk of contracting tick-borne diseases. The study is very essential to determine the economic losses per year, tick borne diseases in animal in India. Moreover, poor animal husbandry practices may be a deterrent in the tick control strategies and programmes. A better understanding of distribution and abundance of tick infestation on large animal, the research study area demanding a complete and randomized surveillance study with in all districts of Uttar Pradesh state.

Conflict of Interest

The author declares no conflict of interest.

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