The Pharma Innovation Journal 2022; 11(12): 1430-1433

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(12): 1430-1433

www.thepharmajournal.com
Received: 05-10-2022
Accepted: 08-11-2022

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Effect of breed and anatomical region on tick distribution in cattle of Dantiwada region of Banaskantha, Gujarat

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Abstract
Tick infestation contributes significantly to economic losses to the cattle industry. The judicious use of acaricides and the selection of resistant animals can minimize economic losses. This study aimed to determine the anatomical distribution of ticks in cattle in the Dantiwada region of the Banaskantha district of Gujarat state. This study was conducted by using a total of 116 cattle (27 Kankrej and 89 Crossbred HF cattle). Tick counts were conducted at monthly intervals under natural challenges over a 3 months period (Summer- May 2021 to July 2021). The whole cattle body was divided into three regions *viz.* Region-I (ear, head, neck, dewlap, and hump), Region-II (cranial limb, thorax, flank, abdomen, and navel), Region-III (rump, caudal limb, udder, crotch, and tail). Female ticks greater than 4 mm in size, present on the left side of the animal body were counted. The generalized linear model procedure of the R programme was used to analyze the data. Kankrej cattle (Mean tick count: 6.69) had a significantly lower tick count than HF cross (Mean tick count: 18.03). The region-III (rump, caudal limb, udder, crotch, and tail) had the highest mean tick number ($p<0.0001$) as compared to the other two regions. The tick numbers of the region-III showed a strong correlation (0.965) with the total tick count. Furthermore, predilection sites are identifies that helps in designing control methods and which parts of the cattle's body to be covered while using ectoparasiticide chemicals. Hence, population dynamics and during hand spraying of cattle special attention should be given to the region-III and other preferable sites of attachment.

Keywords: Effect of breed, anatomical region, tick distribution, Dantiwada region, Gujarat

1. Introduction

Livestock contributes to natural, financial, human, physical, and social capital in different ways and to different degrees within smallholder dairy, crop-livestock, and livestock-dependent systems (Minjauw and McLeod, 2003) [20]. In India, approximately 70% of the people are either directly or indirectly involved in occupations related to agriculture and livestock rearing. Ticks (Acari: Ixodida) are obligate hematophagous ectoparasites of vertebrates belonging to the phylum Arthropoda (Nava *et al.*, 2009) [22]. Tick and tick-borne diseases (TTBDs) affect 80% of the world's cattle population, and their prevalence is throughout the world, within tropical and sub-tropical countries including India having most of the production losses (De Castro *et al.*, 1997) [5]. Ticks are vectors for the greatest range of human and livestock pathogens of any known arthropod. Worldwide, and especially in resource-poor rural communities, ticks cause significant economic loss by a reduction in milk and meat yield, devaluation of leather, diseases transmission, additional hours of work required, additional facility costs, acaricides application, and the emergence of resistance against commonly used one (Minjauw and McLeod, 2003; EstradaPena and Salman, 2013) [20, 6]. It is estimated that the world economy loses about 20-30 billion USD per annum (Lew-Tabor and Rodriguez Valle, 2016) [17] and 498.7 million USD per annum for India due to TTBDs (Minjauw and McLeod, 2003). Hurtado and Giraldo (2018), specifically estimate the losses caused by the *R. microplus*, and associated diseases to the tune of 13.9–18.7 billion USD per year worldwide. Chemical control (acaricides) is widely used across the world but the major challenges for chemical use are their high cost, residue in livestock products, tick resistance against acaricides and require its repeated application. Tick species have specific host species preferences (MacLeod, 1975; Fourie and Kok, 1995) [18, 9], preferred attachment sites on their hosts (Andrews and Petney, 1981; Ogden *et al.*, 1998; Kiffner *et al.*, 2011a) [1, 23, 15], and seasonal variation in activity and abundance (Castella *et al.*, 2001) [4].

Information on predilection sites of ticks is helpful in spraying individual animals since it gives a clue as to which part of the body requires more attention (Pegram *et al.*, 1981) [24]. Keeping all this in view, the study was conducted to determine the effect of breed and anatomical region on tick distribution in cattle of the Dantiwada region of Banaskantha, Gujarat.

2. Materials and Methods

2.1. Study period and location

The study was conducted between May 2021 and July 2021, on various farms in the Dantiwada taluka of Banaskantha district of Gujarat, India. A number of livestock species including cattle, sheep, and goats are reared in this area and are managed extensively.

2.2. Experimental cattle and sampling areas

The cattle were selected randomly from different herds in the study area. Each selected herd was managed on its original farms by the farmer. Tick counts were conducted on 116 cattle over 3 months period (May 2021-July 2021).The cattle were exposed to natural tick infestation at all farms. Tick counts were carried out three times at monthly intervals on all the animals.

2.3. Tick counting

Selected animals were subjected to tick counts by using the method described by Wharton and Utech (1970) [29] and again used by Kamble *et al.* (2020) [1]. The whole cattle body was divided into three regions *viz.* region-I (ear, head, neck, dewlap, and hump), region-II (cranial limb, thorax, flank, abdomen, and navel), region-III (rump, caudal limb, udder, crotch, and tail) (Table-1). Either fully or partially engorged female ticks were counted on the left side of the animal's body. Each time immediately after tick counting from the animal's body, a commercial preparation of Deltamethrin 1.25% (Butox® Vet, MSD Animal Health India) procured from the local market was sprayed @ 2ml per litre water.

Table 1: Description of anatomical regions of cattle used for tick counts

Sr. No.	Broad Region	Name of the anatomical region	Anatomical position
1	Region-I	Ear	External and internal ear.
2		Head	Excluding only the components of the ear.
3		Neck	In the horizontal plane, from the atlas to the spine of the scapula; in the vertical plane, from the cervical to the ventral face of the trachea.
4		Dewlap	Flap of skin hanging below the neck.
5		Hump	Prominent region above the dorsal line of the cervical and thoracic spine.
6	Region-II	Cranial Limb	All the extension of the cranial limb, including the lateral and medial sides.
7		Thorax	Upper and lower rib region
8		Flank	Between the lumbar column and the imaginary line, and between the last costal arch and the iliac bone.
9		Abdomen	Between the last costal arch and the caudal limb and between the imaginary line and the central ventral line. Excludes the navel and the scrotum (In males) or udder (In females).
10		Naval	In males: hanging skin that surrounds the navel and prepuce up to the beginning of the scrotal sac. In females: hanging skin surrounds the navel up to the udder.
11	Region-III	Rump	Region between the iliac, ischium, and femoral bones.
12		Caudal Limb	All the extension of the caudal limb, starting from below the femur line. Includes the lateral and medial sides of the limb.
13		Tail	From the first coccygeal vertebra. Includes the dorsal and ventral sides.
14		Udder	In males: area of the scrotal sac. In females: udder.
15		Crotch	Area between the caudal limbs to the tibia-fibular-tarsal joint. This region is not included in the sum of the right side of the animal.

2.4 Statistical analysis

The generalized linear model of the R programme (R core team, 2020) [25] was used to analyze the data.

3. Results

3.1. Breed wise mean tick count:

In the studied population of Kankrej and HF crossbred cattle, our results showed that Kankrej cattle (Mean tick count: 6.69) have a low tick burden as compared to HF crossbred cattle (Mean tick count: 18.03). HF crossbred as well as Kankrej cattle have the highest tick count in region-III. The lowest tick count in HF crossbred cattle was observed in region-I, but in Kankrej cattle region-II has the lowest tick count.

Table 2: Breed wise mean TC in different anatomical region of body

Animal	Region	Mean TC	Std. Error	N
HF Cross	I	13.47^a	0.992	89
	II	15.66^a	0.992	89
	III	24.96^b	0.992	89
	Total	18.03	0.678	267
Kankrej	I	6.29^a	1.802	27
	II	3.40^a	1.802	27
	III	10.37^b	1.802	27
	Total	6.69	0.842	81
Total	I	11.80^a	0.814	116
	II	12.81^a	1.022	116
	III	21.57^b	1.087	116
	Total	15.39	.6121	348

3.2. Anatomical distribution of ticks

In the 15 anatomical regions studied for tick load, a significant variation in the number of ticks was noted during the monthly tick count (p<0.0001). The regions-III had a higher rate of infestation whereas region-I had the lowest mean number of ticks.

3.3. Total number of ticks × ticks per body region

The highest correlation coefficients between the total number of ticks and the anatomical regions investigated in this study were noted for region-III. The region-II had a moderate positive correlation and region-I had a low positive correlation with the total number of ticks.

4. Discussion

4.1. Effect of breed on tick infestation

Significant effect of breed observed on the tick infestation in the studied population of cattle. In the breeding tract, Kankrej cattle are famous for resistance to tick infestation and other infectious diseases as compared to pure exotic breeds and HF crossbred (Sodhi *et al.*, 2006) [27], and the present study further substantiates this hypothesis. Similar to the present findings, many of the workers also reported the more susceptible to tick infestation and diseases of the Crossbred population as compared to the native cattle (Kolte *et al.*, 2017; Ghosh *et al.*, 2018) [16, 10]. Furthermore, Gopalakrishnan *et al.* (2020) [11] revealed that the Crossbred cattle were found to be more susceptible (96.39%) to tick infestation compared to the native breeds (3.61%). Kakar *et al.* (2017) [13] also observed a higher prevalence of tick infestation (59%) in pure HF than in the Crossbred (28.5%), and Bhag Nari cattle breed (17.5%) in Baluchistan Province Pakistan.

4.2. Effect of anatomical region on tick infestation

In the present finding, we observed that region-III has higher tick infestation as compared to the other two regions (I and II) in both Kankrej as well as HF crossbred cattle. Whereas region-II and region-I have the lowest tick counts in Kankrej and HF Crossbred cattle, respectively. Similar to this finding Ferrazzini and Vidotto (2018) [8] also observed a higher rate of tick infestation in regions of the caudal limb, crotch, abdomen, and prepuce (22.85, 12.90, 8.94, and 8.25 ticks on average, respectively). Mapholi *et al.* (2022) [19] revealed that the preferred tick attachment site in cattle is under the tail and then in the perineum and belly. Similarly, Fanos *et al.* (2011) [7] also noted that the most infested body part of the cattle was udder-scrotum (32.4%) followed by anno-vulva (21.9%), perineum (18.77%), dewlap (16.7%) and brisket (3.1%) in cattle. Warwick *et al.* (2016) conducted a study on Boran cattle and Somali sheep in northern Tanzania and noted that the body areas with the highest mean tick loads are the ears and perineum, the highest mean tick loads are observed in head and the hind legs in cattle and sheep, respectively. Asfaw *et al.* (2020) [2] reported a significant difference (p< 0.001) in mean tick burden between the different body regions in cattle. They recorded the largest mean burden in axial (8.69±4.21) and udder (8.67±4.11) regions and concluded that the reason for the larger burden of ticks in these body regions may be due to the fact that they are so closer to the ground that ticks from the environment can easily climb up and attach. In contrast to our finding Ayana *et al.* (2021) collected high proportions of ticks from the head and ear (34.57%), followed by the anus and vulva (29.47%), scrotum/udder (19.18%), dewlap and neck (8.77%), brisket (7.16%), belly and back (0.85%). The reason behind higher tick infestations in the caudal region (region-III: rump, caudal limb, udder, crotch, and tail) may be that ticks prefer to attach to body parts with short hair and softer or thinner skin for their mouth parts to easily enter vascularly dense areas for feeding (Sajid *et al.,* 2007; Muchenje *et al.,* 2008) [26, 21].

5. Conclusion

Kankrej cattle (Mean tick count: 6.69) had significantly lower tick count then HF cross (Mean tick count: 18.03), supports the hypothesis that native breeds are more tick resistant. Tick load is observed to be highest in region III which is highly correlated with total tick load advocates that tick count within this region may give idea about total tick load. Furthermore, predilection sites are identifies that helps in designing control methods and which parts of the cattle's body to be covered while using ectoparasiticide chemicals. Hence, population dynamics and during hand spraying of cattle special attention should be given to the region-III and other preferable sites of attachment.

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