CLIMATIC EFFECTS ON OCCURRENCE OF CLINICAL MASTITIS IN DIFFERENT BREEDS OF COWS AND BUFFALOES

EFECTOS CLIMÁTICOS SOBRE LA OCURRENCIA DE MASTITIS CLÍNICA EN DIFERENTES RAZAS DE VACAS Y BÚFALAS

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ADDITIONAL KEYWORDS

Season. Temperature humidity index.

PALABRAS CLAVE ADICIONALES

Estación. Índice de temperatura-humedad.

SUMMARY

The study was conducted to find out the effect of different seasons on incidence of mastitis throughout the year in Indigenous cows, crossbred cows and Murrah buffaloes. Lactation records pertaining to the 12 year period were collected and incidence of mastitis was plotted against the climograph of the Karnal zone, Haryana, India. The hot humid climate was found to adversely affect the incidence of mastitis in all the breeds of cows and Murrah buffaloes. The incidence was significantly affected by the season (p<0.01) in all the breeds, however incidence was lowest in Murrah buffaloes in comparison to cows. Further incidence was more in Sahiwal and Tharparkar cows (p<0.01) than the crossbred Karan Swiss and Karan Fries cows. The increase in temperature humidity index resulted in increased incidence of mastitis in cows (p<0.01) but Murrah buffaloes were less affected.

RESUMEN

Este estudio fue realizado para hallar la influencia estacional sobre la incidencia de la mastitis a lo largo del año, en vacas indígenas, vacas cruzadas y búfalas Murrah. Se analizaron los registros de lactación correspondientes a un periodo de 12 años, la incidencia de mastitis fue comparada con los climogramas de la zona de Karnal, Haryana, India. El clima cálido y húmedo afectó negativamente a la incidencia de mastitis en todas las razas bovinas y los búfalos. La incidencia fue afectada significativamente por la estación (p<0,01) en todas las razas, aunque el efecto fue menor en las búfalas Murrah. El registro de mastitis fue más elevado en las razas Sahiwal y Tharparkar (p<0,01) que en los cruces Karan-Suiza y Karan-Fries. El incremento del índice de temperatura y humedad dio lugar a una mayor incidencia de mastitis en las vacas (p<0,01), aunque las búfalas Murrah resultaron menos afectadas.

INTRODUCTION

Mastitis is one of the most economically devastating diseases of dairy cattle particularly for the back yard farmers in developing world with huge economic losses reported by different countries (Dua, 2001; Tiwari *et al.*, 2013). Mastitis, inflammation of the mammary gland, stand second to foot and mouth disease as a most challenging disease of high yielding dairy animals as it causes inflammation of parenchyma of mammary glands, alters quality and quantity of milk, adversely affects animal health, and economics of milk production of dairy herds (De and Mukherjee, 2009; Sharma *et al.*, 2012). Increase in temperature-humidity index (THI) increases occurrence of clinical mastitis (Morse *et al.*, 1988) while no trend was evident with average rainfall. Hot weather condition especially above 24 °C has also been linked to increased milk SCC,

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increased microbes, reduced dry matter intake and low immunity leading to negative energy balance which makes dairy cattle more susceptible to infections (Singh *et al.*, 1996; Olde *et al.*, 2007; Ranjan *et al.*, 2011). Precipitation also poses a series of problems and ingestion of pathogens resulting in environmental mastitis (Bramley, 1982; Hogan and Smith, 2003). The wind and rain during summer and winter season increases heat loss and cold stress in cattle (Chand and Behra, 1993).The losses due to mastitis are not only economic, but issues such as animal health and welfare, milk quality, antibiotic usage and the image of the dairy sector are important reasons to focus on mastitis control (Hovi *et al.*, 2004). The pattern of mastitis occurrence in Asia is also significantly increasing in both cattle and buffaloes which is a major challenge for policy makers, field veterinarians and researchers. In view of the abrupt change in global weather pattern during the last one decade, it is the need of hour to find out the impact of climate on mastitis incidence so that appropriate ameliorative measures could be taken to minimize the mastitis incidence. The present study was undertaken to determine the responses of indigenous vis a vis crossbred cows and Murrah buffaloes to the changed environment conditions on mastitis incidence.

MATERIALS AND METHODS

Data pertaining to 4520 lactation records of Karan Fries (n=2154), Karan Swiss (n=292), Sahiwal (n=822), Tharparkar cows (n=160) and Murrah buffaloes (n=1092) spread over twelve year period (2000-2011) was collected from the livestock stock register of the institute herd. Tharparkar and KS cows were less in number in the livestock herd and therefore fewer observations were recorded. The climate of the farm is subtropical in nature and the animals are being managed in a loose housing system as a routine practice. Karnal is located in Haryana state of India. The climate of the area is tropical with highest temperature of 45 °C in summer season and lowest temperature range between 2-5 °C in winter season. The fodder and concentrate are being offered in a feeding manger covered with asbestos roof. The data was classified on monthly basis in association with the climatic variables. The clinical mastitis was judged by the clinical symptoms like inflamed udder, pain and swelling of udder and apparent changes in milk colour (yellowish, watery and pinkish or reddish).The incidence of mastitis (%) was calculated by dividing the number of mastitis cases with average number of milking animals per month of the year. Climatic data for minimum, maximum, dry and wet bulb temperatures, rainfall and relative humidity were collected from observatory unit of CSSRI, Karnal, pertaining to the period 2000-2011 of study and was classified on monthly basis. Temperature-humidity index (THI) which is used as an indicator of thermal stress was calculated as per the formula:

$$THI= 0.72\ (W_b+D_b) + 40.6$$

where:
W_b= wet bulb temperature ºC.
D_b= dry bulb temperature ºC.

The data was analysed using Analysis of Variance with a Stat-3 software programme. Correlations among the parameters were found out using Pearson Correlation matrix. Least square Means were compared with paired *t* test to find out the significance.

RESULTS

The climograph of Karnal **(figure 1)** depicts four distinct zones viz., hot-dry, hot-humid, cold-dry and cold-humid with centrally placed thermo-neutral zones (TNZ). The climograph was prepared using % relative humidity against the dry bulb temperature by pooling the data of 12 years. The overall incidence of mastitis, irres-

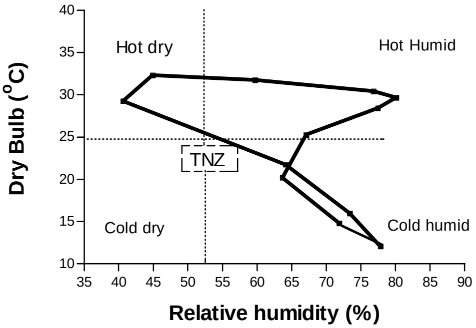

***Figure 1.** Climograph of Karnal (2000-2011) showing different zones with centrally placed thermoneutral zone.* (Climograma de Karnal (2000-2011) mostrando diferentes zonas y una zona termoneutral (TNZ) en el centro).

pective of breeds in different zones of climograph indicated significant effect of season ($p<0.01$) on mastitis incidence in descending order of hot-humid > cold-humid > hot-dry **(figure 2)**. The incidence of mastitis was more ($p<0.01$) in hot-humid season in all the breeds of cows viz., Karan Fries, Karan Swiss, Sahiwal and Tharparkar (**figure 3** to **6**). Contrary to this incidence of mastitis was less ($p<0.05$) in cold-humid season in Murrah buffaloes **(figure 7)**. The incidence of mastitis was positively correlated with THI ($p<0.05$, $r= 0.137$) in Karan Fries cows, but effect of THI on mastitis was non-significant for other breeds **(table III)**. The different breeds of cow responded differently to the climatic change around the year in the loose housing system of management. Further incidence of mastitis was more ($p<0.05$) in crossbred cows (Karan Fries and Karan Swiss) during the hot-dry season (May-June) and humid season (July-September) of year. However, indigenous Sahiwal cows exhibited significantly more ($p<0.05$) mastitis incidence throughout the year, except in October and November months than crossbred cows. The higher incidence was also evident in Tharparkar cows during the summer and winter months. In Murrah buffaloes, the incidence was higher ($p<0.05$) in hot and humid climate of rainy season. The lower ambient temperature

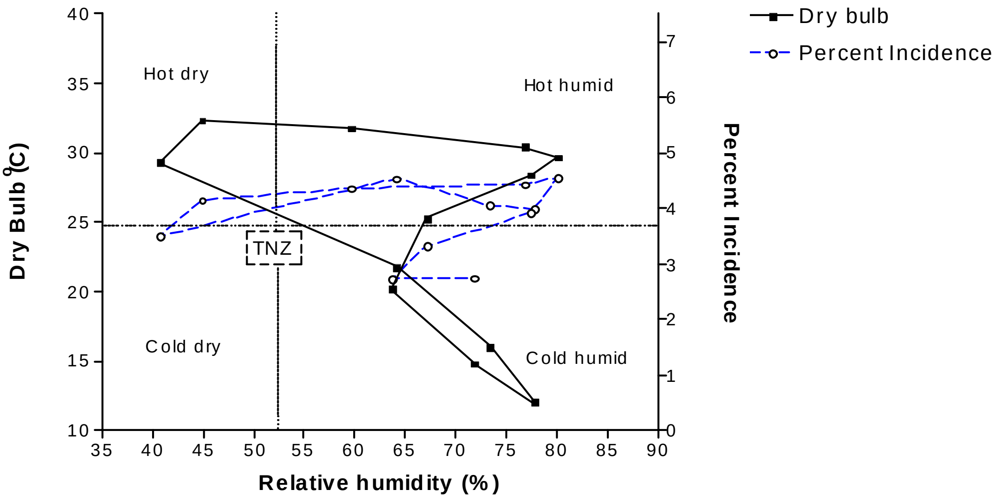

***Figure 2.** Percent incidence of clinical mastitis in different zones of climograph in dairy animals.* (Incidencia porcentual de mastitis clínica en ganado lechero en diferentes zonas del climograma).

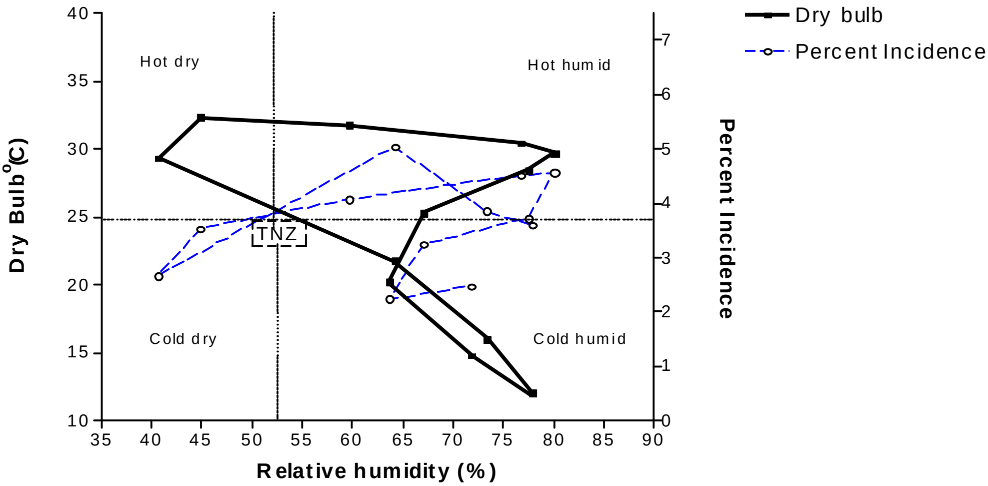

Figure 3. *Percent incidence of clinical mastitis in Karan Fries cows in different zones of climograph.* (Incidencia porcentual de mastitis clínica en vacas Karan Fries en diferentes zonas del climograma).

(<5 °C) during winter months also affected mastitis incidence **(table I)**. The overall incidence of mastitis was <5 % in the institute herd during the period of study. THI was significantly less ($p<0.01$) during the month of November to March in comparison to April to October month. THI was positively correlated to mastitis incidence in KF cows, however in other breeds of cows and Murrah buffaloes the correlations were non-significant **(table III)**. The positive correlation of THI with dry bulb and relative

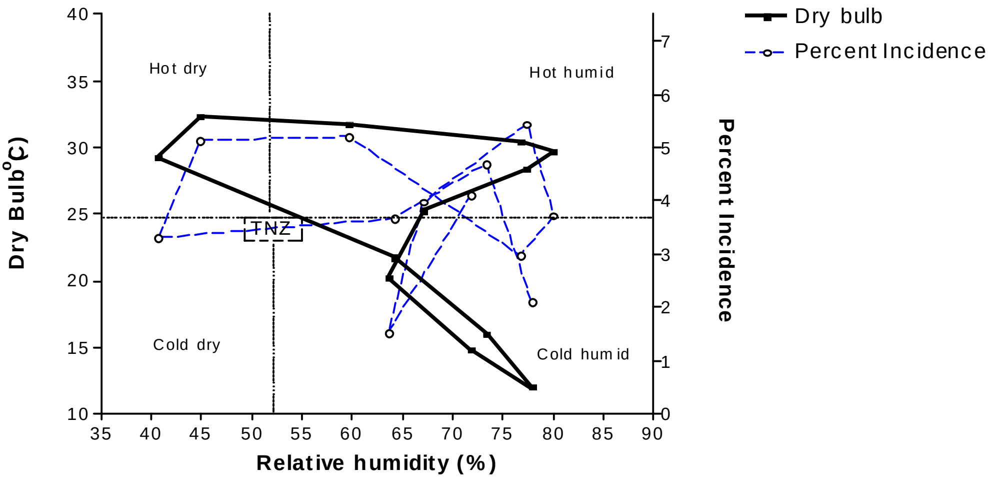

Figure 4. *Incidence of clinical mastitis (%) in Karan Swiss cows in different zones of climograph.* (Incidencia porcentual de mastitis clínica en vacas Karan Swiss en diferentes zonas del climograma).

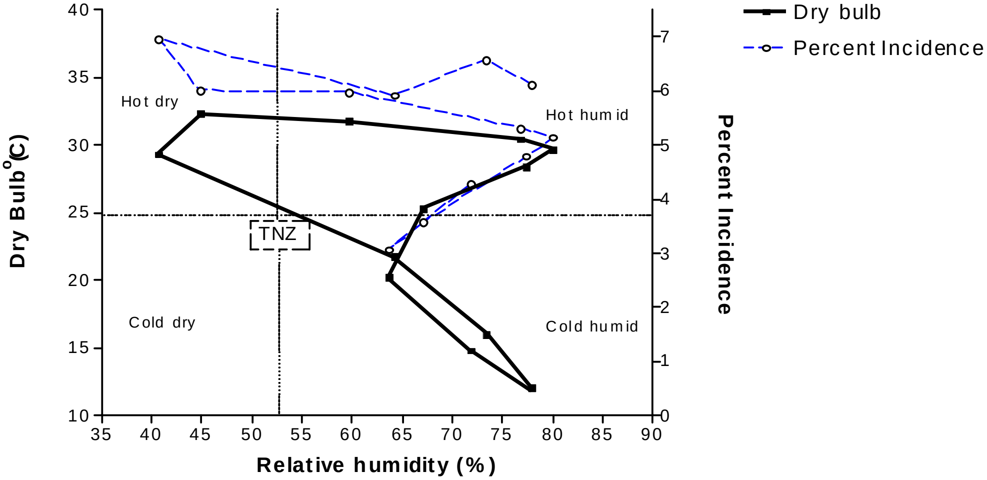

Figure 5. *Incidence of clinical mastitis (%) in Sahiwal cows in different zones of climograph.* (Incidencia porcentual de mastitis clínica en vacas Sahiwal en diferentes zonas del climograma).

humidity indicated that both the climatic variables give combined effect.

DISCUSSION

The higher incidence of mastitis in Murrah buffaloes in winter season was due to low THI- associated cold stress during the night as the animals were in a loose housing system. However significantly low incidence of mastitis in Murrah buffaloes

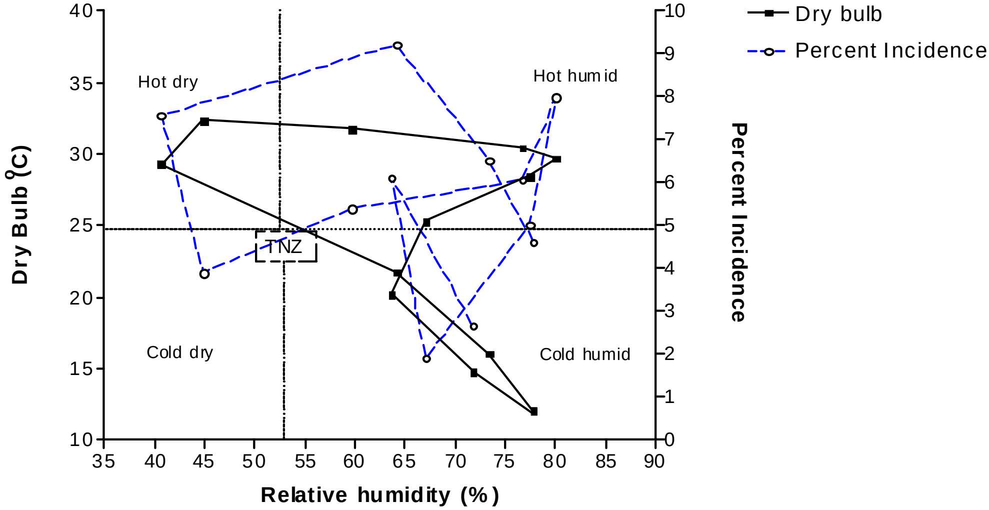

Figure 6. *Incidence of clinical mastitis (%) in Tharparkar cows in different zones of climograph.* (Incidencia porcentual de mastitis clínica en vacas Tharparkar en diferentes zonas del climograma).

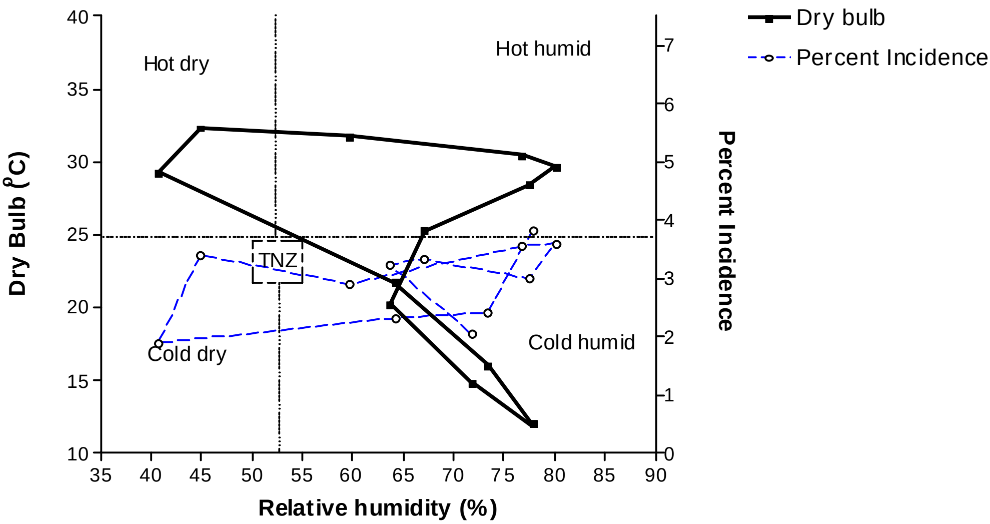

Figure 7. *Incidence of clinical mastitis (%) in Murrah buffaloes in different zones of climograph.* (Incidencia porcentual de mastitis clínica en búfalas Murrah en diferentes zonas del climograma).

than the cows in summer season ($p<0.05$) indicated a positive impact of mist and fan cooling effects on udder health which is being practiced in routine during summer season to alleviate heat stress as a routine practice (Singh *et al.*, 2001). Further

Table I. *Average value of weather changes during the years 2000 to 2011.* (Valores climáticos medios durante los años 2000 a 2011).

Month	Temperature(°C) Max.	Min.	DB	WB	RH (%)	Rain fall (mm)	THI
January	17.84	6.28	12.08	10.37	77.83	24.23	56.76
February	22.26	8.64	16.02	12.97	73.35	40.55	61.47
March	28.32	12.88	21.76	17.05	64.14	17.20	68.55
April	36.39	18.34	29.30	19.28	40.65	9.51	75.58
May	38.20	23.53	32.33	22.71	44.88	38.68	80.23
June	36.59	25.45	31.75	25.04	59.70	105.53	81.48
July	33.88	26.47	30.44	26.98	76.78	140.68	81.94
August	32.96	25.74	29.68	26.82	80.08	136.74	81.28
September	32.41	23.16	28.43	25.11	77.42	133.11	79.15
October	31.76	17.28	25.30	20.34	67.09	8.36	73.46
November	27.58	11.66	20.21	15.29	63.64	2.14	66.16
December	21.50	7.42	14.81	11.51	71.83	5.88	59.55
Average	29.97	17.24	24.34	19.46	66.45	55.22	72.13

Max.= maximum; Min.= minimum; DB= dry blub; WT= wet blub; RH= relative humidity; THI= temperature humidity index.

Table II. *Average month incidence of mastitis in different breeds of dairy animals in relation to climatological factors during the period 2000-2011.* (Incidencia media mensual de mastitis en diferentes razas de animales lecheros en relacion a factores climatológicos durante el periodo 2000-2011).

	Dry bulb (°C)	RH (%)	THI	Karan Fries nº	Karan Fries Incid. %	Karan Swiss nº	Karan Swiss Incid. %	Sahiwal nº	Sahiwal Incid. %	Tharparkar nº	Tharparkar Incid. %	Murrah nº	Murrah Incid. %	Overall incid. nº	Overall incid. Incid. %
Jan	12.08	77.83	56.76	2115	3.59(76)	284	2.11(6)	670	6.12(41)	130	4.62(6)	1202	3.83(46)	4401	3.98(175)
Feb	16.02	73.35	61.47	2158	3.85(83)	293	4.78(14)	745	6.58(49)	138	6.52(9)	1201	2.41(29)	4535	4.06(184)
March	21.76	64.14	68.55	2224	5.04(111)	300	3.67(11)	811	5.92(48)	152	9.21(14)	1162	2.32(27)	4649	4.54(211)
April	29.30	40.65	75.58	2212	2.67(59)	303	3.30(10)	862	6.96(60)	172	7.56(13)	1105	1.90(21)	4654	3.50(163)
May	32.33	44.88	80.23	2235	3.53(80)	312	5.13(16)	915	6.01(55)	180	3.89(7)	941	3.40(32)	4583	4.15(190)
June	31.75	59.70	81.48	2180	4.08(90)	307	5.21(16)	936	5.98(56)	167	5.39(9)	997	2.91(29)	4587	4.36(200)
July	30.44	76.78	81.94	2195	4.51(99)	303	2.97(9)	941	5.31(50)	165	6.06(10)	982	3.56(35)	4586	4.43(203)
Aug	29.68	80.08	81.28	2214	4.56(101)	295	3.73(11)	933	5.14(48)	188	7.98(15)	1025	3.61(37)	4655	4.55(212)
Sept	28.43	77.42	79.15	2152	3.72(80)	294	5.44(16)	876	4.79(42)	180	5.00(9)	1067	3.00(32)	4569	3.92(179)
Oct	25.30	67.09	73.46	2037	3.24(66)	277	3.97(11)	784	3.57(28)	156	1.92(3)	1110	3.33(37)	4364	3.32(145)
Nov	20.21	63.64	66.16	2059	2.23(46)	264	1.52(4)	719	3.06(22)	147	6.12(9)	1141	3.24(37)	4330	2.73(118)
Dec	14.81	71.83	59.55	2067	2.47(51)	268	4.10(11)	677	4.28(29)	149	2.68((4)	1171	2.05(24)	4332	2.75(119)
Av.	24.34	66.45	72.13	2154	3.63(78)	292	3.83(11)	822	5.31(44)	160	5.58 (9)	1092	2.96(32)	4520	3.87(15)

The incidence percent was calculated by dividing the number of mastitis new cases by the average milking cows/buffaloes per month of the year. DB= dry bulb; WT= wet bulb; RH= relative humidity; THI= temperature humidity index; Nº= number of observation; NCM= number of cases of mastitis cows and buffaloes.

Table III. *Correlation coefficient (r) between climatological factors (dry bulb, DB; relative humidity, RH; temperature humidity index, THI) and percent incidence of clinical mastitis in dairy animals.* (Coeficientes de correlación (r) entre factores climatológicos (bulbo seco, DB; humedad relativa, RH, índice de temperatura humedad, THI) y porcentaje de incidencia de mastitis en animales lecheros).

Parameters/breed	DB	RH	THI	Incidence (%)
DB	--			
RH	-0.391**	--		
THI	0.983*	0.224*	--	-
Karan Fries cows' incidence (%)	0.113 NS	0.102 NS	0.137*	-
Karan Swiss cows incidence (%)	0.083 NS	-0.063 NS	0.071 NS	-
Sahiwal cows incidence (%)	0.048 NS	-0.108 NS	0.021 NS	-
Tharparkar cows incidence (%)	0.047 NS	-0.001 NS	0.046 NS	-
Murrah buffaloes incidence (%)	0.057 NS	0.165 NS	0.093 NS	-

*p<0.05; **p<0.01. NS= non significant.

buffaloes need more cooling due to black color coat and less number of sweat glands. The highest prevalence of mastitis has been reported in cows during the monsoon season earlier and corroborates the results of this study (Khate and Yadav, 2010; Paranjape and Das, 1986). We observed lower incidence (1.90-3.83 %) of mastitis in buffaloes in comparison to higher incidence of mastitis (10.86 to 31.72 %) reported earlier (Singh *et al.*, 1996; Shinde *et al.*, 2001). The lowest incidence of clinical mastitis in winter and highest incidence in rainy season in buffaloes has been attributed to anatomical structure of mammary gland which render mammary gland more resistant to pathogens (Taraphder *et al.*, 2006). The crossbred and Sahiwal cows were more affected by high humidity and high ambient temperature (THI>79 to 89) due to more growth of pathogens and more udder exposure to unhygienic conditions in rainy season (Singh *et al.*, 2001). Wetness of the udder due to moist stalls floor or due to frequent washing of the udder increases the deleterious effect of draughts by increasing heat loss from its skin (De and Mukherjee, 2009). The Sahiwal and Tharparkar cows are heat tolerant breed and can resist rigors of high ambient temperature but are more susceptible to hot and humid climate. This fact was further evident from the low incidence of mastitis at THI score of <72 which did not influence mastitis incidence in these animals. Thus comparison of Sahiwal and Tharparkar cows suggest that Tharparkar cows are more resistant to high temperature of hot-humid season in comparison to Sahiwal cows. Some reports indicate significant effect of season of calving on clinical mastitis in crossbred cows (Chand and Behra, 1993; Khate and Yadav, 2010; Shinde *et al.*, 2001; Jadhav *et al.*, 1995). The negligible incidence of mastitis in the cold-dry zone of climograph reveal that low ambient temperature during winter season with humidity up to 75 % was not detrimental to the udder health of cows and buffaloes. However higher humidity in conjunction with moderate temperature (30-35 °C) led to more stress on animals as evident from the high THI score in this study. The coliform bacteria have been found as a main cause of bacterial mastitis during cold months (Shathele, 2009). Thus cold dry and hot dry conditions were found to be good for the udder health, while hot- humid and cold-humid season were detrimental to udder health and caused more mastitis incidence. Further different breeds of cows responded to the changed weather condition differently for mastitis incidence and the humidity was one of the critical factors in causing the climatic stress leading to mastitis incidence (Steeneveld *et al.*, 2008). The farmers therefore needs to manage their dairy cows and buffaloes with proper shelter and hygienic milking practices to reduce mastitis incidence and somatic cell counts of milk to produce clean milk (Singh and Ludri, 2001; Shailja and Singh, 2002). The positive correlation of THI with mastitis incidence in KF cows only indicated that rigor of climatic stress affected KF cows more than the rest of breeds in this study.

CONCLUSION

It was concluded that hot and humid climate significantly increases mastitis incidence in all the breeds of cows. The cows were more venerable to mastitis while buffaloes can withstand rigors of adverse weather in comparison to indigenous and crossbred cows. Proper shelter management interventions are required to ameliorate the heat stress of summer in conjunction with the adequate hygiene practices.

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