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Effect of season on seminal characteristics of bovine bull

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Abstract
The present study was undertaken to investigate the effect of temperature humidity index (THI) on seminal attributes in cross bred bulls. Forty one ejaculates from two bulls aged 4 to 6 years, weighing 300 to 450 KGS reared at the Semen Production Centre, Department of Veterinary Gynaecology and Obstetrics, Pantnagar, India, were used for the study. Semen was collected for 6 months. The temperature and relative humidity of respective days was taken from the meteorological department located nearby. THI was calculated. Three groups were prepared on the basis of THI range ie GI (THI <72, n=10), GII (THI 72-78, n=13) and GIII (THI 78-84, n=18). THI variations had no significant effect on ejaculate volume and mass activity but pH and progressive motility affected significantly. With the increase in THI, the pH of the semen decreases significantly and becomes more acidic and progressive motility also gets significantly decreased.

Keywords: season, temperature humidity index, semen quality, cross bred bull

1. Introduction
The report on cattle welfare, edited by the Scientific Committee on Animal Health and Animal Welfare (2001), suggested that the highest threshold temperature guaranteeing a sustainable welfare condition for animals is up to 30° C when humidity is below 80%**.** Therefore, in order to identify potential conditions of heat stress at the farm level a Temperature-Humidity-Index (THI) should be considered instead of temperature and humidity separately [1]. THI is commonly applied to estimate heat stress in dairy cows and semen donor bulls. When THI values were above 75, cows and bulls showed physiological signs of stress such as increased body temperature, modification of hearts and respiratory rates and change in reproductive functions [2]. The same environmental conditions also modified feeding behavior and resting of dairy cattle.
Sperm quality is influenced by environmental factors such as temperature, humidity, atmospheric pressure, and day length. Elevated testicular temperatures, either by exposure to high ambient temperatures or high body temperature, have been identified as causing a disruption in spermatogenesis, producing sperm abnormalities with a consequent decrease in semen quality, resulting in decreased embryo quality or failure of the embryo to signal maternal recognition of pregnancy [3]. Not only temperature on day of collection, but also during epididymal maturation or spermatogenesis up to about 70 days before collection seems to affect semen production [4, 5, 6, and 7]. However, notable differences between individual bulls were reported, suggesting differences in particular heat tolerance. The knowledge of trend of seasonal influence on semen characteristics would help to know the requirement of bulls to meet the demand of frozen semen and to provide any suitable additional managerial requirements time to time. Hence, the present study was undertaken to investigate the effect of seasons in reference to ambient temperature and relative humidity on bovine semen characteristics of Tarai region, Uttarakhand.

2. Material and Method
The present experiment was conducted on forty one ejaculates collected from two cross bred cattle bulls (3-4 years and 300-450 kg) maintained at Semen Production Centre, Department of Veterinary Gynaecology and Obstetrics, Pantnagar, India. The bulls were healthy, free from diseases, sexually mature, of good libido and clinically normal. Semen was collected in the morning twice a week by AV method during April to October, 2015. Three groups were formed on the basis of THI range ie GI (THI <72, n=10), GII (THI 72-78, n=13) and GIII (THI 78-84, n=18).

Volume of whole ejaculate was measured after collection. Colour and consistency were assessed. The consistency was graded as thick creamy, thin creamy, milky, cloudy and clear white. The pH was measured by Whatmann's pH indicator paper. Motility of spermatozoa was estimated within 10-15 min after semen collection. Mass motility was determined by placing a small drop of fresh undiluted semen on a glass slide warmed to 34^0C and examined under the low power microscope. A score of 0-5 was given according to the intensity of swirling patterns. Progressive or individual motility was examined by putting drops of diluted semen on a glass slide, under high power microscope. Two hundred individual spermatozoa across the field was estimated and recorded for progressive motility. The temperature and relative humidity of respective days was taken from the meteorological department located nearby. Data analyzed statistically by using Least squares means model and ANOVA using the LSML-91 software package, Walter Harvey.

3. Results and Discussion

Table 1 indicates the effect of increase in THI on various parameters of semen collected from cattle bull. The appearance of the ejaculate varied between light milky and creamy. There was no significant difference in semen volume among the groups but highest semen volume was observed in group II (6.93±0.50) and lowest volume of semen was in group III. (Fig 1) The pH of semen observed during the experimental period was varied from 6.5-6.7. There was a significant decrease in pH of semen with increase in THI value i.e. group I had more pH than group II and group III (Table 1 and Fig 2).

The results of mass motility in table 1 indicated non-significant effect of THI on mass motility of semen collected. The mass motility of the spermatozoa was between rapid (very good) and moderate (good).

The progressive motility of semen collected was between 60-80%. The highest progressive motility (73.33±0.93) was observed at the mean THI value of 68.42. The lowest progressive motility (69.73±0.56) being recorded at mean THI value of 80.54 the results indicated a significant decrease in progressive motility in group III as compared group I. The ability of homeotherms to successfully maintain a constant body temperature can be compromised when environmental conditions limit the loss of metabolic heat or contribute to the heat load of the animal (i.e., when the surrounding temperature is greater than surface temperature or heat is gained from other objects by radiation). Estimates of the degree of heat stress affecting animal regulation of body temperature and ultimately the production of animal were made by developing temperature humidity index formulae that combines temperature and humidity meteorological variables.

Our results indicated that volume and mass motility ejaculate parameters are not significantly influenced by THI but it influenced pH and progressive motility of ejaculate significantly. This could be because of the spermatogenesis process is highly temperature sensitive and needs the proper temperature (2ºC lower than the body temperature) to go on smoothly. The moderate and severe heat stress causes the increase in the testicular temperature which does not allow the proper maturation of sperms and leads to the production of abnormal and dead sperms and ultimately affecting the progressive motility of ejaculate motility.

In our present study, highest semen volume was observed in group II and lowest in group III, which indicates non-significant decrease in semen volume with an increase in THI. Similar results were obtained by [8] when the ejaculate volume was significantly higher in Holstein Friesian bulls during stress free and wet summer and it was highest during wet summer in Jersey bulls. [9] Noted lowest ejaculate volume in humid summer (THI greater than 80) in Nili Ravi buffalo bulls. However, [10, 3] reported that season had no effect on ejaculate volume for Nelore and Holstein bulls, respectively. These differences in findings might be attributed to differences in breeds of bulls studied and environmental conditions. Wet summer has THI values ranging 70 to 75. According to [11] the ejaculate volume had no significant correlations with any of the meteorological variables.

The trend in pH indicated that there was significant decrease in pH with increase in THI value. [12] found significant ($P<0.05$) seasonal difference in pH of ejaculate in murrah bulls which is in agreement with us. However**,** [13] in swamp buffalo and [14] in Murrah buffalo bulls reported no significant change in pH of semen with seasonal variation.

The mass motility of the spermatozoa was between rapid (very good) and moderate (good). Our findings are in agreement with [15] who observed non-significant change in mass activity with a season in Nili-ravi bulls. Opposite to this [16, 14, 17] reported significant variations in ejaculatory volume with the seasonal variations in Murrah buffalo bulls, Mehsana and Surti buffalo bulls respectively. The highest mass activity is present during winter as THI level is in normal range [18]. However, in Murrah bulls [19, 20] observed highest mass motility during rainy season i.e. THI level is towards high heat stress condition.

The progressive motility of semen collected was between 60-80%. There was a significant decrease in progressive motility in group III with respect to group I. [21, 22] reported significant enhancement in buffalo bull initial sperm motility during autumn months, which agree in part with the present results. Our results are in agreement with Ramadan *et al* 2009 as observed in buffalo bulls. The highest ($P<0.05$) motility was noted during the summer and autumn seasons. Earlier reports, however, gave conflicting results regarding the effect of seasonal variations especially temperature and humidity on the percentages of sperm progressive motility. [21, 22] reported significant enhancement in buffalo bull initial sperm motility during autumn months, which agree in part with the present results as the THI values are in normal range in autumn (60 to 75). Our results are in agreement with the findings obtained by [23] in Murrah buffalo bulls and [24] in Surti buffalo bulls and [25] in Murrah buffalo bulls who found the Significant ($P<0.01$) seasonal difference in percent initial motility. It was found maximum during winter during which THI value remains in normal range and varied significantly ($P<0.05$) in summer and rainy season.

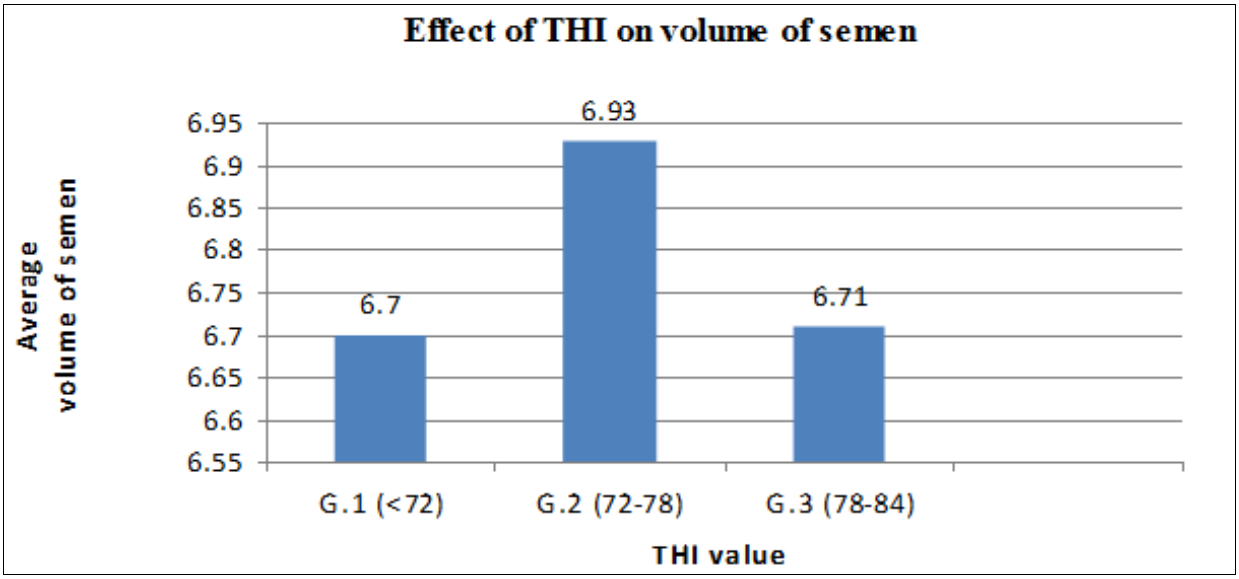

Fig 1: Effect of change in THI on volume of bovine semen

Table 1: Effect of THI on volume, pH, mass and progressive motility of bovine semen.

Parameters	Group-I (below 72, n=10)	Group-II (72-78, n=13)	Group- III (78-84, n=18)
Volume (ml)	6.70±0.53	6.93±0.50	6.71±0.54
pH	6.57±0.01^{c}	6.53±0.01^{b}	6.42±0.02^{a}
Mass motility	3.33±0.34	3.33±0.34	3.07±0.32
Prog. Motility	73.33±0.93^{b}	71.80±1.23^{ab}	69.73±0.56^{a}

Means bearing different superscript letters (a, b, c) in a row differ significantly ($p<0.05$)

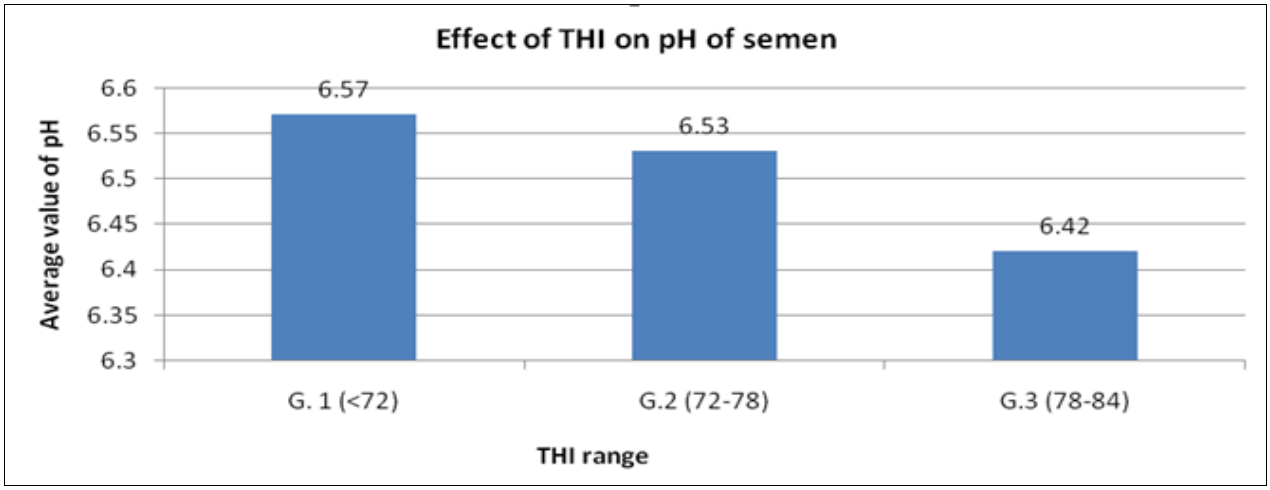

Fig 2: Effect of change in THI on pH of bovine semen.

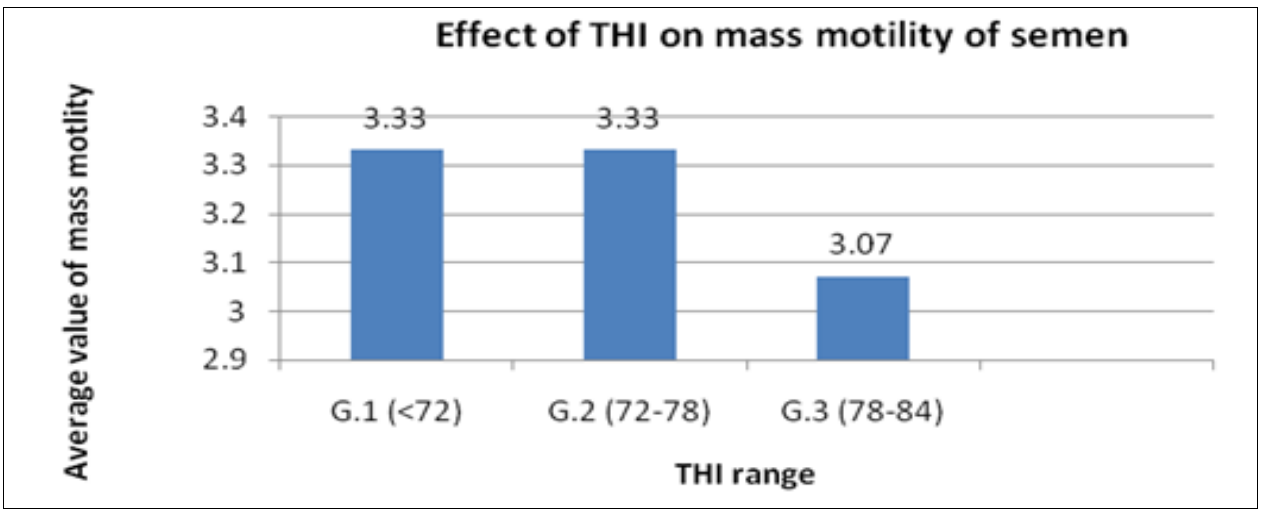

Fig 3: Effect of change in THI on mass motility of bovine semen

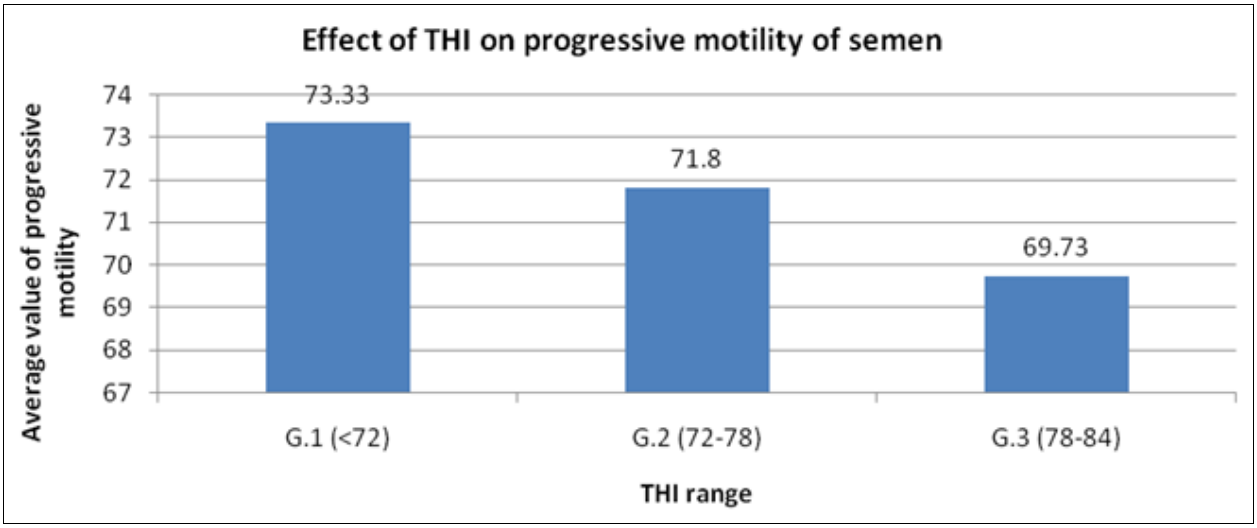

Fig 4: Effect of change in THI on progressive motility of bovine semen

4. Conclusion

THI variations had no significant effect on ejaculate volume and mass activity but pH and progressive motility affected significantly. With the increase in THI, the pH of the semen decreases significantly and becomes more acidic and progressive motility also gets significantly decreased.

5. Acknowledgement

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