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Study of Cattle Adoptability in the Central Plain Zone of Uttar Pradesh throughout the Spring and Summer Seasons

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ABSTRACT

Extreme weather conditions are the key environmental factors determining growth and metabolism of cattle's and other livestock. Adaptability in cattle during summer and spring seasons in three districts of central plain zone were studied by different. Heat tolerance indices like Ibrea heat tolerance coefficient (IHTC), Gaalaas heat tolerance test, Benezara coefficient of adaptability and dairy search index. All parameters of heat tolerance indices were calculated by using different physiological parameter like rectal temperature, pulse rate and respiration rate. There was a significant ($p<0.01$) deference in Temperature humidity index (THI) values in spring and summer seasons in all three districts of central plane zone of Uttar Pradesh. Values of overall Mean±SEm of Iberia heat tolerance coefficient and Gaalaa's heat tolerance coefficient were significantly ($p<0.01$) more closure to 100 in spring season. Values of overall Mean±SEm of Benezera coefficient of adaptability and dairy search index were significantly ($p<0.01$) more closure to 2.00 and 1.00 respectively, in spring season these values showed more adaptability of cattle in spring season as compared to summer season.

Keywords Adaptability, Cross bred cattle, Dairy search index, Temperature humidity index.

INTRODUCTION

India is the largest milk producer in the world. Milk productions of Indian dairy cows are adversely affected by heat stress. Extreme weather conditions are the key environmental factors determining growth and metabolism of cattle's and other livestock. It causes economic losses due to decrease in milk yield and growth performance in dairy cattle. Temperature humidity index (THI) is an index of heat stress. THI can be used to evaluate the cooling requirements for better productivity and efficiency of management plan in dairy cattle. However, calves are especially sensitive to external environment. Therefore, different parameters of stress should be monitored more

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accurately. Abdelatif and Alameen (2012) reported in hot climate dairy cattle, decreases feed consumption, productivity and the metabolic rates due to activation of thermoregulatory mechanisms. Homoeothermic animal must be in thermal balance with its external environment (Kadzere *et al*. 2002). Animal suffers from thermal stress when combination of environmental states causes the effective temperature of the environment to be greater than the animal's comfort zone (Armstrong 1994). THI is a good indicator of degree of stress on cows and heat stress reduces the milk production, milk fat content and reproductive efficiency of dairy cows, mainly in animals of high genetic value (Dikmen and Hansen 2009). Lactating dairy cow's performance and healthy status can be negatively affected by uncomfortable thermal environment.

The dissipation of surplus body heat is eliminated by the respiratory tract through evaporation of water and by body surface via panting and sweating respectively. In this context, the adaptation of animals to the hot and cold climatic conditions is also a major field of interest as such animals shows the least variation in their physio-biochemical traits when raised under such stressful conditions. It has been commonly observed that the animals differ in their nature of being susceptible and tolerant when subjected to the thermal stress. Literature suggested that heifers and cows are heat resistant as compared to the other species due to their nature and efficiency of more heat dissipation and production of less metabolic heat. The increased rate of respiration and panting during the heat stress conditions accelerate the deprivation of carbon-dioxide which results in the change in the chemistry acid-base balance and respiratory alkalosis of animal. It also affects the motility of rumen and affecting the fermentation and digestibility of feed in ruminant. One of the severe constraints of heat stress is prenatal suppression of the embryo which causes the impaired placenta, which not only results in hypoxia and malnutrition, but also reduces the future milk production, growth, immunity of animal.

The endeavour of present study was to assess, how influence of extreme hot condition effect of heat stress on overall adaptability in the cross bred cattle in central plane zone of Uttar Pradesh.

MATERIALS AND METHODS

The study was conducted in spring (March) and summer (June) seasons in the year 2021 at Lucknow, Unnao and Sitapur districts of central plane zone of Uttar Pradesh. All the climatic variable were recorded twice daily at 7:30 am to 2:30 pm in the experimental period. Eighteen lactating cross bred cows of age group 4-6 years and body weight between 360 to 410 kg were randomly selected for the study. The animals were divided into 3 groups as one group in each district containing six animals in each group. Cattles are maintained in good managemental condition.

Meteorological parameters like maximum and minimum environmental temperature and relative humidity were recorded in both seasons during study period. To evaluate animals for their tolerance capacity the following test was applied.

Iberia heat tolerance test (HTC):- Evaluate as per Rhoad (1944).

HTC= 100-10 (RT-101)

HTC= Heat tolerance coefficient

RT= Average rectal temperature of six reading.
101º F= Average temperature of cattle

Interpretation: If the calculated value of test is more nearer to 100 then the particular animal is more heat tolerant than others. When the two particular animals have the same heat tolerance coefficient, than the animal, which has higher respiration rate is less heat tolerant.

Gaalaa's heat tolerance test:- Evaluate as per Gaalass (1947).

The formula for calculating the heat tolerance coefficient is as follows

= 100-14 (RT-101)

Interpretation of results are also similar to Iberia heat tolerance test i.e., if the calculated values is more nearer to 100 than particular animals is more heat tolerant than other.

Benezra's coefficient of adaptability (BCA):- Evaluate as per Benezra (1954).

$$BCA = \frac{RT + RR}{38.33 + 23}$$

Where,
RT= Rectal temperature, RR= Respiration rate/min
38.33= Normal RT (ºC)
23= Normal RR/min

Interpretation: A calculated value of 2 shows maximum adaptability and values over 2 indicate a state of lower adaptability.

Dairy search index (DSI):- Evaluate as per Thomas *et al*. (1973).

0.5 X1/X+ 0.3 Y1/Y+ 0.2 Z1/Z

Where,
X_1, Y_1 and Z_1 are rectal temperature, pulse rate and respiration rate after exposure and X, Y and Z the same parameters before exposure respectively.

Interpretation: If calculated value is more nearer to 1 then the animals is more heat tolerant than the animal are deviating more from one.

Temperature humidity index (THI)

THI was calculated from the formula (National Research Council 1971).

THI = (1.8XTdb + 32) – (0.55- 0.0055 X RH) X (1.8XTdb-26)

Where,
Tdb= Dry bulb temperature in Celsius, RH= Relative Humidity.

Statistical analysis

The correlations among the various parameters were also calculated (Snedecor and Cochran 2004).

RESULTS AND DISCUSSION

The results of study on the influence of extreme hot conditions on adaptability, in cattle in central plane zone of Uttar Pradesh are being presented in this chapter.

Table 1. Mean ± SE of temperature humidity index (THI) during spring and summer season in Lucknow, Sitapur and Unnao district of Uttar Pradesh.

THI	Lucknow	Sitapur	Unnao
Spring (March)	79.52±1.11	79.25±1.17	79.20±1.11
Summer (June)	87.93±0.91	85.78±1.83	87.94±0.91

Temperature humidity index (THI)

Mean±SE of temperature humidity index (THI) in spring and summer season of Lucknow, Sitapur and Unnao district of Uttar Pradesh which is recorded in afternoon hours and represented in Table 1.

Values of Mean±SE of (THI) were 79.52±1.11, 79.25±1.17 and 79.20±1.11 in Lucknow, Sitapur and Unnao districts respectively in central plane zone of Uttar Pradesh in spring season and values of Mean±SE of (THI) were 87.93±0.91, 85.78±1.83 and 87.94±0.91 in Lucknow, Sitapur and Unnao districts respectively central plane zone of Uttar Pradesh in summer season.

There was significant ($p<0.01$) deference in temperature humidity index values in both seasons. In the present study temperature humidity index in all 3 districts during spring showed that there was no or mild stress in animal whereas, moderate to sevior stress in summer season which affects physiological responses hematological and biochemical changes in animal including productive and reproductive performance in dairy cattle (Hsu and Liu 1996, Johnson *et al*. 1963) and buffaloes (Aggarwal and upadhyay 1998).

Influence of thermal stress on adaptability in cattle

The Thermal stress at high (THI) value in summer as compared to spring season influences adaptability in cattle in all (3) districts which are presented in the following sections.

Table 2. Mean ± SE of Iberia heat tolerance coefficient and Gaalaa's heat tolerance coefficient during spring and summer season in cattle in Lucknow district of Uttar Pradesh.

Week	Iberia heat tolerance coefficient		Gaalaa's heat tolerance coefficient	
	Spring	Summer	Spring	Summer
First	95.33±0.56	94.50±0.50	93.47±0.78	92.30±0.70
Second	95.33±0.42	93.50±0.22	93.47±0.59	90.90±0.31
Third	95.17±0.40	94.67±0.49	93.23±0.56	92.53±0.69
Fourth	95.50±0.43	91.50±0.22	94.35±0.51	88.10±0.31
Mean ± SEm	95.33^{a}±0.45	93.54^{b}±0.36	93.63^{a}±0.61	90.96^{b}±0.50

Note: Means bearing different superscripts differ significantly ($p<0.01$).

Table 4. Mean ± SE of Iberia heat tolerance coefficient and Gaalaa's heat tolerance coefficient during spring and summer season in cattle in Unnao district of Uttar Pradesh.

Week	Iberia heat tolerance coefficient		Gaalaa's heat tolerance coefficient	
	Spring	Summer	Spring	Summer
First	95.33±0.56	94.50±0.50	93.47±0.78	92.30±0.70
Second	95.33±0.42	93.50±0.22	93.47±0.59	90.90±0.31
Third	95.17±0.40	94.33±0.42	93.23±0.56	92.07±0.59
Fourth	95.00±0.58	91.50±0.22	93.00±0.81	88.10±0.31
Mean ± SEm	95.21^{a}±0.49	93.46^{b}±0.34	93.29^{a}±0.69	90.84^{b}±0.48

Note: Means bearing different superscripts differ significantly ($p<0.01$).

Iberia heat tolerance coefficient (IHTC)

Changes in Mean±SE of Iberia heat tolerance coefficient during spring and summer season in cattle in Lucknow districts are represented in Tables 2 - 4 respectively. The Mean±SE of Iberia heat tolerance coefficients were 95.33±0.45, 95.38±0.74 and 95.21±0.49 in Lucknow, Sitapur and Unnao districts respectively in spring season. Mean±SE of Iberia heat tolerance coefficient was 93.54±0.36, 93.75±0.36 and 93.46±0.34 in Lucknow, Sitapur and Unnao districts respectively in summer season.

Values of overall Mean±SEm of Iberia heat Tolerance coefficient were significantly ($P<0.01$) more closure to 100 in spring session showed more adaptability in spring season as compared to summer session observation made by Mandal and Tyagi (2008).

Gaalaa's heat tolerance coefficient

Changes in Mean±SE of Gaalaa's heat tolerance coefficient during spring and summer session in cattle in Lucknow, Sitapur and Unnao districts are represented in Tables 2 - 4 respectively.

Values of Mean±SE of Gaalaa's heat tolerance coefficients were 93.63±0.61, 93.53±0.66 and 93.29±0.69 in Lucknow, Sitapur and Unnao districts respectively in spring season.

Values of Mean±SE of Gaalaa's heat tolerance coefficients were 90.96±0.50, 91.25±0.51and 90.84±0.48 in Lucknow, Sitapur and Unnao districts respectively in summer season.

Benezara coefficient of adaptability (BCA)

Changes in Mean±SE Benezara coefficient of adaptability during spring and summer season in cattle in Lucknow, Sitapur and Unnao districts are represented in Tables 5 - 7 respectively.

Values of Mean±SE of Benezara coefficients

Table 3. Mean ± SE of iberia heat tolerance coefficient and gaalaa's heat tolerance coefficient during Spring and Summer season in cattle in sitapur district of Uttar Pradesh.

Week	Iberia heat tolerance coefficient		Gaalaa's heat tolerance coefficient	
	Spring	Summer	Spring	Summer
First	95.50±0.50	94.67±0.56	93.70±0.70	92.93±0.78
Second	95.50±0.43	93.50±0.22	93.70±0.60	90.90±0.31
Third	95.33±0.49	95.00±0.37	93.47±0.69	93.00±0.51
Fourth	95.17±0.48	91.83±0.31	93.23±0.67	88.57±0.43
Mean ± SEm	95.38^{a}±0.74	93.75^{b}±0.36	93.53^{a}±0.66	91.25^{b}±0.51

Note: Means bearing different superscripts differ significantly ($p<0.01$).

Table 5. Mean ± SE of Benezra coefficient of adaptability and dairy search index during spring and summer season in cattle in Lucknow district of uttar pradesh.

Week	Benezra coefficient of adaptability		Dairy search index	
	Spring	Summer	Spring	Summer
First	2.27±0.03	2.49±0.04	1.03±0.01	1.10±0.01
Second	2.30±0.03	2.44±0.03	1.03±0.01	1.09±0.01
Third	2.27±0.03	2.47±0.04	1.03±0.01	1.10±0.02
Fourth	2.28±0.04	2.67±0.03	1.03±0.01	1.15±0.01
Mean ± SEm	2.28^{a}±0.03	2.52^{b}±0.03	1.03^{a}±0.01	1.11^{b}±0.01

Note: Means bearing different superscripts differ significantly ($p<0.01$).

Table 6. Mean ± SE of Benezra coefficient of adaptability and dairy search index during spring and summer season in cattle in Sitapur district of Uttar pradesh.

Week	Benezra coefficient of adaptability		Dairy search index	
	Spring	Summer	Spring	Summer
First	2.27±0.02	2.49±0.04	1.02±0.004	1.10±0.004
Second	2.27±0.02	2.47±0.02	1.03±0.006	1.09±0.008
Third	2.29±0.04	2.44±0.04	1.04±0.007	1.09±0.014
Fourth	2.34±0.02	2.65±0.04	1.04±0.004	1.14±0.006
Mean ± SEm	2.29^{a}±0.03	2.51^{b}±0.04	1.03^{a}±0.005	1.10^{b}±0.008

Note: Means bearing different superscripts differ significantly ($p<0.01$).

of adaptability were 2.28±0.03, 2.29±0.03 and 2.28±0.03 in Lucknow, Sitapur and Unnao districts respectively in spring season.

Values of Mean±SE Benezera coefficients of adaptability were 2.52±0.03, 2.51±0.04 and 2.52±0.04 in Lucknow, Sitapur and Unnao districts respectively in summer season.

Values of overall Mean±SEm of Benezara coefficient of Adaptability were significantly ($p<0.01$) more closure to 2.00 in spring season showed more adaptability in spring season as compared to summer season.

Dairy search index (DSI)

Changes in Mean±SE of Dairy search index (DSI) during spring and summer season in cattle in Lucknow, Sitapur and Unnao districts are represented in Tables 5 - 7 respectively.

Table 7. Mean ± SE of Benezra coefficient of adaptability and dairy search Index during spring and summer season in cattle in Unnao district of Uttar Pradesh.

Week	Benezra coefficient of adaptability		Dairy search index	
	Spring	Summer	Spring	Summer
First	2.27±0.03	2.49±0.04	1.03±0.005	1.09±0.017
Second	2.30±0.03	2.45±0.03	1.03±0.007	1.08±0.007
Third	2.27±0.03	2.47±0.04	1.03±0.009	1.09±0.019
Fourth	2.28±0.04	2.67±0.03	1.03±0.008	1.14±0.012
Mean ± SEm	2.28^{a}±0.03	2.52^{b}±0.04	1.03^{a}±0.007	1.10^{b}±0.014

Note: Means bearing different superscripts differ significantly ($p<0.01$).

Values of Mean±SE of dairy search indexes were 1.03±0.01, 1.03±0.005 and 1.03±0.07 in Lucknow, Sitapur and Unnao districts respectively in spring season.

Values of Mean±SE of dairy search index were 1.11±0.01, 1.10±0.08 and 1.10±0.014 in Lucknow, Sitapur and Unnao districts respectively in summer season.

Values of overall Mean±SEm of dairy search index were significantly ($p<0.01$) more closure to 1.00 in spring season showed more adaptability in spring season as compared to summer season. Our observations are in agreement with Mandal and Tyagi (2008).

CONCLUSION

Temperature humidity index (THI) values in spring and summer season showed no or mild stress in spring season where as moderate to severe stress in summer season. Rectal temperature, pulse rate and respiration rate of cattle were higher in summer season in comparison to spring season. Iberia HTC, Gaalaas HTC, Dairy search index and Benezra coefficient were showed more thermo- adaptability in spring season as compare to summer season.

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