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Short Communication

Climatic stress estimation and its nutritional management in crossbred cows: Field trial

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Heat stress in dairy cattle is one of the leading causes of decreased production and fertility in dairy cattle during summer months (Collier *et al.,* 2006). In India, annual total milk loss due to thermal stress was reported to be 1.8 million tonnes or about 2.0% of the total milk production of the country (Upadhyay *et al*., 2009). Heat stressed cattle may try to reduce the body heat through thermoregulatory mechanisms which in turn affect feed conversion efficiency and lead to decreased milk production (Prathap *et al*., 2017; Sunil Kumar *et al.* 2019; Rai *et al.* 2020; Yallappa *et al.* 2021). The objective of the study was to see the effect of nutritional supplementation on productive performance of dairy animals in summer.

The field trial was undertaken during summer months (June to August 2019) at organized dairy farm of Banka district, Bihar. Forty early lactating cross bred cows (HF x Jersey) in their 2nd to 4th lactation were selected. All the cows were divided into four groups of ten animals in each group and animals in control group were fed basal diet comprising of concentrates 4.5 kg, green fodder 15 kg and 4.3 kg straw (NRC, 2001). In experimental group in addition to control diet supplemented with niacin 12g+ probiotics @ 20g/animal (T_1), niacin 12g+ ($NaHCo3$ 70g; MgO 15g+ KCl 50g)/day/animal (T_2) and niacin 12g+ Oat 500g/day/animal (T_3). Supplementation of Niacin and other feed additives were as per NRC (2001).

Within-shed environmental conditions were recorded daily at 9:30 AM and 2:00 PM of Indian Standard Time (IST) using digital hygrometer. THIs were calculated using the following formula given in (NRC, 1971): THI = (1.8×T°C+32) − (0.55−0.0055×RH%) × (1.8×T°C−26), where T = temperature in °C, and RH% = relative humidity. Rectal temperature and respiration rate were recorded twice daily for two consecutive days every week.

Milk production was recorded daily morning and evening milking and after proper mixing, about 100-150mL of milk sample from each cow was analysed for fat and SNF contents by an automatic milk analyzer. Average feeding cost and realization receipt from the sale of milk was calculated based on current market prices. The chemical composition of feeds and fodders offered was estimated (AOAC, 2005).

Weather Conditions during the Experimental Periods

The difference in environment temperature and farm temperature was highest in July by 7.1°C. The shed THI was almost similar in June, July and august month are varied between 77.0-79.8 means cows are in mild to moderate heat stress. Animals were in mild, medium and severe stress on THI 72-79, 80-89 and 90-98, respectively (ICAR, 2013).

Table 1: Temperature humidity index of dairy farm

Month	Air temp	Farm temp	Farm THI	Temp. difference
June	33.7±1.10	30.6±0.25	78.3±0.23	3.1± 1.27
July	34.6±0.22	27.5±0.89	79.8±1.57	7.1±0.92
August	29.4±0.30	26.7±0.53	77.0±0.85	3.3±0.41

Average rectal temperature and respiration rate were significantly higher ($P<0.05$) in control group as compared to experimental group (Table 2) indicating more effect of heat stress on cows in control group when the THI higher than 72 units which might be due to the function of supplement helped animals to alleviate heat stress. Gaughan *et al*., (2005) suggested that the addition of exogenous osmolytes significantly reduced the rectal temperature and increased the feed intake and heat endurance of cows during heat stress.

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Table 2: Average rectal temperature and respiration rate of different groups of cows

Parameters	Control	T1	T2	T3	SEM
Rectal temperature (°C)	39.3^{c}±0.02	38.6^{b}±0.03	38.5^{a}±0.02	38.6^{b}±0.07	0.05
Respiration rate/ min.	67.7^{a}± 2.0	56.2^{b}±1.6	53.0^{b}±0.7	54.2^{b}±1.3	0.62

^{a,b} Values with different superscripts in a row differed (p<0.05) significantly

Table 3: Average feed intake and feed conversion efficiency of cows

Parameters	Control	T1	T2	T3
Feed intake				
DMI (kg/d)	12.99^{a}±0.09	14.09^{b}±0.12	14.78^{c}±0.0.7	14.18^{b}±0.11
DMI (%B.Wt.)	3.03^{a}±0.07	3.28^{ab}±0.08	3.37^{b}±0.09	3.23^{ab}±0.09
Av.DMI/FCM	1.28± 0.04	1.22±0.03	1.15± 0.02	1.23± 0.02
Feed conversion efficiency				
CPI (kg/d)	1.37± 0.08	1.40± 0.06	2.06± 0.09	1.97±0.03
CPI/kg FCM	0.135^{a}± 0.004	0.121^{a}±0.003	0.161^{b}±0.003	0.171^{b}±0.002
TDNI/kg FCM	0.688±0.023	0.658±0.02	0.661± 0.01	0.736±0.01
CPI (% Req)	113^{b}± 2.9	105^{a}± 2.1	142^{c}± 2.3	148^{c}± 1.4
TDNI (% Req)	114^{a}±2.0	113^{a}±1.7	122^{b}± 1.5	129^{b}±0.9
CaI (% Req)	55^{a}±1.3	101^{b}±1.9	93^{b}±1.4	104^{b}± 0.9
PI (% Req)	58^{a}±1.3	91^{b}±1.7	86^{b}±1.2	92^{b}±0.8

^{a,b}Values with different superscripts in a row differed (p<0.05) significantly

Table 4: Average Milk yield and composition of different group of cows

Parameters	Control	T1	T2	T3
Milk yield (kg day^{-1})	10.09^{a}±0.32	11.27^{b}±0.20	11.91^{c}±0.22	11.10^{b}±0.10
Fat% (kg)	4.12^{a}±0.10	4.23^{a}±0.15	4.54^{b}±0.08	4.26^{a}±0.07
Fat yield (kg)	0.415^{a}±0.02	0.477^{b}±0.02	0.540^{b}±0.01	0.472^{b}±0.01
FCM yield (kg)	10.26^{a}±0.34	11.66^{b}±0.31	12.87^{b}±0.26	11.53^{b}±0.14
% Increase		13.68	25.42	12.32

^{a,b}Values with different superscripts in a row differed (p<0.05) significantly

Table 5: Economics of milk production of cows

Parameters	Control	T1	T2	T3
Cost/kg MY	16.41^{ab}± 0.53	15.87^{a}± 0.27	15.84^{a}±0.29	18.52^{b}±0.16
Daily cost of feeding	164^{a}± 3.2	178^{b}±2.6	188^{c}±4.3	205^{c}±2.8
Total receipt (Rs)	191±7.19	229±8.25	249±5.9	250±3.78
BCR	1.16^{a}±0.04	1.28^{ab}± 0.05	1.32^{b}±0.03	1.22^{ab}±0.02
(DROF) Daily return over feed cost	27^{a}±7.19	50^{ab}±8.25	60^{b}±5.93	44^{ab}±3.78
More return over control		23	33	18
% more return		88	125	66
90 days more return (Rs)		2128	3025	1583

^{a,b}Values with different superscripts in a row differed significantly (p<0.05)

The average DMI after 90 days trial was significantly (P<0.05) higher by 10-15% in treatment than control group (Table 3) which indicated that heat stress had comparatively lower effect on DMI in experimental group than control and least effect on T_2 group. Reduction in DMI is the most important effect of heat stress in tropical and sub-tropical conditions (Marai and Habeeb, 2010).

Feed conversion efficiency in terms of CP intake/ kg FCM (Table 3) was significantly higher (P<0.05) in T2 group than control group showed the efficient utilization of nutrient in heat stress condition.

The average daily milk yield was significantly (P<0.05) higher in treatment than control group but highest in T2 group. Supplementation of Niacin with probiotic and with MgO, KCl and NaHCO3 or oat improved the (P<0.05) milk yield by 16.2 to 18 % and improvement in fat% was highest by 10.27% in T2 group (Table 4). Fat yield and FCM yield was significantly (P<0.05) higher in treatment than control group. Similarly for each point increase in the value of THI beyond 69, milk production dropped by 0.41 kg per cow per day (Ganter *et al*., 2011).

The daily feed cost (Table 5) was higher (P<0.05) in oat and chemical supplemented group than control group. The feeding cost/kg milk yield was lowest in T2 group and highest higher (P<0.05) in T3 group. Higher feed cost in experimental group was mainly due to higher DMI and supplement cost. However, daily realizable receipt (Rs/head/day) from the sale of milk and net profit was higher in T1, T2 and T3 group respectively than control.

The results indicated that the supplementation of Niacin with $NaHCO_3$, MgO and KCl to crossbred cow during heat stress improved feed intake, feed conversion efficiency, milk yield, fat and SNF contents resulting in higher daily income of farmers. It also helped in maintaining lower rectal temperature and respiration rate during the heat stress period in hot and humid environment of India. Therefore, supplementation of Niacin with $NaHCO_3$, MgO and KCl is an effective strategy to ameliorate the decrease in productivity of cow due to heat stress in alert zone.

Conflict of Interest Statement: The author(s) declare(s) that there is no conflict of interest.

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