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Effect of Shelter Management on Lactating Crossbred Cows During Summer Under the Agro-Climatic Condition of Konkan Region of India

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ABSTRACT

An experiment was carried out on nine lactating crossbred cows (Jersey x local) were randomly allotted into three housing system in switch over design. The treatments were asbestos (T_1) roofing, paddy straw thatched roof (T_2) white painted asbestos roof (T_3) during hot and humid season of Konkan. The variation in rectal temperature, respiration rate and pulse rate was recorded in the morning and evening through out the experiment. Temperature humidity index was more in microenvironment of thatched roof shed followed by white painted asbestos roof and asbestos roofing. Milk samples collected from experimental cows were analyzed for milk constituents. The use of paddy straw thatched roof shed significantly ($P<0.05$) reduced rectal temperature, pulse rate and respiration rate of cows. Thatched roof shed had significantly ($P<0.05$) incremental effect on the milk yield and milk composition of cows than the cows in white painted roof shed and asbestos roof shedding. The study revealed that paddy straw thatched roof shed effectively improves environmental temperature, humidity and during summer in the agro-climatic conditions of Konkan region of India.

Keywords: Crossbreds cows, Housing system, Microenvironment, Physiological Response.

Livestock is an integral part of agriculture in India more particularly in this state as most of the people due to multifarious reasons depend on the animal for their economic support. Climate Change poses formidable challenge to the development of livestock sector in India. The rise in temperature between 2 to 3°C with increased humidity resulting from climate change is likely to aggravate the heat stress in dairy animals affecting the milk yield and growth of animal. Due to rapid growth of human population, demand for milk and meat is increasing day by day. So, there is an urgent need for the study of effect of change of different micro environmental components on livestock production to

reduce the adverse effect of micro environmental changes for more production of milk and meat at household level under small-scale production system. Research findings indicated that the productive performances such as milk yield of cattle, cardinal physiological reaction are directly and indirectly affected by change of different micro environmental factors such as temperature, relative humidity. The heat stress can be reduced by physical modification of the environment. Several managemental practices such as sprinkling of water, cold drinking water cool hour feeding and body wetting (Kumar and Gupta,1991) have been used with varying success rates to ameliorate heat stress in buffaloes. However, higher construction and operational cost make them difficult to adopt due to poor financial status of small and marginal farmers. Therefore, it is essential to use cheap and easily available material for environment modification. Therefore an effort was made to asses the effect of asbestos roofing, paddy straw thatched roof and white painted asbestos roofing on physiological responses, microenvironment, milk yield, milk composition of crossbred cows.

MATERIALS AND METHODS

The experiment was conducted on nine lactating crossbred (J x L) cows. Three cows were allotted randomly into three shelters in switch over design for the fixed period of 18 days. There was five days interval kept between successive periods of the treatment as allowed the adjustment period for the cows.

The internal construction of each shed was almost same. The changes were done in three shelters in respect to roofing. T_1 was having simple asbestos roofing, T_2 was thatched roof house as modified house with six inch layer of paddy straw bedding with bamboo structure over asbestos roof and T3 was having white painted on asbestos sheets of the shed. The micro environmental data between the sheds was recorded during the whole period of experiment. The maximum minimum, wet dry bulb thermometers were fixed at 2m height in the centre of each shed. The readings were recorded at 7.30 am and 2.30 pm in each shed daily. The body temperature, respiration rate and pulse count were recorded at 9.00 am and 3.00 pm once in week.

As per the dry matter requirement of cows, each group was fed with jowar kadbi, dry grass, green maize and concentrate mixture. The concentrates mixture was feed at the time of milking. The milk yield was recorded in respect of each individual cows during entire trial in the morning and evening. For evaluating the treatment effect on milk composition, milk samples were collected once in forthrightly intervals and were analyzed for milk constituents.

RESULTS AND DISCUSSION

Effect of Shelter on Milk Yield and Composition

The average milk yield and its composition are presented in Table 1. The average milk yield was higher ($P<0.05$) in thatched roof than asbestos and white painted roof shed. Average milk yield in crossbred cows was lower ($P<0.05$) in asbestos roofed shed which may be due to high temperature than other sheds. Confirm the findings of (Singh and Mishra, 2007) who reported high environmental temperature decreased milk production mainly due to lower feed intake. This results was also in agreement with findings of the (Singh *et al.,* 2008) who proved that use of paddy straw bedding over the asbestos sheet ($P<0.05$) improved the milk yield of crossbreds cows than asbestos roofed shed.

The mean $\pm$ SE of total solids percent in milk of crossbred cows were presented in Table 1. The percentage of total solids in milk of cows was higher ($P<0.05$) in thatched roof shed (13.71 ± 0.02) than the asbestos roof (13.04 ± 0.03) and white painted rood shed (13.31 ± 0.03).

Table 1: Effect of Housing Systems on DM Intake, Water Intake, Yield and Composition of Milk of Experimental Cows.

Particulars	Housing systems		
	T_1	T_2	T_3
Average DM intake (kg/100 kg BW)	$2.78^{c} \pm 0.02$	$2.92^{a} \pm 0.05$	$2.86^{b} \pm 0.04$
Average water intake (lit/day/Cow)	$53.83^{a} \pm 0.35$	$45.41^{c} \pm 0.34$	$50.53^{b} \pm 0.36$
Average milk yield (kg/day)	$7.52^{c} \pm 0.28$	$8.17^{a} \pm 0.27$	$7.91^{b} \pm 0.28$
Total solids (%)	$13.04^{c} \pm 0.03$	$13.71^{a} \pm 0.02$	$13.31^{b} \pm 0.03$
Fat (%)	$4.45^{c} \pm 0.013$	$4.87^{a} \pm 0.012$	$4.64^{b} \pm 0.014$
SNF (%)	$8.41^{c} \pm 0.011$	$8.89^{a} \pm 0.013$	$8.62^{b} \pm 0.015$
Protein (%)	$3.28^{c} \pm 0.05$	$3.48^{a} \pm 0.04$	$3.40^{b} \pm 0.03$

Values in row bearing different superscripts differ significantly ($P<0.05$).

The lower percentage of total solids in milk of crossbred cow in asbestos roofed shed might be due to high temperature and high humidity in this shed. The result of this study was corroborated with the findings reported of (Fumaiki *et al*., 1998) who revealed that percent of total solids in milk was decreased in hot environment.

The data pertaining to average of milk fat percent in milk of crossbred cows under different types of sheds were presented in Table 1. From the table it was cleared

that cows in thatched roof shed had significantly higher fat percent than the other two sheds. The lower fat percent in milk cows in asbestos shed which might be due to high temperature and higher water intake than the thatched roof and white painted roof sheds. The findings are similar to those of (Singh and Mishra, 2007) who reported high temperature decreased milk fat production mainly due to lower feed intake during thermal stress. Similarly there is an increase in water intake during summer which results in reduced milk fat percentage (Aggarwal and Singh, 2006).

The solids not fat percent in milk of experimental crossbred cows are given in Table 1. The solid not fat percent in milk was significantly ($P<0.05$) higher in thatched roof shed (8.89 $\pm$ 0.013%) than asbestos (8.41 $\pm$ 0.011%) and white painted sheds (8.62 $\pm$ 0.015%). Similar trend was also observed by Fumaiki *et al.,* (1998), who revealed that solids not fat percent in milk of lactating cows decreases in hot environment.

The average protein percent in milk of crossbred cows was observed as 3.28$\pm$0.05, 3.48$\pm$0.04 and 3.40$\pm$0.03 percent in asbestos, thatched roof and white painted sheds, respectively. The average protein percent in milk of crossbred cows was higher ($P<0.05$) in thatched roof shed than other two sheds. The marked decreased in protein percent in the milk of lactating cows due to high temperature in the shed have been reported by Moody *et al.*, (1967).

Dry Matter and Water Intake

The mean DMI and water intake of crossbred cows in different sheds are given in Table 1, which showed that intake of DM and water intake was affected ($P<0.05$) by roof modification or shelter management. The cows reared under thatched roof shed (2.92$\pm$0.05kg) consumed more ($P<0.05$) dry matter per 100 kg body weight than those reared in asbestos shed (2.78$\pm$0.02 kg) and white painted roof shed (2.86$\pm$0.04kg). The higher DMI per 100 kg body weight of crossbred cows in thatched roof shed might be due to better physical environment as evident from low maximum temperature humidity index (Table 3). The higher DMI in crossbred calves (Yazdani and Gupta, 2000) reared under thatched roof house consumed more ($P<0.05$) dry matter/100 kg body weight (3.02 kg) than reared in loose houses (2.52 kg) system.

The average daily water intake was 53.83$\pm$0.35, 45.41$\pm$0.34 and 50.53$\pm$0.36 lit per cow in T_1, T_2 and T_3, respectively. The asbestos roofed shed cows drank more ($P<0.05$) water than those in other two sheds. Similarly, lower water intake in crossbred calves under thatched roof was observed by Yazdani and Gupta (2000). These findings also confirm with the results of Senthilkumar *et al*., 2002) who clearly stated that heat stress increased the water consumption of cross bred cows.

Cardinal Physiological Responses of Crossbred Cows

The mean ±SE of Respiration Rate (RR), Rectal Temperature (RT) and Pulse Rate (PR) under three housing systems were presented in Table 2. The close scrutiny of the table revealed that the cows under asbestos roofed shed showed higher (P<0.05) respiration rate/minute (43.50±0.17) than white painted roof shed (39.41±0.18) followed by thatch roofed shed (37.26±0.19). This might be due to high ambient temperature in asbestos shed (34.27±0.17) than the white painted roof shed (32.98±0.18) and thatched roof shed (31.90±0.16). Vagtapilly *et al*., (1990) was also reported that significant effect of high ambient temperature on respiration rate in cross bred cows.

Table 2: Effect of Housing Systems on Physiological Responses of Experimental Cows.

Particulars	T_1	T_2	T_3
Respirations rate/minute	$43.50^{a} \pm 0.17$	$37.26^{c} \pm 0.19$	$39.41^{b} \pm 0.18$
Rectal temperature (^{0}C)	$38.85^{a} \pm 0.09$	$38.33^{c} \pm 0.010$	$38.52^{b} \pm 0.011$
Pulse rate/ minute	$64.33^{a} \pm 0.08$	$60.27^{c} \pm 0.05$	$61.49^{b} \pm 0.09$

Values in row bearing different superscripts differ significantly (P<0.05).

The RT of crossbred cows was found significantly higher (P<0.05) in the asbestos roof shed (38.85±0.09) in comparison to white painted roof shed (38.52 ± 0.011) and thatched roof shed (38.33±0.010). This may be due to high thermal stress in asbestos roofed shed than the other two sheds. The results are similar to those of Vagtapilly *et al*.,(1990) who reported high temperature caused increase in body temperature in cows.

The average pulse rate /min of crossbred cows was found significantly more (P<0.05) in asbestos roofed shed (64.33±0.08) than white painted roofed shed (61.49±0.09) and thatched roof shed (60.27±0.05). The high PR in asbestos roofed shed might be due to high temperature in the shed. Similarly Soly and Singh (2003) reported that there was considerable increase in physiological parameters during evening hours when microclimatic temperature goes above the thermo neutral level. These result are also in agreement with the findings of Bhoite *et al., (*2007) reported that the pulse rate was lowest in higher tied under shed followed by higher flushed with water and highest in control group

Micro and Macro Environment

The mean values of climatic components in different micro ad macro environment were presented in Table 3. The maximum temperature remained on higher side of macro environment as compared to other three shelters in all the experimental periods. The overall mean of maximum temperature (^{0}C) of macro environment and micro environment like asbestos roofed shed, thatched roof shed and white painted roofed shed were 37.20±0.17, 34.21±0.17 31.90±0.16 and 32.98±0.18,

Table 3: Climatic Components in Different Micro and Macro Environment in Experimental Sheds.

Treatments	Parameters	Days of trial 1-18	19-36	37-54	Overall
Asbestos roofed shed (T_1)	MAX (^{0}C)	33.44^a±0.44	34.35^a±0.10	35.02^a±0.13	34.27^a±0.17
	MIN (^{0}C) RH morn. (%)	20.36^b±0.37	23.42^b±0.20	25.52^b±0.28	23.10^b±0.33
	RH even. (%)	88.27^c±1.04	87.94^c±0.63	84.50^c±1.04	86.90^c±0.57
	THI morn.	56.72^d±1.04	62.44^d±0.78	63.66^d±1.24	60.94^d±0.79
	THI even.	70.70^e±0.55	75.69^e±0.31	78.89^e±0.26	75.09^e±0.51
		80.42^f±0.41	83.09^f±0.24	83.75^f±0.20	82.42^f±0.26
Thatched roofed shed (T_2)	MAX (^{0}C)	31.17^g±0.39	31.87^g±0.07	32.65^g±0.15	31.90^g±0.16
	MIN (^{0}C)	20.86^h±0.38	24.00^h±0.20	25.95^h±0.18	23.60^h±0.32
	RH morn. (%)	86.00^i±1.05	83.94^i±0.75	81.88^i±1.41	83.94^i±0.66
	RH even. (%)	53.72^j±1.49	54.72^j±0.99	58.33^j±1.20	55.59^j±0.75
	THI morn.	70.10^k±0.52	75.28^k±0.32	78.32^k±0.23	74.56^k±0.51
	THI even.	77.19^l±0.41	79.58^l±0.15	80.30^l±0.18	79.02^l±0.24
White painted roof shed (T_3)	MAX (^{0}C)	32.26^m±0.45	32.94^m±0.10	33.75^m±0.16	32.98^m±0.18
	MIN (^{0}C)	20.57^n±0.39	23.73^n±0.22	25.61^n±0.18	23.30^n±0.32
	RH morn. (%)	86.61^o±1.24	86.11^o±0.67	84.38^o±1.12	85.70^o±0.60
	RH even. (%)	55.88^p±1.42	59.55^p±0.64	61.83^p±1.29	59.09^p±0.74
	THI morn.	70.30^q±0.55	75.57^q±0.32	78.50^q±0.24	74.77^q±0.51
	THI even.	78.89^r±0.40	81.12^r±0.21	81.86^r±0.20	80.63^r±0.23
Macro environment	MAX (^{0}C)	36.21^s±0.37	37.85^s±0.13	37.56^s±0.16	37.20^s±0.17
	MIN (^{0}C)	19.89^t±0.36	22.47^t±0.25	23.84^t±0.17	22.07^t±0.27
	RH morn. (%)	84.22^u±0.82	81.72^u±0.47	80.88^u±1.01	82.27^u±0.49
	RH even. (%)	50.27^v±1.28	49.16^v±0.81	53.16^v±1.42	50.87^v±0.72
	THI morn.	72.28^w±0.54	77.09^w±0.31	80.36^w±0.26	76.58^w±0.50
	THI even.	82.13^x±0.37	84.98^x±0.23	86.12^x±0.18	84.41^x±0.27

Similar superscripts do not differ significantly ($P<0.05$) from each other

respectively. These observations were in agreement with the findings of Singh *et al*.,(1989) who revealed that maximum temperature was significantly lower in thatched shed in comparison to that in litter roof shed and asbestos roof shed. Bhakat *et al*.,(2004) was proved that maximum temperature of thatched roof shed was lower than asbestos roofed and loose house type of shelter.

The minimum temperature was lower under asbestos roofed shed and was followed by white painted shed and thatched roofed shed. This might be due to reason that asbestos roofed concrete shelter was somewhat close type shelter than the thatched roof shelter, which was an open type shed. Similar findings were observed by Singh *et al*., (1989) mean minimum temperature was significantly lower in asbestos roof shed in comparison to thatched and lit roof sheds.

Over the whole periods of trial RH (morning) was higher under asbestos roofed shed (86.90±0.57%) than remaining treatment of thatched roof shed (83.94±0.66) and white painted roof shed (85.70±0.60).Similar trend was found in case RH (evening). The overall average RH (evening) of asbestos, thatched, white painted roofed shed and macro environment were 60.94±0.79, 55.59±0.75, 59.09±0.74 and 50.87±0.72, respectively. Jat *et al*., (2005) reported that average RH (%) was low in thatched house. The higher values of RH (morning and evening) were obtained in asbestos roofed shed as compared to thatched roofed and white painted roofed shed. This might be due to higher condensation power of moisture present in air by asbestos roofed shelter.

Table 4: Average Feed Cost in Crossbred Cows under Different Housing Condition.

Particulars	T_1	T_2	T_3
Average feed cost / head/days (₹/cow/day)	70.13	72.18	71.44
Average daily milk production/cow (kg)	7.52	8.17	7.92
Average feed cost / kg milk (₹/ kg milk)	9.32	8.83	9.02

Over the complete periods of experiment THI was higher in macro environment and followed by asbestos roofed shed, white painted roofed shed and thatched roofed shed. The overall average of THI-morning in macro environment, asbestos roofed shed, thatched roof shed and white painted roofed shed were 76.58±0.50, 75.09±0.51, 74.56±0.51 and 74.77±0.51, respectively. Similar trend was found in case of THI-evening. The average THI-evening in macro environment, asbestos, thatched and white painted roofed shed were 84.41±0.27, 82.42±0.26, 79.02±0.24 and 80.63±0.23, respectively. The lower values of THI were obtained under thatched roof shed as compared to other two sheds in all periods of trial. This might be due to less moisture and less temperature under thatched roof shed as compared to white painted roofed shed and asbestos roofed shed (Bhakat *et al*., 2004). Jat *et al.,* (2005) who reported the average THI values was lower in thatch house than loose house, barn house and asbestos roof shelter.

Cost of Feeding

The cost of feeding was worked out by considering the prevailing cost of feeds. The data pertinent to average feed cost per day per cow (₹), average daily milk production per cow (Kg) and average feed cost per kg milk are tabulated in Table 4. Perusal of the Table 4 revealed that the average feed cost /head/day was ₹ 70.13 in asbestos roofed shed (T_1), ₹ 72.18 in thatched roof shed (T_2) and ₹ 71.44 in white painted roof (T_3) shed respectively.

The average feed cost per kg milk production was ₹ 9.32 in asbestos roofed shed, ₹ 8.83 in thatched roof shed and ₹ 9.02 in white painted roof shed, respectively. Shiyani *et al.,* (1995) concluded that the total cost of milk production of cow in summer season was ₹ 4.84 per litre. Cows in thatched roof shed had significantly ($P < 0.05$) higher average daily milk production (8.17 kg) than white painted roof shed (7.92 kg) and asbestos roofed shed (7.52 kg). Due to high milk production in thatched roof shed, the average feed cost per kg milk production was lower in thatched roof shed than white painted roof shed and asbestos roofed shed.

CONCLUSION

This study revealed that, paddy straw thatching over the asbestos sheet effectively ameliorates heat stress during the summer season. It is concluded that paddy straw thatched roof shed was more comfortable to maintain the microenvironment to the crossbred cows for high milk production during summer season in the Konkan region.

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