



ISSN (E): 2277-7695  
ISSN (P): 2349-8242  
NAAS Rating: 5.23  
TPI 2023; SP-12(9): 1935-1940  
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[www.thepharmajournal.com](http://www.thepharmajournal.com)  
Received: 03-06-2023  
Accepted: 04-07-2023

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## Effect of bedding systems on the behaviour of crossbred dairy cows

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#### Abstract

In dairy farming, bedding and its management contribute predominantly to the behavior of cows. Dairy cows express normal behavioural patterns, only if provided with sufficient space and adequate facilities. Dairy cows prioritise resting over other behaviours and those who are denied the opportunity to lie down exhibit behavioural and physiological abnormalities (Munksgaard and Thomsen, 2012) [10]. As the behavior of cows has a direct relation with the comfort and quality of milk, the present study was undertaken to evaluate the different behavior expressed in bedding systems of crossbred cows. The study was carried out on twenty four crossbred cows at the Cattle farm of the Instructional Livestock Farm Complex, Pookode, Wayanad District in Kerala state for one lactation period in three seasons. The effect of different bedding materials such as, rubber mats, coir pith and dried Dried Solid Manure (DSM) was compared with concrete floor on the behavior of crossbred dairy cows. The lying behaviour of cows viz., lying time per day (h), night time lying (h), day time lying (h), duration of lying bouts (h) and total number of lying bouts (nos.) in different bedding materials were recorded. The cows maintained on concrete floor had significantly ( $p < 0.01$ ) shortest overall mean lying time ( $09.23 \pm 0.04$ h) per day while the cows on coir pith had the longest lying time per day ( $11.15 \pm 0.05$ h). Overall, the total number of lying bouts of  $8.13 \pm 0.18$  and  $7.31 \pm 0.17$  no was exhibited by cows on rubber mat and DSM, respectively with significant difference ( $p < 0.01$ ) between them. Coirpith and DSM as bedding material could be recommended for use by dairy farmers when compared to rubber mats and concrete floor bedding for improving cow comfort and milk production.

**Keywords:** Crossbred cows, bedding systems, behaviour, milk yield

#### Introduction

Dairying is an important vocation for farmers to expand their income and access to more nutritious nourishment for their families. As per the 20<sup>th</sup> livestock census (2019), India has 192.49 million cattle, ranking second in the world population, while 93 percent of the cattle population are crossbreds in Kerala. The World Organisation for Animal Health (OIE, 2008) has propounded five freedoms in relation to welfare, among them one is freedom from physical and thermal discomfort by providing access to shelter and a comfortable resting area. Another one is freedom to express normal behavioural patterns, by providing sufficient space, proper facilities and company of other animals of its kind. Dairy cows priorities resting over other behaviours and those who are denied the opportunity to lie down exhibit behavioural and physiological abnormalities (Munksgaard and Thomsen, 2012) [10]. Various bedding materials are available for the animals such as sand, wood chips, rubber mats, concrete floor, sawdust, straw etc. Choosing a good bedding material is always advisable to improve the welfare, comfort and performance of dairy animals in different seasons. New approaches are being followed to improve the comfort of dairy animals by providing them with appropriate bedding materials. Hence, the present study was undertaken to evaluate the effect of different bedding materials such as rubber mats, coir pith and DSM compared to concrete flooring, on the behavior of crossbred dairy cows.

#### Materials and Methods

The study was carried out at the Cattle farm of the Instructional Livestock Farm Complex, Pookode, Wayanad District in Kerala state during 2018 to 2019. The study was carried out for one lactation period spread over three different seasons as described by Biya (2011) [2] viz., summer months (Feb-May), monsoon months (June-Sep) and post monsoon months (Oct-Jan). Twenty four crossbred dairy cows in early stage of lactation aged between 4 and 6 years were selected for the study.

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The animals were divided into four groups with six animals in each group as uniformly as possible with regard to their body weight (295 to 350 kg), parity and milk yield (8.10 to 11.30 kg).

The animals were let loose in the shed except during the feeding and milking time. Floor space of 13 sq. m and manger space of 1.2 m length and 0.6 m width were provided per cow. Six experimental animals were maintained in the existing management system, *viz.*, and concrete floor without any bedding materials (T<sub>1</sub>). This group was considered as the control group. Rubber mats on concrete floor of 1.2m × 1.8m × 0.025m were used for six experimental animals (T<sub>2</sub>). All other activities including feeding regime were followed as per routine practice. The Rubber mat used in experiment weighed 40 kg. Coir pith was provided at the rate of 7.5 cm thickness as bedding (T<sub>3</sub>). DSM was provided at the rate of 7.5 cm thickness as bedding (T<sub>4</sub>).

Behavioural data were recorded using closed circuit television camera fixed in the barn. Hikvision® DS-2CE1AD0T-IRPF 2MP (1080P) plastic body night vision bullet camera was used. The visual inspection of activity was observed for 24 h by camera recording. A particular group activity was counted and confirmed if ≥ 4 numbers of animals in a group of six were involved in the activity (Harikumar, 2017) [7]. Lying data based on 4 d continuous sampling was sufficient to obtain a representative herd mean lying time estimate. The total duration of lying and the duration and frequency of individual lying bouts were computed using Excel macros® (Microsoft

Corp., Redmond, WA) for the 4 d period (Vasseur *et al.*, 2012) [15], from which daily lying time (h/d), bout frequency (bout/d), and bout duration (min/bout) were calculated for each cow. In addition, variation in duration of lying bouts within cow over 4 d was calculated from the standard deviation of bout duration, previously identified as being associated with lameness (Ito *et al.*, 2009) [9]. The lying down behaviour of cows was an important criterion in the assessment of comfort including lying time per day (h), night lying (h), day lying (h), duration of lying bouts (h), total number of lying bouts, eating (h) and standing while ruminating was observed and assessed as per Solano *et al.* (2015) [14]. Data on daily milk yield (kg) was recorded in all experimental animals both in the morning at 5.30 AM and in the afternoon at 2.30 PM. Two-way ANOVA with interaction effect was performed to study the effect of different bedding materials and seasons on milk yield of cows.

## Results and Discussion

### Behavioural Pattern in Cows.

#### Effect of bedding materials on lying behaviour in cows

The lying behaviour of cows *viz.*, lying time per day (h), night time lying (h), day time lying (h), duration of lying bouts (h) and total number of lying bouts (nos.) in different bedding materials were recorded and the results are presented in Table 1.

**Table 1:** Mean lying time per day in different bedding systems during different seasons

Treatments** (N=24)		Lying time per day (Mean±SE)			
		Seasons <sup>NS</sup>			Overall (h)
		Summer (h)	Monsoon (h)	Post monsoon (h)	
T <sub>1</sub>	Concrete	09.18±0.09	09.31±0.06	09.20±0.07	09.23±0.04 <sup>d</sup>
T <sub>2</sub>	Rubber mat	11.12±0.11	11.19±0.08	11.14±0.12	11.15±0.05 <sup>c</sup>
T <sub>3</sub>	Coir pith	11.92±0.19	11.94±0.19	11.93±0.19	11.92±0.10 <sup>a</sup>
T <sub>4</sub>	DSM	11.29±0.04	11.33±0.03	11.31±0.04	11.32±0.02 <sup>b</sup>
Season (Mean±SE)		10.87±0.22	10.93±0.21	10.90±0.22	10.91±0.12

Means with different superscripts (a-d in rows) differ significantly ( $p < 0.01$ )

\*\*Highly significant ( $p < 0.01$ ); NS - Non-Significant

#### Effect of bedding materials on lying time per day

The cows maintained on concrete floor had significantly ( $p < 0.01$ ) shortest overall mean lying time (09.23±0.04h) per day while the cows on coir pith had the longest lying time per day (11.15±0.05h). Sadharakiya and Sorathiya (2019) [12] observed similar values in the lactating crossbred dairy cows however, they spent more time for lying on rubber mats (11.31±0.10) than on concrete floor (9.35±0.15h). The findings are in agreement with Herlin (1997) [8] who revealed that 71 per cent of the lying time was spent in cubicles with comfort mats, 55 per cent in cubicles with rubber mats, and 18 per cent in those with concrete flooring and cows preferred comfort mats in comparison to the rubber mats and concrete floor. The cows spent overall mean lying time of 11.15±0.05 and 11.32±0.02h on rubber mat and DSM, respectively with significant difference ( $p < 0.01$ ) between

them which indicated its superiority over the concrete floor.

The overall mean lying time of cows maintained on different bedding materials was not influenced by the seasonal variations as the differences of seasonal means within the cow groups were statistically insignificant. The overall mean lying time of cows during different seasons ranged from 10.87±0.22 in summer to 10.93±0.21 h in monsoon. Gastelen *et al.* (2011) [5] had reported that the duration of lying was longer on foam mattresses (12.24±0.14) compared to horse manure (10.12±0.32 h) and they found no difference during seasons, which differed from the present findings.

#### Effect of bedding materials on night time lying

The details of overall mean night time lying (h) of cows maintained on different bedding materials are presented in Table 2.

**Table 2:** Mean night time lying in different bedding systems during different seasons

Treatments** (N=24)		Night time lying (Mean±SE)			
		Seasons <sup>NS</sup>			Overall (h)
		Summer (h)	Monsoon (h)	Post monsoon (h)	
T <sub>1</sub>	Concrete	7.87±0.07	7.98±0.05	7.90±0.05	7.93±0.03 <sup>d</sup>
T <sub>2</sub>	Rubber mat	8.34±0.08	8.39±0.06	8.35±0.07	8.36±0.04 <sup>c</sup>
T <sub>3</sub>	Coir pith	8.93±0.14	8.96±0.15	8.95±0.14	8.94±0.08 <sup>a</sup>
T <sub>4</sub>	DSM	8.46±0.03	8.49±0.04	8.48±0.03	8.49±0.01 <sup>b</sup>
Season (Mean±SE)		8.16±0.17	8.20±0.16	8.17±0.16	8.18±0.09

Means with different superscripts (a-d in rows) differ significantly ( $p < 0.01$ )

\*\*Highly significant ( $p < 0.01$ ); NS - Non-Significant

The overall mean night time lying of the cows maintained on concrete floor (7.93±0.03h) was significantly ( $p < 0.01$ ) shortest while the cows on coir pith had the longest overall night time lying (8.94±0.08h). Chaplin *et al.* (2000) observed similar response of cows on mattresses spending longer period for lying (8.45±0.13) than on concrete floor (7.97±0.14h). They spent less time standing idle in mattress than cows on mats.

The cows spent overall mean night time lying of 8.36±0.04 and 8.49±0.01h on rubber mat and DSM, respectively with significant difference ( $p < 0.01$ ) between them. The findings of Broucek *et al.* (2017) [3] are in accordance to the present study. They revealed that cows laid down for more time on coir pith beddings (8.97±0.15h) in free-stall housing than in

stanchion-stall with not much variations during season.

It may also be noted that the overall mean night time lying of cows maintained on different bedding materials was not influenced by the seasonal variations as the differences of seasonal means within the cow groups were statistically insignificant. The overall mean night time lying of cows during different seasons ranged from 8.16±0.17 h in summer to 8.20±0.16 h in monsoon.

**Effect of bedding materials on day time lying**

The details of overall mean day time lying (h) of cows maintained on different bedding materials are presented in Table 3.

**Table 3:** Mean day time lying in different bedding systems during different seasons

Treatments** (N=24)		Day time lying (Mean±SE)			
		Seasons <sup>NS</sup>			Overall (h)
		Summer (h)	Monsoon (h)	Post monsoon (h)	
T <sub>1</sub>	Concrete	2.29±0.02	2.33±0.02	2.30±0.02	2.31±0.12 <sup>d</sup>
T <sub>2</sub>	Rubber mat	2.77±0.03	2.80±0.02	2.78±0.02	2.79±0.05 <sup>c</sup>
T <sub>3</sub>	Coir pith	2.96±0.05	2.97±0.05	2.98±0.05	2.98±0.13 <sup>a</sup>
T <sub>4</sub>	DSM	2.82±0.01	2.83±0.01	2.84±0.01	2.83±0.04 <sup>b</sup>
Season (Mean±SE)		2.71±0.06	2.73±0.05	2.72±0.05	2.73±0.03

Means with different superscripts (a-d in rows) differ significantly ( $p < 0.01$ )

\*\*Highly significant ( $p < 0.01$ ); NS - Non-Significant

The cows maintained on concrete floor had significantly ( $p < 0.01$ ) shortest overall mean day time lying (2.31±0.12h) while the cows on coir pith had the longest overall day time lying (2.98±0.13h). According to Fregonesi and Leaver (2001) the cows had significantly longer day time lying (2.99±0.33h) in coir pith than concrete floor (2.42±0.32h) which is similar to the present study. The cows spent overall mean day time lying of 2.79±0.05 and 2.83±0.04h on rubber mat and DSM, respectively with significant difference ( $p < 0.01$ ) between them.

It may also be noted that the overall mean day time lying of cows maintained on different bedding materials was not influenced by the seasonal variations as the differences of

seasonal means within the cow groups were statistically insignificant. The overall mean day time lying of cows during different seasons ranged from 2.71±0.06 h in summer to 2.73±0.05 h in monsoon. The findings are similar to that of Grant and Albright (2001) [6] as they also noted that seasonal variation did not have influence on day lying time of dairy cows on recycled manure solids compared to concrete floor in free stall housing.

**Effect of bedding materials on duration of lying bouts**

The details of overall mean duration of lying bouts (h) of cows maintained on different bedding materials are presented in Table 4.

**Table 4:** Mean duration of lying bouts in different bedding systems during different seasons

Treatments** (N=24)		Duration of lying bouts (Mean±SE)			
		Seasons <sup>NS</sup>			Overall (h)
		Summer (h)	Monsoon (h)	Post monsoon (h)	
T <sub>1</sub>	Concrete	1.09±0.06	1.15±0.05	1.10±0.03	1.11±0.04 <sup>d</sup>
T <sub>2</sub>	Rubber mat	1.39±0.07	1.43±0.06	1.42±0.04	1.41±0.05 <sup>c</sup>
T <sub>3</sub>	Coir pith	1.74±0.13	1.98±0.11	1.82±0.10	1.80±0.12 <sup>a</sup>
T <sub>4</sub>	DSM	1.63±0.02	1.68±0.08	1.87±0.07	1.73±0.07 <sup>b</sup>
Season (Mean±SE)		1.57±0.07	1.64±0.24	1.58±0.06	1.60±0.12

Means with different superscripts (a-d in rows) differ significantly ( $p < 0.01$ )

\*\*Highly significant ( $p < 0.01$ ); NS - Non-Significant

The overall mean duration of lying bouts in the cows maintained on concrete floor (1.11±0.04h) was significantly ( $p<0.01$ ) shorter while the cows on coir pith had the longest overall duration of lying bouts (1.80±0.12h). In the present study, the least comfortable bedding system was found to be the concrete floor which is in agreement with Sinha *et al.* (2017) [13] who reported shorter duration of lying bouts in the cows maintained on concrete floor (1.23±0.14h) than on sand (2.23±0.32h). The overall mean duration of lying bouts of on rubber mat and DSM were 1.41±0.05 and 1.73±0.07h, respectively with significant difference ( $p<0.01$ ) between them.

The present study differed from the reports of Norring *et al.* (2008) [11]. They found that the total duration of lying bout for cows on sand bedding (2.13±0.34) lasted longer than coir pith bedding (2.80±0.12h). The reports of Gastelen *et al.* (2011) [5] supports this study as they reported that the duration of lying

bout in cattle on horse manure (1.84±0.16 h) as bedding was longer compared to foam mattresses bedding (1.31±0.14 h). It may also be noted that the overall mean duration of lying bouts of cows maintained on different bedding materials was not influenced by the seasonal variations as the differences of seasonal means within the cow groups were statistically insignificant. The overall mean duration of lying bouts of cows during different seasons ranged from 1.57±0.07 in summer to 1.64±0.24 h in monsoon. This results are similar to Sinha *et al.* (2017) [13]. They also found no seasonal variations in the duration of lying bouts.

**Effect of bedding materials on the number of lying bouts**

The details of overall mean total number of lying bouts of cows maintained on different bedding materials are presented in Table 5.

**Table 5:** Mean total number of lying bouts in different bedding systems during different seasons

Treatments** (N=24)		Total number of lying bouts (Mean±SE)			
		Seasons <sup>NS</sup>			Overall (No.)
		Summer (No.)	Monsoon (No.)	Post monsoon (No.)	
T <sub>1</sub>	Concrete	8.21±0.25	8.37±0.46	8.26±0.34	8.34±0.20 <sup>a</sup>
T <sub>2</sub>	Rubber mat	8.11±0.19	8.17±0.44	8.14±0.30	8.13±0.18 <sup>b</sup>
T <sub>3</sub>	Coir pith	7.15±0.21	7.24±0.27	7.17±0.25	7.19±0.16 <sup>d</sup>
T <sub>4</sub>	DSM	7.30±0.21	7.35±0.10	7.31±0.37	7.31±0.17 <sup>c</sup>
Season (Mean±SE)		7.74±0.24	7.89±0.29	7.76±0.28	7.65±0.16

Means with different superscripts (a-d in rows) differ significantly ( $p<0.01$ )

\*\*Highly significant ( $p<0.01$ ); NS - Non-Significant

The cows maintained on concrete floor had significantly ( $p<0.01$ ) shortest overall mean of lying bouts (8.34±0.20 no.) while the cows on coir pith had the longest overall mean of lying bouts (7.19±0.16 no.). The cows exhibited total number of lying bouts of 8.13±0.18 and 7.31±0.17 no., on rubber mat and DSM, respectively with significant difference ( $p<0.01$ ) between them. The results are in agreement with Absmanner *et al.* (2009) [1] who reported that the number of lying bouts on was significantly lower ( $p<0.01$ ) on coir pith (7.19±0.16) than on rubber mats (7.31±0.17 no.).

It may also be noted that the overall means of the total number of lying bouts of cows maintained on different bedding materials was not influenced by the seasonal variations as the differences of seasonal means within the cow groups were statistically insignificant. The overall mean total

number of lying bouts of cows during different seasons ranged from 7.74±0.24 in summer to 7.89±0.29 no. in monsoon. This report is similar to of the results of Absmanner *et al.* (2009) [1]. They found no difference in the number of lying bouts of cows during different seasons

**Effect of bedding materials on eating time**

The overall mean eating time (h) of cows maintained on different bedding materials are presented in Table 6. The overall mean eating time in the cows maintained on concrete floor (4.16±0.03) was significantly ( $p<0.01$ ) shorter, while the cows on coir pith had the longest overall mean eating time (4.41±0.02 h) which indicated that coir pith was found to be the most comfortable bedding material.

**Table 6:** Mean eating time in different bedding systems during different seasons

Treatments** (N=24)		Eating time (Mean±SE)			
		Seasons <sup>NS</sup>			Overall (h)
		Summer (h)	Monsoon (h)	Post monsoon (h)	
T <sub>1</sub>	Concrete	4.11±0.05	4.19±0.03	4.17±0.04	4.16±0.03 <sup>d</sup>
T <sub>2</sub>	Rubber mat	4.30±0.06	4.34±0.05	4.33±0.03	4.31±0.03 <sup>c</sup>
T <sub>3</sub>	Coir pith	4.36±0.02	4.49±0.04	4.42±0.05	4.41±0.02 <sup>a</sup>
T <sub>4</sub>	DSM	4.34±0.03	4.40±0.02	4.36±0.03	4.35±0.02 <sup>b</sup>
Season (Mean±SE)		4.31±0.03	4.35±0.04	4.32±0.02	4.33±0.02

Means with different superscripts (a-d in rows) differ significantly ( $p<0.01$ )

\*\*Highly significant ( $p<0.01$ ); NS - Non-Significant

The cows spent overall mean eating time of 4.31±0.03 and 4.35±0.02h on rubber mat and DSM, respectively with significant difference ( $p<0.01$ ) between them. It may also be noted that the overall mean eating time of cows maintained on different bedding materials was not influenced by the seasonal variations as the differences of seasonal means within the cow

groups were statistically insignificant. The overall mean eating time of cows during different seasons were found ranged from 4.31±0.03 in summer to 4.35±0.04 h in monsoon. The findings are in accordance with Grant and Albright (2001) [6] who stated that dairy cows in free stall housing in recycled manure solid, spent more hours eating (4.38±0.13h)

per day compared to concrete floor ( $4.18 \pm 0.32$ ) without any significant difference ( $p > 0.05$ ) in season. The importance of this finding is that the cows resting in comfortable bedding spends more time on eating which led to increased milk production.

### Effect of bedding materials on standing time while ruminating

The overall mean standing time while ruminating time (h) of

cows maintained on different bedding materials are presented in Table 7. The cows maintained on concrete floor had significantly ( $p < 0.01$ ) shortest overall mean standing time while ruminating ( $4.16 \pm 0.03$ ) while the cows on coir pith had the longest overall mean standing time while ruminating ( $4.41 \pm 0.02$  h). The cows spent mean standing time of  $4.31 \pm 0.03$  and  $4.35 \pm 0.02$  h on rubber mat and DSM, respectively with significant difference ( $p < 0.01$ ) between them, while ruminating.

**Table 7:** Mean standing time while ruminating in different bedding systems during different seasons

Treatments** (n=24)		Standing time while ruminating (Mean±SE)			
		Seasons <sup>NS</sup>			Overall (h)
		Summer (h)	Monsoon (h)	Post monsoon (h)	
T1	Concrete	2.32±0.04	2.45±0.04	2.37±0.14	2.35±0.05 <sup>a</sup>
T2	Rubber mat	2.27±0.03	2.32±0.04	2.30±0.04	2.29±0.02 <sup>b</sup>
T3	Coir pith	1.37±0.04	1.43±0.04	1.40±0.04	1.38±0.02 <sup>d</sup>
T4	DSM	1.42±0.03	1.46±0.03	1.44±0.04	1.43±0.02 <sup>c</sup>
Season (Mean±SE)		1.82±0.09	1.89±0.05	1.85±0.11	1.87±0.06

Means with different superscripts (a-d in rows) differ significantly ( $p < 0.01$ )

\*\*Highly significant ( $p < 0.01$ ); NS - Non-Significant

It may also be noted that the overall mean standing time while ruminating of cows maintained on different bedding materials was not influenced by the seasonal variations as the differences of seasonal means within the cow groups were statistically insignificant. The overall mean standing time while ruminating of cows during different seasons ranged from  $4.31 \pm 0.03$  in summer to  $4.35 \pm 0.04$  h in monsoon. Sinha *et al.* (2017) [13] reported that mean values of standing time while ruminating in cows was shortest in concrete floor ( $4.19 \pm 0.12$ ) than on sand bedding ( $4.32 \pm 0.32$ ) irrespective of any season which is in agreement with present findings.

### Milk yield

The mean daily milk yield of cows in different bedding

materials is presented in Table 8. The results revealed that the type of bedding material, season and the interaction between seasons and bedding materials significantly alter the mean milk yield of cows ( $p < 0.05$ ). The cows maintained on concrete floor had the lowest overall daily milk yield ( $8.66 \pm 0.22$  kg) while the cows on coir pith had the highest yield ( $9.98 \pm 0.30$  kg). Reneau *et al.*, 2005 [16] reported that milk production increased to  $9.57 \pm 0.12$  kg in compost bedded pack than bedded with dry fine wood shavings or sawdust ( $9.76 \pm 0.03$  kg). The rubber mat and DSM had the overall mean milk yield of  $9.26 \pm 0.20$  kg and  $9.48 \pm 0.22$  kg, respectively indicating their superiority over the concrete floor.

**Table 8:** Mean daily milk yield in different bedding systems during different seasons

Treatments (N=6)		Daily milk yield (Mean±SE) (kg)			
		Summer	Monsoon	Post monsoon	Overall
T <sub>1</sub>	Concrete	8.16±0.07	9.31±0.03	9.28±0.03	8.66±0.22 <sup>d</sup>
T <sub>2</sub>	Rubber mat	8.23±0.01	10.28±0.03	9.30±0.03	9.26±0.20 <sup>c</sup>
T <sub>3</sub>	Coir pith	8.35±0.04	11.28±0.04	10.35±0.03	9.98±0.30 <sup>a</sup>
T <sub>4</sub>	DSM	8.28±0.01	10.75±0.03	9.41±0.05	9.48±0.22 <sup>b</sup>
(Mean±SE)		8.15±0.09 <sup>C</sup>	10.66±0.09 <sup>A</sup>	9.52±0.15 <sup>B</sup>	9.34±0.13

Means with different superscripts (a-d in rows, A-C in columns) differ significantly ( $P < 0.05$ )

Greater activity and better overall milk yield were observed in high-yielding dairy cows reared on elastic rubber flooring ( $9.28 \pm 0.12$ ) than that on concrete flooring ( $8.68 \pm 0.12$  kg) in a loose housing system. The per cent increase in milk yield was 19.50, 17.21, 15.33 and 12.14 on coir pith, DSM, rubber mat and concrete floor, respectively. The mean milk yield of 11.34, 10.32, 9.31 and 9.26 L/animal/d in coir pith bedding at a thickness of 30 cm, 20 cm, 10 cm on concrete floor and in the present study bedding material of 7.5 cm thickness was provided.

From Table 8, it may also be inferred that the mean milk yield of cows maintained on different bedding materials were also influenced by the seasonal variations as the differences of overall means of milk yield during different seasons within the cow groups were statistically significant ( $p < 0.05$ ). Moreover, the mean values for different seasons ranged from  $8.15 \pm 0.09$  kg in summer to  $10.66 \pm 0.09$  kg in monsoon. Singh

*et al.* (2015) obtained the highest seasonal milk production of  $10.52 \pm 0.12$  and  $9.54 \pm 0.14$  kg in crossbred during winter and summer season, respectively with significant difference ( $p < 0.05$ ) in seasonal variation and milk production performance which is similar with the present study.

### Conclusion

The behaviour of crossbred cows in different bedding systems was assessed in the present study. The cows maintained on concrete floor had significantly ( $p < 0.01$ ) shortest overall mean lying time ( $09.23 \pm 0.04$ h) per day while the cows on coir pith had the longest lying time per day ( $11.15 \pm 0.05$ h). The overall mean duration of lying bouts in the cows maintained on concrete floor ( $1.11 \pm 0.04$ h) was significantly ( $p < 0.01$ ) shortest while the cows on coir pith had the longest overall duration of lying bouts ( $1.80 \pm 0.12$ h). The cows spent overall eating time of  $4.31 \pm 0.03$  and  $4.35 \pm 0.02$ h on rubber mat and

DSM, respectively with significant difference ( $p < 0.01$ ) between them. The cows maintained on concrete floor had the lowest overall daily milk yield ( $8.66 \pm 0.22$ ) while the cows on coir pith had the highest milk yield ( $9.98 \pm 0.30$  kg). Thus, coir pith and DSM as bedding materials could be recommended to the dairy farmers compared to rubber mats and concrete floor bedding for reducing microbial count and improving and milk production.

#### Acknowledgment

The author express sincere gratitude to the Department of LPM, CVAS, Pookode, Dean, CVAS, Pookode and Head, ILFC, Pookode for the help rendered and facilities provided for conducting the study.

#### References

1. Absmanner E, Rouha-Mulleder C, Scharl T, Leisch F, Troxler J. Effects of different housing systems on the behaviour of beef bulls, anon-farm assessment on Austrian farms. *Applied Animal Behaviour Science*. 2009;118:12-19.
2. Biya AJ. Assessment and Alleviation of environmental stress on productive performance of Rabbits. Ph.D. thesis, Kerala Veterinary and Animal Sciences University, Pookode; c2011. p. 121.
3. Broucek J, Uhrincat M, Mihina S, Soch M, Mrekajova A, Hanus A. Dairy cows produce less milk and modify their behaviour during the transition between tie-stall to free-stall. *Animals*. 2017;7:16.
4. Chaplin SJ, Tierney G, Stockwell C, Logue DN, Kelly M. An evaluation of mattresses and mats in two dairy units. *Applied Animal Behaviour Science*. 2000;66:263-272.
5. Gastelen SV, Westerlaan B, Houwers DJ, Eerdenburg FJCMV. A study on cow comfort and risk for lameness and mastitis in relation to different types of bedding materials. *Journal of Dairy Science*. 2011;94:4878-4888.
6. Grant RJ, Albright JL. Effect of animal grouping on feeding behavior and intake of dairy cattle. *Journal of Dairy Science*. 2001;84:156-163.
7. Harikumar S. Behavioural, Physiological and Biochemical stress responses of crossbred cows to varying thermal indices in different management systems. Ph.D thesis, Kerala Veterinary and Animal Sciences University, Pookode; c2017. p. 141.
8. Herlin AH. Comparison of lying area surfaces for dairy cows by preference, hygiene and lying down behaviour. *Swedish Journal of Agricultural Research*. 1997;27:189-196.
9. Ito K, Weary DM, Von Keyserlingk MAG. Lying behavior: Assessing within and between herd variations in free-stall-housed dairy cows. *Journal of Dairy Science*. 2009;92:4412-4420.
10. Munksgaard L, Thomsen P. Effects of cow characteristics on lying behaviour and activity in Danish dairy herds with free stalls. The first dairy cattle welfare symposium, 23-26 October 2012, Guelph, Ontario, Canada; c2012.
11. Norring M, Manninen E, De Passille AM, Rushen J, Munksgaard L, Saloniemi H. Effects of sand and straw bedding on the lying behaviour, cleanliness and hoof and hock injuries of dairy cows. *Journal of Dairy Science*. 2008;91:570-576.
12. Sadharakiya KH, Sorathiya LM. Effects of rubber mat flooring on behaviours, welfare and production performance in crossbred cows. *International Journal of Livestock Research*. 2019;9(1):210-231.
13. Sinha R, Kamboj M, Ranjan A. Effects of bedding material on comfort and behavior of dairy cows. *International Journal of Livestock Research*. 2017;7(7):67-73.
14. Solano L, Barkema HW, Pajor EA, Mason S, LeBlanc SJ, Nash CGR, *et al.* Associations between lying behavior and lameness in Canadian Holstein-Friesian cows housed in free stall barns. *Journal of Dairy Science*. 2015;99:2086-2101.
15. Rand BP, Cheyns D, Vasseur K, Giebink NC, Mothy S, Yi Y, *et al.* The impact of molecular orientation on the photovoltaic properties of a phthalocyanine/fullerene heterojunction. *Advanced Functional Materials*. 2012 Jul 24;22(14):2987-95.
16. Reneau JK, Seykora AJ, Heins BJ, Endres MI, Farnsworth RJ, Bey RF. Association between hygiene scores and somatic cell scores in dairy cattle. *Journal of the American veterinary medical association*. 2005 Oct 15;227(8):1297-301.