

*Original Research***Effect of Environmental Factors on Production and Reproduction Traits of Vrindavani Cattle****Amit Baranwal<sup>1</sup>, Neerasa Govardhana Sagar<sup>1</sup>, Pruthviraj D R<sup>1\*</sup>, Babu Lal Saini<sup>1</sup>, Satish Kumar<sup>1</sup> and Avneesh Kumar<sup>2</sup>**<sup>1</sup>PhD Scholar, ICAR- IVRI, Izatnagar, Bareilly-243122, Uttar Pradesh, INDIA<sup>2</sup>Assistant Professor, DUVASU, Mathura-281001, Uttar Pradesh, INDIA**\*Corresponding author:** [saadhane.pdrs@gmail.com](mailto:saadhane.pdrs@gmail.com)

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**Abstract**

The aim of the present study was to understand the effect of season of calving, period of calving and parity on productive and reproductive performance in a Vrindavani herd of 591 cows at the Cattle and Buffalo farm, Indian Veterinary Research Institute, Izatnagar, India from 2011 to 2016. The least squares fixed model analysis by SAS indicated overall least squares means ( $\pm$  standard error) of 3134.88  $\pm$  50.41 kg, 3222.25  $\pm$  38.25 kg, 17.06  $\pm$  0.16 kg, 318.69  $\pm$  3.91 days, 73.51  $\pm$  3.22 days, 408.05  $\pm$  4.04 days and 123.63  $\pm$  3.23 days for total lactation milk yield (TLMY), 305 days milk yield (MY305), peak yield (PY), total lactation length (TLL), dry period (DP), calving interval (CI) and service period (SP), respectively. The season of calving had significant influence on TLMY, PY, TLL, DP, SP ( $P < 0.01$ ) and CI ( $P < 0.05$ ). The TLMY and TLL showed better performance in summer whereas winter had better values for PY, DP, SP and CI. For a comprehensive assessment of the effect of season, there is a need to consider threshold traits in addition to production and reproduction traits. Effect of period of calving was significant on TLMY, TLL ( $P < 0.01$ ), SP ( $P < 0.05$ ). Among the three periods, performance in period I and II was better. Parity had significant effect on MY305, PY, CI, SP ( $P < 0.01$ ) and TLMY ( $P < 0.05$ ). In general, parity did not follow a particular trend. The results indicated that environmental factors have significant effects on productive and reproductive performance of Vrindavani cows in the herd under study.

**Key words:** Environmental Factors, Production Traits, Reproduction Traits, Vrindavani Cattle

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**Introduction**

India ranks first being the largest producer of milk in the world. Its production increased from 17 million tonnes in 1950-51 to about 163.7 million tonnes in 2016-17 and per capita availability of milk in India was around 352 grams (Basic Animal Husbandry Statistics, 2017) which is more than the world average

294 grams per day. Contribution of crossbred dairy cattle with a share of 26% of total milk production of India is significant in achieving this feat (Basic Animal Husbandry Statistics, 2017). Vrindavani, one of the crossbreds developed in India has also made its contribution in this regard. Development of Vrindavani was initiated in 1970s at Indian Veterinary Research Institute (IVRI), Izatnagar, India as an ad-hoc scheme of crossbreeding using Holstein Friesian, Brown Swiss and Jersey semen on Haryana cows. This scheme was upgraded to an All India Co-ordinated Research Project on Cattle from 1969 to 1985. Various genotypes were developed in the process of evolution which were subsequently merged in view of their similar performance and the crossbred population was named Vrindavani in 2006 (Pandey *et al.*, 2006). The genetic constitution of Vrindavani cattle is 50–75% inheritance from exotic cattle breeds (Holstein-Friesian, Jersey and Brown Swiss) and 25–50% from indigenous Haryana breed. The Vrindavani cattle exhibit almost all possible coat colours in addition to roan, light-dark brown, black and white and brown and white (Pandey *et al.*, 2006; Singh *et al.*, 2011).

The region under present study is humid, subtropical with extreme temperatures. Effect of environmental factors become significant in this context as the animals will be thriving in harsh conditions with scanty fodder resources which may affect their performance adversely (Hammoud *et al.*, 2010; Kumar *et al.*, 2015; Lodhi *et al.*, 2016). Low to moderate heritability values for production and reproduction traits in dairy animals indicate that the major part of variation is governed by environmental factors. Thus, efficient management practice is the key factor to maintain optimum production levels (Thomas and Sastry, 2008). The most important environmental factors that affect lactation performance in cattle include management, nutrition, year of calving, season of calving and lactation number or parity (Msanga *et al.*, 2000; Epaphras *et al.*, 2004; M'hamdi *et al.*, 2012). There have been no studies on Vrindavani cattle considering the effect of season and period on production and reproduction traits. Earlier studies concentrated on farm characterisation and effect of lactation order (Singh *et al.*, 2011). The information obtained from the present study would give an idea about the current status of the farm as well as a comparison to the effect of parity that is previously reported. Therefore, the present study was undertaken with an objective to determine the effect of season of calving, period of calving and parity on productive and reproductive traits in Vrindavani crossbred cattle at cattle and buffalo farm, IVRI, Izatnagar, India from 2011 to 2016. The information thus obtained might help us understand the adaptability and performance of these cows under local conditions.

## Material and Methods

### Location and Climate

The present study was conducted at cattle and buffalo farm, Indian Veterinary Research Institute, Izatnagar, India, which is classified under the upper Gangetic plains region. The farm is located at an

altitude of 169.2 m above the mean sea-level, with latitude of 28°22' north and longitude of 79°24' east. The mean annual temperature is about 21°C. The mean monthly temperature ranges between around 13°C in January and 30°C in May, whereas the extreme temperature ranges between 5°C and 40°C. Relative humidity ranges between 15 and 85 percent. The average amount of precipitation is 1038.9 mm. July with highest precipitation of 307.3 mm and November with the least at 5.1 mm is seen.

### Management

Animals at this farm were maintained under loose housing and group management system. Nutritional requirements of animals are met through a balanced combination of dry and green fodder with supplementation of concentrate mixture. Machine milking is practiced and it is done twice daily. Milk recording starts from the first day of calving till date of drying. Calves were weaned on the day of their birth. Teaser bulls were used for detection of cows in heat twice daily (in early morning and evening). Vaccination and deworming were performed as per schedule.

### Data

The data included a total of 591 Vrindavani cows that calved from August, 2011 to March, 2016. Data were classified according to season of calving as November to February (Winter- I), March to June (Summer-II) and July to October (Rainy-III) to look for the effect of season on the traits under study. The total period of study was divided and coded into three periods of calving in order to account for the changes in herd size, age of the animals and better management practices introduced from year to year. Three periods studied were 2011 to 2012 (I); 2013 to 2014 (II); 2015 to 2016 (III). Another classification based on parity (I-IX) was made to observe its effect on different traits. The traits included in the study were; total lactation milk yield (TLMY), 305 days milk yield (MY305), peak yield (PY), total lactation length (TLL), dry period (DP), calving interval (CI) and service period(SP).

### Statistical Analysis

Data were subjected to the GLM Procedure of the SAS package to see the effects of seasons, period and parity on TLMY, MY305, PY, TLL, DP, CI and SP. Duncan's Multiple Range Test (DMRT) was used to test the significance of differences between treatment means. The Least Squares Analysis was performed by taking the following model-

$$Y_{ijkl} = \mu + P_i + S_j + A_k + e_{ijkl}$$

Where,

$Y_{ijkl}$  = observation on  $l^{\text{th}}$  cow in  $i^{\text{th}}$  period of calving,  $j^{\text{th}}$  season of calving and  $k^{\text{th}}$  parity;  $\mu$  = overall mean;  $P_i$  = effect of  $i^{\text{th}}$  period of calving ( $i = 1-3$ );  $S_j$  = effect of  $j^{\text{th}}$  season of calving ( $j = 1-3$ )

$A_k$  = effect of  $k^{\text{th}}$  parity ( $k = 1-9$ );  $e_{ijkl}$  = random error  $\sim \text{NID}(0, \sigma_e^2)$ .

## Results and Discussion

### Overall Means

The production performance in the herd under study, in terms of TLMY, MY305, PY and TLL, represented as overall least squares means along with the analysis of variance (ANOVA) are shown in Table 1.

**Table 1:** Least Squares ANOVA and overall mean for the effect of non-genetic factors on various productive and reproductive traits in Vrindavani cattle

| S. No.                            | Environmental Factors | Degrees of Freedom | F-value for Productive and Reproductive Traits |                                 |                              |                               |                              |                               |                               |
|-----------------------------------|-----------------------|--------------------|------------------------------------------------|---------------------------------|------------------------------|-------------------------------|------------------------------|-------------------------------|-------------------------------|
|                                   |                       |                    | TLMY (kg)                                      | MY305 (kg)                      | PY (kg)                      | TLL (days)                    | DP (days)                    | CI (days)                     | SP (days)                     |
| 1                                 | Season of calving     | 2                  | 7.29**                                         | 1.15 <sup>NS</sup>              | 28.89**                      | 9.51**                        | 6.18**                       | 3.28*                         | 11.55**                       |
| 2                                 | Period of calving     | 2                  | 6.52**                                         | 2.71 <sup>NS</sup>              | 0.07 <sup>NS</sup>           | 11.10**                       | 2.23 <sup>NS</sup>           | 2.18 <sup>NS</sup>            | 4.07*                         |
| 3                                 | Parity                | 8                  | 2.00*                                          | 8.95**                          | 9.25**                       | 1.94 <sup>NS</sup>            | 1.28 <sup>NS</sup>           | 3.79**                        | 3.13**                        |
| Overall mean $\pm$ standard error |                       |                    | 3134.88<br>$\pm$ 50.41<br>(591)                | 3222.25<br>$\pm$ 38.25<br>(333) | 17.06<br>$\pm$ 0.16<br>(589) | 318.69<br>$\pm$ 3.91<br>(591) | 73.51<br>$\pm$ 3.22<br>(386) | 408.05<br>$\pm$ 4.04<br>(386) | 123.63<br>$\pm$ 3.23<br>(479) |

Figures in parentheses are the numbers of animals used to derive mean; TLMY= Total Lactation Milk Yield, MY305= 305 Days Milk Yield, PY= Peak Yield, TLL= Total Lactation Length, DP= Dry Period, CI= Calving Interval, SP= Service Period; \*\* = significant at 1% level ( $P < 0.01$ ), \* = significant at 5% level ( $P < 0.05$ ) and NS = Non-significant.

These estimates are in close agreement with those reported by Singh *et al.* (2011) in a herd of Vrindavani cattle where they had reported 3219 kg of TLMY, 3047 kg of MY305, 16.58 kg of PY and 337 days of TLL. The values for TLMY, MY305 and TLL were lower than those found by Japheth *et al.* (2015) in a herd of Karan Fries crossbred cattle. However, the herd under study had better performance in comparison to those reported by Singh and Gurnani (2004), Singh *et al.* (2008), Tiwari *et al.* (2010), Moges *et al.* (2012), Singh *et al.* (2016), Lodhi *et al.* (2016), and Thorat *et al.* (2016). Thus, it can be stated that the production performance obtained in the present study are in agreement with the values obtained by other researchers in different indigenous breeds and their crosses.

The overall least squares mean values for some of the reproductive traits such as dry period (DP), calving interval (CI) and service period (SP) are shown in Table 1. Singh *et al.* (2011) had reported 99.65 $\pm$ 5.75 days DP, 425.95 $\pm$ 4.87 days CI and 149.54 $\pm$ 4.55 days SP in a herd of Vrindavani, compared to which values obtained in the present study are better indicating improvement in the management conditions at the farm. Similar values for DP, CI and SP at 75 $\pm$ 6 days, 423 $\pm$ 11 days and 143 $\pm$ 11 days, respectively, in Karan Fries and Karan Swiss (Singh and Gurnani, 2004); 115.29 $\pm$ 8.83 days, 423.05 $\pm$ 12.24 days and 148.24 $\pm$ 12.66 days, respectively, in Frieswal crossbred (Kumar *et al.*, 2015) were reported. Values more than the present estimates were reported by Yadav *et al.* (2004), Dubey and Singh (2005) and Hassan and

Khan (2013) in different herds. Therefore, it is evident that the herd under study had better performance in reproductive traits.

### Effect of Season of Calving

Season of calving showed significant effect on all performance traits except 305 days milk yield (Table 2).

**Table 2:** Effect of season of calving on different productive and reproductive traits in Vrindavani cows (Least squares Mean  $\pm$  SE)

| Traits            | TLMY (kg)                          | MY305(kg)                        | PY(kg)                         | TLL (days)                       | DP (days)                       | CI (days)                        | SP (days)                       |
|-------------------|------------------------------------|----------------------------------|--------------------------------|----------------------------------|---------------------------------|----------------------------------|---------------------------------|
| Season of Calving | **                                 | NS                               | **                             | **                               | **                              | *                                | **                              |
| 1 (Nov-Feb)       | 3191.81<br>$\pm 116.06^a$<br>(238) | 3590.06<br>$\pm 101.85$<br>(126) | 19.27<br>$\pm 0.36^a$<br>(237) | 289.15<br>$\pm 8.99^b$<br>(238)  | 61.56<br>$\pm 9.65^b$<br>(154)  | 382.42<br>$\pm 12.12^b$<br>(154) | 99.82<br>$\pm 7.21^b$<br>(213)  |
| 2 (Mar-Jun)       | 3248.00<br>$\pm 146.68^a$<br>(123) | 3656.29<br>$\pm 122.29$<br>(82)  | 17.90<br>$\pm 0.46^b$<br>(123) | 314.95<br>$\pm 11.36^a$<br>(123) | 94.33<br>$\pm 12.27^a$<br>(55)  | 411.17<br>$\pm 15.41^a$<br>(55)  | 141.26<br>$\pm 9.53^a$<br>(95)  |
| 3 (July-Oct)      | 2802.10<br>$\pm 122.84^b$<br>(231) | 3500.17<br>$\pm 113.44$<br>(126) | 16.45<br>$\pm 0.39^b$<br>(230) | 267.23<br>$\pm 9.51^b$<br>(231)  | 61.95<br>$\pm 10.24^b$<br>(178) | 380.62<br>$\pm 12.87^b$<br>(178) | 104.81<br>$\pm 8.32^b$<br>(172) |

Figures in parentheses are the numbers of animals used to derive mean; TLMY= Total Lactation Milk Yield, MY305= 305 Days Milk Yield, PY= Peak Yield, TLL= Total Lactation Length, DP= Dry Period, CI= Calving Interval, SP= Service Period; \*\* = significant at 1% level ( $P < 0.01$ ), \* = significant at 5% level ( $P < 0.05$ ) and NS=Non-significant; The values with different superscript within a column differs significantly 5% (\*) and 1 %(\*\*)

TLMY was significantly ( $P < 0.01$ ) affected by the season. Cows calved during the summer season had maximum TLMY (3248.00 kg) while those calved during the rainy season had minimum (2802.10 kg). Significance of season of calving ( $P < 0.01$ ) on TLMY was also observed by Singh and Tomar (1991) in Karan Fries cattle, Raheja (1994) in HF cross with Haryana, Singh *et al.* (2008) in crossbred cattle, Tiwari *et al.* (2010) in crossbred cattle, Moges *et al.* (2012) in crossbred cattle, Japheth *et al.* (2015) in Karan Fries, Lodhi *et al.* (2016) in crossbred cattle, Singh *et al.* (2016) in Gir and Thorat *et al.* (2016) in Holdeo crossbreds.

Season had a significant effect on peak yield. Cows calved during winter season had maximum PY (19.27 days) while those in rainy season had minimum PY (16.45 days). Lactation length was also significantly affected by season. Maximum lactation length was observed for cows calved during summer (315 $\pm$ 11 days) which was significantly different from animals calved in other seasons. Season of calving was statistically significant on total lactation length as reported by Biradar *et al.* (1993), Gupta *et al.* (1986), Dalal *et al.* (1991) and Jadhav *et al.* (1991) in different HF crosses. Singh and Gurnani (2004) had also observed higher lactation length in summer; however, Japheth *et al.* (2015) had observed longer lactation length during winter in a herd of Karan Fries crossbred cattle. The longest DP was observed in summer calvers (94.33  $\pm$  12.27 days) while shortest was observed in winter (61.56  $\pm$  9.65 days). The CI for summer calvers was highest and also significantly differed from other seasons (Table 2). Cows calved

during summer showed maximum CI ( $411.17 \pm 15.41$  days), while rainy season calvers ( $380.62 \pm 12.87$  days) showed minimum CI. Season of calving had significant ( $P < 0.01$ ) influence on SP too. Cows calved during summer season had the longest SP ( $141.26 \pm 9.53$  days) and those in winter season had the shortest ( $99.82 \pm 7.21$  days). Singh and Gurnani (2004), Hassan and Khan (2013), Kumar *et al.*, (2015), Japheth *et al.* (2015) and Lodhi *et al.* (2016) reported significant effect of season on DP, CI and SP. However, Yadav *et al.* (2004) and Dubey and Singh (2005) reported non-significant effect of season on these traits.

Season of calving was not having any significance on MY305 in the present study in contrast to the findings made by Panda and Sandhu (1983) Singh and Tomar (1990), Singh and Gurnani (2004), Singh *et al.* (2008), Tiwari *et al.* (2010), Moges *et al.* (2012), Japheth *et al.* (2015) and Thorat *et al.* (2016). Rainy season calvers showed the least 305MY ( $3500.17 \pm 113.44$  kg) which might be due to higher humidity and unhygienic conditions which are predisposing factors for diseases leading to reduced productivity.

Highest TLMY in summer might be attributed to longer TLL in that season (Table 2). Longer TLL of summer calvers could be due to higher CI of such cows. This higher CI appears to be due longer SP. The longer SP for summer could be due to higher heat stress. In addition, cows might have better availability of alternate fodder preparations like silage during summer season.

### Effect of Period of Calving

The period of calving had a significant effect on TLMY, TLL ( $P < 0.001$ ) and SP ( $P < 0.05$ ) in the present study. It was observed that the cows calved during II-period showed maximum TLMY whereas the cows calved during III-period had the least (Table 3).

**Table 3:** Effect of period of calving on different productive and reproductive traits in Vrindavani cows (Least squares Mean  $\pm$  SE)

| Traits       | TLMY (kg)                          | MY305(kg)                       | PY(kg)                       | TLL (days)                      | DP (days)                    | CI (days)                      | SP (days)                       |
|--------------|------------------------------------|---------------------------------|------------------------------|---------------------------------|------------------------------|--------------------------------|---------------------------------|
| Period of    | **                                 | NS                              | NS                           | **                              | NS                           | NS                             | *                               |
| 1. (2011-12) | 3322.15<br>$\pm 112.86^a$<br>(221) | 3410.45<br>$\pm 84.20$<br>(144) | 17.87<br>$\pm 0.35$<br>(220) | 322.73<br>$\pm 8.74^a$<br>(221) | 85.36<br>$\pm 9.72$<br>(142) | 402.31<br>$\pm 12.20$<br>(142) | 121.94<br>$\pm 7.68^a$<br>(150) |
| 2. (2013-14) | 3370.68<br>$\pm 94.26^a$<br>(338)  | 3571.43<br>$\pm 79.20$<br>(180) | 17.97<br>$\pm 0.30$<br>(337) | 311.47<br>$\pm 7.53^a$<br>(338) | 80.06<br>$\pm 8.81$<br>(225) | 405.72<br>$\pm 11.06$<br>(225) | 131.86<br>$\pm 6.02^a$<br>(304) |
| 3. (2015-16) | 2549.09<br>$\pm 222.85^b$<br>(33)  | 3764.64<br>$\pm 232.89$<br>(10) | 17.77<br>$\pm 0.70$<br>(33)  | 237.13<br>$\pm 17.26^b$<br>(33) | 52.42<br>$\pm 16.33$<br>(20) | 366.18<br>$\pm 20.57$<br>(20)  | 92.1<br>$\pm 14.58^b$<br>(26)   |

Figures in parentheses are the numbers of animals used to derive mean; TLMY= Total Lactation Milk Yield, MY305= 305 Days Milk Yield, PY= Peak Yield, TLL= Total Lactation Length, DP= Dry Period, CI= Calving Interval, SP= Service Period; \*\* = significant at 1% level ( $P < 0.01$ ), \* = significant at 5% level ( $P < 0.05$ ) and NS=Non-significant; The values with different superscript within a column differs significantly 5% (\*) and 1 %(\*\*)

Rehman and Khan (2012) had observed a significant ( $P < 0.01$ ) difference in period of calving on TLMY in Sahiwal cows and the variation was attributed to management and climatic differences from year to year. Cows calved during I period had maximum TLL. Gupta *et al.* (1986), Singh and Tomar (1990),

Birader *et al.* (1993) and Nayak and Raheja (1996), Singh and Gurnani (2004), Dubey and Singh (2005), Hadge *et al.* (2012), Japheth *et al.* (2015) and Lodhi *et al.* (2016) had also reported significant effect of period of calving in different crossbred cattle.

Cows calved during I and II period had maximum SP whereas those calved during III-period had the least number of days of SP. The variation of SP in different periods might be due to differences in management, failure of heat detection and failure of A.I. Effect of period of calving on SP was also observed by Dubey and Singh (2005), Hadge *et al.* (2012), Japheth *et al.* (2015) and Kumar *et al.* (2015). Period of calving had no significant effect on MY305, PY, DP and CI in contrast to reports of Panda and Sandhu (1983), Dalal *et al.* (1991), Jadhav *et al.* (1991) Singh and Gurnani (2004), Singh *et al.* (2008), Tiwari *et al.* (2010), Moges *et al.* (2012), Kumar *et al.* (2015) and Japheth *et al.* (2015) who had reported a significant effect of period of calving on these traits in various crossbreds. The variation observed in the traits due to period of calving could be attributed to changes in herd size, age of the animals, feeding and management practices introduced from one year to another.

### Effect of Parity

In the present study, parity had a significant effect on TLMY ( $P<0.05$ ), MY305, PY, CI and SP ( $P<0.01$ ) (Table 4). Highest TLMY was observed in seventh lactation ( $3636.04 \pm 318.26$  kg) and the least in the first lactation. Cows in the ninth lactation showed maximum MY305 ( $3853.33 \pm 358.15$ kg) while the first lactation cows showed the lowest MY305 ( $2946.60 \pm 97.18$  kg). Higher MY305 in 3<sup>rd</sup> and above parities may be attributed to fully developed udder and adaptation to calving and lactation stress. Parity also showed significant influence on PY and highest PY was observed in seventh lactation ( $20.20 \pm 1.01$ kg). A particular trend was not observed for TLMY, MY305 and PY among different lactations. Significant influence of parity on production traits was also reported by Singh *et al.* (2008), Singh *et al.* (2011), Rehman and Khan (2012), Tiwari *et al.* (2010), Moges *et al.* (2012), Japheth *et al.* (2015), Lodhi *et al.* (2016) and Thorat *et al.* (2016).

Parity had influence on the CI. Longest CI ( $429.57 \pm 9.01$ days) was seen in second lactation and shortest CI ( $333.66 \pm 80$  days) in the first. Parity was also significant on SP. Cows in seventh lactation showed longest SP ( $154.64 \pm 21.46$  days), while shortest was observed in fifth lactation ( $92.77 \pm 13.00$  days). Lactation order did not follow a particular trend with respect to CI and SP. Similar observations of no particular trend were made by Kumar *et al.* (2015). Significant effect of lactation order on CI and SP was also reported by Khanna and Singh (2003), Tadesse and Dessie (2003), Japheth *et al.* (2015), Singh *et al.* (2016), Lodhi *et al.* (2016) and Thorat *et al.* (2016).

**Table 4:** Effect of parity on different productive and reproductive traits in Vrindavani cows (Least squares Mean  $\pm$  SE)

| Traits | TLMY (kg) | MY305(kg) | PY(kg) | TLL (days) | DP (days) | CI (days) | SP (days) |
|--------|-----------|-----------|--------|------------|-----------|-----------|-----------|
|--------|-----------|-----------|--------|------------|-----------|-----------|-----------|



| Parity | *                           | **                         | **                      | NS                       | NS                      | **                        | **                       |
|--------|-----------------------------|----------------------------|-------------------------|--------------------------|-------------------------|---------------------------|--------------------------|
| 1      | 2709.08<br>±106.95<br>(204) | 2946.6<br>±97.18<br>(138)  | 15.33<br>±0.34<br>(204) | 320.14<br>±8.28<br>(204) | 52.6<br>±63.70<br>(201) | 333.66<br>±80.00<br>(201) | 135.52<br>±7.13<br>(155) |
| 2      | 2929.61<br>±125.57<br>(138) | 3354.95<br>±106.16<br>(78) | 16.81<br>±0.39<br>(138) | 302.89<br>±9.72<br>(138) | 76.45<br>±7.17<br>(138) | 429.57<br>±9.01<br>(138)  | 116.3<br>±7.99<br>(115)  |
| 3      | 3154.71<br>±145.65<br>(94)  | 3660.23<br>±127.46<br>(46) | 18.52<br>±0.46<br>(92)  | 294.61<br>±11.28<br>(94) | 67.2<br>±8.17<br>(93)   | 393.32<br>±10.26<br>(93)  | 100.66<br>±9.46<br>(76)  |
| 4      | 3046.58<br>±172.32<br>(61)  | 3766.04<br>±142.15<br>(33) | 18.21<br>±0.54<br>(61)  | 282.83<br>±13.35<br>(61) | 56.15<br>±9.43<br>(61)  | 369.87<br>±11.84<br>(61)  | 107.28<br>±10.62<br>(55) |
| 5      | 3089.92<br>±214.20<br>(36)  | 3659.25<br>±205.34<br>(13) | 18.66<br>±0.68<br>(36)  | 280.4<br>±16.59<br>(36)  | 67.65<br>±11.42<br>(36) | 387<br>±14.34<br>(36)     | 92.77<br>±13.01<br>(33)  |
| 6      | 3132.02<br>±268.56<br>(22)  | 3763.4<br>±274.90<br>(7)   | 18.59<br>±0.85<br>(22)  | 281.97<br>±20.80<br>(22) | 93.63<br>±14.11<br>(22) | 385.41<br>±17.72<br>(22)  | 94.62<br>±17.97<br>(17)  |
| 7      | 3636.04<br>±318.26<br>(15)  | 3851.41<br>±268.41<br>(7)  | 20.2<br>±1.01<br>(15)   | 305.63<br>±24.65<br>(15) | 78.23<br>±17.16<br>(14) | 406.1<br>±21.56<br>(14)   | 154.64<br>±21.47<br>(11) |
| 8      | 2884.83<br>±324.06<br>(15)  | 3384.34<br>±254.21<br>(8)  | 16.79<br>±1.03<br>(15)  | 260.07<br>±25.10<br>(15) | 96.01<br>±16.99<br>(15) | 410.88<br>±21.34<br>(15)  | 138.35<br>±20.86<br>(12) |
| 9      | 3142.95<br>±466.17<br>(7)   | 3853.33<br>±358.15<br>(4)  | 17.74<br>±1.48<br>(7)   | 285.45<br>±36.11<br>(7)  | 65.6<br>±24.14<br>(7)   | 406.81<br>±30.31<br>(7)   | 97.55<br>±29.04<br>(6)   |

Figures in parentheses are the numbers of animals used to derive mean; TLMY= Total Lactation Milk Yield, MY305= 305 Days Milk Yield, PY= Peak Yield, TLL= Total Lactation Length, DP= Dry Period, CI= Calving Interval, SP= Service Period; \*\* = significant at 1% level ( $P < 0.01$ ), \* = significant at 5% level ( $P < 0.05$ ) and NS=Non-significant.

Parity had no significant effect on TLL and DP. Cows in the first lactation showed maximum TLL (320.14±8.28days). The non-significant effect of parity on DP was also reported by Rehman *et al.* (2008) in indigenous cattle.

## Conclusion

Present study indicates that non-genetic factor like season of calving, period of calving and parity has significant influence on most of the production and reproduction traits of Vrindavani cattle. In the herd under study, for most traits, cows had better performance in the summer season, indicating the essential nature of adaptation displayed by tropical breeds and their crossbreds. In addition, this finding suggests requirement of better management during rainy as well as winter seasons. In terms of period, performance in period I and II was better. This finding suggests necessity for immediate intervention so as to improve conditions at the farm in order to increase the production level on par with the other two periods mentioned. In the present study, parity did not follow a particular trend making it difficult to provide a valid suggestion. Similar study with a larger data set may help to obtain a valid conclusion on parity. As a

whole, the results indicated that environmental factors certainly play a significant role in productive and reproductive performance of Vrindavani cows in the herd under study and they can be improved by modifying the feeding pattern and other management practices. Strategies to improve these non-genetic factors are helpful in counteracting the adverse effect of periodical and seasonal changes thus reducing the environmental variability. In addition to the effect of environment on production and reproduction traits, their effect on threshold traits should also be considered for comprehensive assessment of animals.

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