Original Research

Factors Affecting First Lactation Traits in Rathi Cattle in Semi-arid Region of Rajasthan

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Abstract

A study was conducted on the performance of 425 Rathi cattle maintained at Livestock Research Station, Bikaner and Nohar. The overall least-squares means for FL305MY, FLL, AFC and FSP were observed to be 1547.99 ± 28.44 kg, 298.32± 4.91 days, 1482.11 ± 27.64 days and 149.61 ± 3.38 days, respectively. The effect of the farm was observed to be highly significant (P≤0.01) on AFC and FL305MY while significant (P≤0.05) on FSP. The non-significant effect of farm had been observed on FLL. The season had significant effect (P≤0.05) on FSP and FLL. The effect of period was highly significant (P≤0.01) for AFC, FL305MY and FLL while significant (P≤0.05) for FSP. The study suggested that period of calving affected all the first lactation traits in Rathi cattle.

Key words: AFC and FSP, FL305MY, FLL, Non-Genetic, Rathi Cattle

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Introduction

Rajasthan is the second largest producer of milk which produces 12.7% of the total milk production in India. The indigenous/non-descript cattle contribute 28% in total milk produced by Rajasthan state (2013-14). The major share of cow milk produced by few cattle breeds like Tharparkar, Gir, Rathi, Kankrej and Sahiwal. Rathi is an important dual-purpose cattle breed known for both its milking and draught power, found in the semi-arid regions of Rajasthan. The breeding tract of this breed lies in the heart of Thar desert consisting of Bikaner, Hanumangarh, Ganganagar and Jaisalmer districts of Rajasthan. Scorching summer (50˚C), chilly winter (2˚C), dry monsoon (less than 200 mm rainfall in a year) and dust storms are the characteristics of the region. Rathi cows are efficient and good milkers, thrive well on scanty feed-fodder

resources in adverse climatic conditions of Rajasthan. The variability in least squares means of first lactation 305-days milk yield (FL305MY), first lactation length (FLL), age at first calving (AFC) and first service period (FSP) indicates the possibility of improvement of genetic potential of Rathi cattle for these production and reproduction traits through selection. These traits are affected by various management and environmental factors like farm, season of birth/calving and period of birth/calving. The 305-days milk yield among production and age at first calving among reproduction traits are the most important traits of a dairy animal because they directly related to profitability and economy of milk production.

Materials and Methods

The relevant data of 425 Rathi cows were collected for this study from the history-cum-pedigree sheets maintained at Livestock Research Station, Bikaner and Nohar from 1985 to 2017. The Livestock Research Station, Bikaner is located at an altitude of 242 meters above the sea level on 28° 1'N latitude and 73° 19'E longitude and Nohar is located at an altitude of 186 meters above the mean sea level in the trans-gangetic plains on 29°11' N latitude and 74°49'E longitude. The climate of the regions is semi-arid in nature. The minimum temperature falls near to freezing point in winter months whereas the maximum temperature goes as high as 50°C in summer. The annual rainfall ranges between 186 mm and 344 mm out of which most of the rainfall is received during the month of July and August. The relative humidity ranges from 45 percent to a high of 85 percent. Thus, it is obvious that Rathi cattle maintained at these farms have been exposed to extreme climatic conditions.

Normal lactation records were considered for present study. An animal having abnormal lactation records due to other pathological conditions including abortion, still births etc., lactation duration less than 100 days and sires less than three progeny were excluded from the present investigation. The Rathi cows are stall-fed and nutritional requirements are met through a balanced ration of green fodder and roughages (libitum) and concentrate provided as per the requirement. A "letdown" ration is also provided at the time of milking at both farms. The Rathi cows are bred naturally. The male and female calves are kept in covered calf pens up to six months of age and thereafter in loose housing system.

Statistical Analysis

To estimate the effects of various non-genetic factors, data were classified according to farm *viz.* Bikaner and Nohar, season of birth/calving were as winter (November to February), rainy (July to October) and summer (March to June) and period of birth for age at first calving as P1 (1980-1986), P2 (1987-1993), P3 (1994-2000), P4 (2001-2007) and P5 (2008-2014). The whole data were grouped into five periods according to date of calving as P1 (1985-1991), P2 (1992-1998), P3 (1999-2005), P4 (2006-2012) and P5 (2013-2017) assuming that yearly variations within the period were minimum. The effect of age at first calving was taken as regression.

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Least-squares mixed model analysis of data were carried out by Least-squares maximum likelihood programme (Harvey, 1990) to study the effects of non-genetic factors on AFC. The effect of non-genetic factors (farm, season and period of birth) on AFC were analyzed using the following mixed model

$$Y_{ijkl} = \mu + F_i + P_j + M_k + e_{ijkl}$$

Where,
Y_{ijkl} = Observation on the l^{th} progeny of i^{th}farm in j^{th} period of birth and k^{th} season of birth
μ = Population mean
F_i = Fixed effect of $i^{th\ farm}$ (F = 1 to 2)
P_j = Fixed effect of j^{th} period (j = 1 to 5)
M_k = Fixed effect of k^{th} season (k = 1 to 3)
e_{ijkl} = Random error, NID (0, σ^2_e)

Least-squares mixed model analysis of data was carried out by Least-squares maximum likelihood programme (Harvey, 1990) to study the effects of non-genetic factors on first service period, first 305-day lactation milk yield and first lactation length. The model used is:

$$Y_{ijkl} = \mu + F_i + P_j + M_k + b\ (X_{ijkl} - X) + e_{ijkl}$$

Where,
Y_{ijkl} = Observation on the l^{th} progeny of i^{th}farm in j^{th} period and k^{th} season of calving
μ = Population mean
F_i = Fixed effect of i^{th}farm (i = 1,2)
P_j = Fixed effect of j^{th} period (j = 1 to 5)
M_k = Fixed effect of k^{th} season (k = 1 to 3)
b = Regression of variable on age at first calving
X_{ijkl} = age at first calving corresponding to Y_{ijkl}
X = Average age at first calving
e_{ijkl} = Random error, NID (0, σ^2_e)

The data were analyzed by using LSML computer programme of Harvey (1990) and IBM SPSS software (version 20). The difference between two pairs of factor was tested by using modified Duncan's multiple range test by Kramer (1957).

Results and Discussion

Age at First Calving

The overall least squares mean for AFC in the present study was 1482.10 ± 27.64 days (Table 1). Almost similar estimates of average AFC were observed by Singh *et al.* (2013) in Rathi cattle. This average estimate of AFC was lower than the values reported by Kumar (2012) and Sohal (2016) in the same breed. The difference in the estimates of average AFC in Rathi cattle reported by researchers may be attributed to the difference in herds, management strategies and time/period considered.

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Table 1: Least squares means ± SE for AFC (days) and FSP (days) in Rathi cattle

	AFC	FSP
Overall	1482.11 ± 27.64 (423)	149.61 ± 3.38 (423)
Farm	**	*
Bikaner	1431.02 ± 16.96[a] (197)	139.95 ± 4.28[a] (197)
Nohar	1533.28 ± 18.47[b] (165)	158.84 ± 4.66[b] (165)
Season	NS	*
Winter	1470.18 ± 29.99 (198)	140.92 ± 4.27[a] (176)
Summer	1478.94 ± 31.62 (133)	159.22 ± 4.56b (138)
Rainy	1497.19 ± 33.83 (92)	148.04 ± 7.68[a] (48)
Period	**	*
P1	1418.80 ± 54.58b (78)	166.16 ± 6.67b (66)
P2	1568.98 ± 44.62c (92)	152.27 ± 6.51[ab] (67)
P3	1724.92 ± 49.04[d] (47)	140.79 ± 8.69a (38)
P4	1405.18 ± 52.03[b] (50)	147.94 ± 7.18[ab] (57)
P5	1292.63 ± 64.47[a] (156)	139.79 ± 5.19[a] (134)
Regression on AFC	-	0.0074 ± 0.013[NS]

*** Significant at 1% level (P≤ 0.01), * Significant at 5% level (P≤ 0.05); NS = non-significant; Mean with same superscript differs non-significantly*

The least squares analysis of variance revealed that the farm had highly significant (P≤0.01) effect on AFC. The average AFC was found to be i.e. 1533.28 ± 18.47days for the cows born in Nohar farm, while the cows born in Bikaner farm had least squares mean of 1431.02 ± 16.96 days (Table 1).The effect of farm had no significance (P ≤ 0.05) on age at first calving in Rathi cattle as reported by Nehra *et al*. (2005) which is contradictory to present study. The effect of season of birth on AFC was found to be non-significant (Table 1). The effect of season of birth had no significance (P ≤ 0.05) on age at first calving in Rathi cattle as reported by Nehra *et al.* (2005), Singh *et al.* (2013) and Sohal (2016). The period of calving had highly significant (P≤0.01) effect on AFC. The average AFC was found to be maximum i.e. 1724.93 ± 49.04 days for the cows born during P3 period, while the cows born during P5 had the lowest least squares mean of 1292.63 ± 64.47 days (Table 1). However, non-significant effect of periods of birth was reported by Nehra *et al.* (2005), Singh *et al.* (2013) and Sohal (2016) in Rathi cattle. This may be due to differences in availability of feed and fodder and managemental practices of young stock from period to period and the young stock raised during period of adequate nutrition grew faster than others.

First Service Period (FSP)

Service period is the interval between date of calving and fertile service that causes variation in calving interval and thereby influences breeding efficiency of a dairy cow. The overall least squares mean for FSP was found to be 149.61 ± 3.38 days (Table 1). The results of present study had shown close agreement with the estimates of Dhaka *et al.* (2016) in Rathi cattle. However, the least squares mean estimate for FSP in present study was lower than the values reported by Nehra *et al.* (2005), Kumar (2012), Singh *et al.* (2013)

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and Sohal (2016) in the same breed. The least squares analysis of variance revealed that the farm had significanteffect (P≤0.05) on FSP. The average FSP was found to be i.e.158.84 ± 4.66 days for the cows calved in Nohar farm, while the cows calved in Bikaner farm had comparatively lower FSP139.95 ± 4.28 days (Table 1). Dhaka *et al.* (2014) reported highly significant effect of farm on service period in Rathi cattle. Nehra *et al.* (2005) reported non-significant effect of farm on first service period in same breed. The results of the present study revealed that the season of calving had statistically significant (P≤0.05) influence on the FSP (Table 1). The cows calved during the winter had the lowest service period (140.92 ± 4.27 days), while the cows calved during the summer had the longest FSP (159.22 ± 4.56 days). However, Nehra *et al.* (2005), Singh *et al.* (2013) and Dangi *et al.* (2013) were reported non- significant effect of season on service period. Sohal (2016) had reported highly significant effect of season on service period.

The least squares analysis of variance revealed that the period of calving had significant (P≤0.05) effect on FSP. The average FSP was found to be maximum 166.16 ± 6.67 days for the cows calved during P1 period, while the cows calved during P5 had the lowest least squares mean of 139.79 ± 5.19 days (Table 1).The significant effect of period of calving on service period was observed by Nehra *et al.* (2005); Singh *et al.* (2013) and Sohal (2016). The least square analysis of variance showed that the regression of AFC on FSP was non-significant (Table 1). This finding was similar to the results reported by Nehra *et al.* (2005) and Singh *et al.* (2013) in Rathi cattle. However, Sohal (2016) observed positive and significant effect of AFC on service period in the same breed of cattle.

First Lactation 305-Days or Less Milk Yield (FL305MY)

The first lactation 305-days milk yield is most important economic trait in dairy cattle. The FL305MY provides most efficient measure to assess the inherent capacity of an individual and indicate the breeding value of a dairy animal accurately. The overall average FL305MY in the present study was found to be 1547.99 ± 28.44 kg (Table 2). This estimated value was higher to the average values reported by Sohal (2016) in the same breed. The least squares analysis of variance revealed that farm had highly significant effect (P≤0.01) on FL305MY. The average FL305MYwas found to be 1664.36 ± 39.28 kg for the cows calved at Nohar farm, while the cows calved at Bikaner farm had comparatively lower FL305MY1431.62 ± 36.06 kg (Table 2).

The effect of season of calving on FL305MYwas found to be non-significant (Table 2). The season of calving had significant influence on FL305MY in Rathi cattle as reported by Singh *et al.* (2013) and Sohal (2016). However, Nehra *et al.* (2005) did not find significant effect of season on 300 days milk yield. The variations in milk yield in different seasons were not statistically significant and hence it may be deduced that the milch stock was maintained under similar farm conditions during all the seasons at these organized farms. The FL305MY of cows calved during different periods showed a wide variation and the effect of

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period was highly significant (P≤0.01). The average FL305MY was found to be maximum 1850. 39 60. 48 kg for the cows calved during P4 period, while the cows calved during P1 had the lowest least squares mean of 1431.07± 56.15 kg (Table 2). The present finding was in accordance with the reports by Sohal (2016) in Rathi cows. The significantly higher milk yield during P4 period might be due to abundant availability of green fodder (carrots, Lucerne, Burseem and Sorghum). Other than this reason it may be due to differences in availability of feed and fodder and managemental practices from period to period. The regression of AFC on FL305MY was non-significant (Table 2). This finding was similar to the results reported by Singh *et al.* (2013) and Sohal (2016) in Rathi cattle.

Table 2: Least squares means ± SE for first lactation 305-day milk yield (Kg) and first lactation length (days) in Rathi cattle

	FL305MY	**FLL**
Overall	1547.99 ± 28.44 (362)	298.32± 4.91(362)
Farm	**	NS
Bikaner	1431.62 ± 36.06^{a} (197)	295.89± 6.23 (197)
Nohar	1664.36 ± 39.28^{b} (165)	300.76±6.79 (165)
Season	NS	*
Winter	1556.07 ± 35.93 (176)	296.94 ± 6.21^{a} (176)
Summer	1622.04 ± 38.37 (138)	315.91 ± 6.63^{b} (138)
Rainy	1465.86 ± 64.63 (48)	282.12 ± 11.17^{a} (48)
Period	**	**
P1	1431.07± 56.15^{a} (66)	297.57 ± 9.71a (66)
P2	1458.50± 54.77a (67)	332.58 ± 9.47^{c} (67)
P3	1501.45± 73.12^{a} (38)	319.72 ± 12.64^{bc} (38)
P4	1850.39± 60.48^{b} (57)	286.73 ± 10.45^{ab} (57)
P5	1498.54± 43.70^{a} (134)	255.01± 7.55^{a} (134)
Regression on AFC	0.003 ± 0.115^{NS}	0.015 ± 0.019 ^{NS}

*** Significant at 1% level (P≤ 0.01), * Significant at 5% level (P≤ 0.05); NS = non-significant; Mean with same superscript differs non-significantly*

First Lactation Length (FLL)

The overall least squares mean for FLL was found to be 298.32± 4.91days (Table 2). Nehra *et al.* (2005), Singh (2012), Kumar (2012) and Sohal (2016) estimated lower lactation length than present study. The least squares analysis of variance revealed that farm had no significant effect on FLL. The average FLL was found to be i.e.300.76±6.79 days for the cows calved at Nohar farm, while the cows calved at Bikaner farm had comparatively lowerFLL 295.89± 6.23 days (Table 2) this is in accordance with Nehra *et al.* (2005) who had reported non-significant effect of farm on FLL in Rathi cattle.

The effect of season of calving on FLL was found to be significant (Table 2). The average FLL was found to be maximum 315.91 ± 6.63 days for the cows calved during summer season, while the cows calved during rainy season had the lowest least squares mean of 282.12 ± 11.17 days (Table 2). Contrary, to present study Nehra *et al.* (2005) and Singh *et al.* (2013) did not find significant effect of season on FLL in Rathi

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cattle. The FLL of cows calved during different periods showed variation and the effect of period was highly significant (P≤0.01). The average FLL was found to be maximum 332.58 ± 9.47 days for the cows calved during P2 period, while the cows calved during P5 had the lowest least squares mean of 255.01 ± 7.55 days (Table 2).The present finding was in accordance with the reports of Singh et al. (2013) and Sohal (2016) in Rathi cattle. However, Nehra *et al.* (2005) did not find significant effect of period of calving on this trait in Rathi cattle. The regression of AFC on FLL was non-significant (Table 2). This finding was similar to the results reported by Singh *et al.* (2013) and Sohal (2016) in same breed of cattle.

Conclusion

The effect of non- genetic factors were found significant (P≤0.05) on most of the first lactation traits. It indicates that the performances of these traits can be improved by giving better feed-fodder and managemental condition at farms.

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