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Evaluation of crossbred cattle for production and reproduction traits in Jaipur district, Rajasthan

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Abstract
Crossbred cattle significantly enhance milk production in Rajasthan, especially in Jaipur district. However, in-depth insights into their productive and reproductive performance remain limited and underexplored. Therefore, a study was conducted in Chomu and Amer tehsils of Jaipur district during 2023-24 to evaluate performance parameters of crossbred (H.F.) cattle. Data were collected from 887 cows (416 from Chomu and 471 from Amer) through structured interviews with 200 dairy farmers from twenty selected villages using a pre-tested interview schedule. The productive parameters assessed included lactation milk yield (LMY), lactation length (LL), average daily milk yield (DMY), and peak yield (PY). The mean LMY, LL, DMY, and PY were 3786.64±37.13 kg, 305.11±0.55 days, 12.37±0.11 kg/day, and 15.62±0.12 kg, respectively, in Chomu tehsil, while in Amer tehsil, the corresponding values were 3866.75±36.54 kg, 306.15±0.38 days, 12.60±0.11 kg/day, and 15.84±0.12 kg. The reproductive performance was assessed using age at first conception (AFCon), age at first calving (AFC), service period (SP), dry period (DP), calving interval (CI), and gestation period (GP). The reproductive mean values for these parameters in Chomu were 20.38±0.14 months, 29.45±0.14 months, 2.91±0.05 months, 1.99±0.03 months, 12.15±0.04 months, and 277.35±1.04 days and in Amer 20.94±0.13 months, 29.97±0.13 months, 2.87±0.03 months, 1.98±0.03 months, 12.18±0.03 months, and 279.08±0.08 days. The effect of location was significant on AFCon and AFC only. While its effect on other production and reproduction parameters included in the study was non-significant. The findings provide critical benchmarks for improving reproductive and production efficiency in crossbred dairy cattle. The study emphasizes the need to educate farmers on scientific management practices and highlights key areas for strengthening livestock support services in the region.

Keywords: Crossbred cattle, milk production, reproductive performance, lactation yield, daily milk yield, peak yield, lactation length, age at first calving, service period, dry period, calving interval, gestation period, Jaipur

Introduction
Dairy farming plays a pivotal role in India's rural economy, and Rajasthan stands out as a major contributor to the sector's growth. In 2023-24, India produced 239.30 million tonnes of milk, with a per capita availability of 471 grams per day. In contrast, Rajasthan alone accounted for 14.51% of national milk production with significantly higher per capita milk availability of 1, 171 grams per day which is more than double the national average. This remarkable performance is largely attributed to the widespread adoption of crossbred cattle, which offer higher milk yields (8.43 kg/day) compared to indigenous breeds (3.54 kg/day). Jaipur district exemplifies this trend, with crossbred cows producing an average of 9.784 kg per day. For further improvement of dairy enterprises based on crossbred cattle, the basic data of actual field conditions is required. Considering these facts, this study was planned to evaluate the productive and reproductive performance of crossbred cattle.

Materials and Methods
The study was conducted during 2023-24 in Jaipur district, Rajasthan, focusing on two tehsils Chomu and Amer selected due to high population of crossbred cattle. From each tehsil, 10 villages were chosen, and 10 farmers from each village were randomly selected, totaling 200 respondents. Data on production and reproduction performance of crossbred cattle were collected through personal interviews using a pre-tested structured schedule and direct observations.

As farmers lacked written records, information was based on recall. Statistical analysis was performed using mean, standard deviation, standard error, t-test, chi-square test, and p-value to interpret the results.

Results and Discussion

The results of production performance of crossbred cattle in two tehsils are presented in Table 1.

Lactation Milk Yield (LMY)

The average lactation milk yield of crossbred cattle in Chomu was 3786.64±37.13 kg, while in Amer it was 3866.75±36.54 kg. The difference in yield was not statistically significant, indicating no effect of location on milk yield in the study. The milk yields observed in the study were slightly lower than those reported by Japheth *et al.* (2015) [10] but considerably higher than the findings of Meena *et al.* (2015) [14], Das *et al.* (2024) [5], and Sai *et al.* (2023) [19]. The results reflect good productivity of crossbred cows in both tehsils.

Lactation Length (LL)

The mean lactation length of crossbred cattle in Chomu and Amer was 305.11± 0.548 and 306.15± 0.378 days respectively. The difference between the two tehsils was not statistically significant. The present result align well with the optimum range reported by Beneberu (2023) [4]. These findings confirm that the lactation length of crossbred cows in both Chomu and Amer tehsils are within the normal range, indicating satisfactory management practices.

Average Daily Milk Yield (ADMY)

The mean daily milk yield of crossbred cattle in Chomu was 12.37± 0.11 kg, while in Amer it was 12.60± 0.11 kg. The difference between the two tehsils was not statistically significant (t = -1.432, df = 885, p = 0.153). The results are in consonance with the reports of Japheth *et al.* (2015) [10] and Kidane *et al.* (2019) [11], who reported ADMY of 12.93± 0.99 kg and 12.57± 0.08 kg, respectively. On the contrary, Getachew *et al.* (2020) [9] noted a higher yield of 14.33±4.59 liters/day, while Bekuma *et al.* (2020) [3] recorded lower average daily yields. The results indicate that the average daily milk yield performance of crossbred cows in both tehsils is within the desirable range, suggesting farmers maintain good genetic merit and followed optimum management practices.

Peak Yield (PY)

The average peak milk yield of crossbred cattle in Chomu was 15.62±0.12 kg, while in Amer it was 15.84±0.12 kg. The difference was not statistically significant. The peak yields observed in the present study are higher than those reported by Gautam and Khadka (2022) [8], who documented 14.9±4.7 L/day in Holstein crosses, as well as Dev and Dahiya (2018) [7] and Desai *et al.* (2017) [6], who reported lower values ranging from 3.14±0.18 kg to 13.3 kg and 8.61±0.05 liters, respectively.

Table 1: Productive performance of Crossbred cattle

S. N.	Parameter	Chomu	Mean ± SE	SD	Amer	Mean ± SE	SD	Difference	SEd	t-Test	df	P Value
1	Lactation milk yield (kg)	416	3786.64±37.127	757.245	471	3866.75±36.538	792.973	-80.108	52.24	-1.533	885	0.126
2	Lactation length (in days)	416	305.11±0.548	11.178	471	306.15±0.378	8.209	-1.038	0.654	-1.589	885	0.113
3	Av. milk yield (kg/day)	416	12.37±0.10925	2.22825	471	12.60±0.10963	2.37916	-0.2225	0.1554	-1.432	885	0.153
4	Peak yield (kg)	416	15.62±0.123	2.5	471	15.84±0.118	2.566	-0.218	0.171	-1.28	885	0.201

The results of reproduction performance of crossbred cattle in two tehsils are presented in Table 2.

Age of First Conception (AFCon)

The mean age at first conception in crossbred cattle was significantly lower at 20.38± 0.14 months in Chomu as compare to 20.94± 0.13 months in Amer. Considerably lower age at first conception was reported by Petrovic *et al.* (2007) [15] who observed first conception at a much earlier age of 16.15 and 16.22 months, respectively in HF crossbred and HF cows. The higher AFCon may be attributed to suboptimal feeding, health care, or heat detection, highlighting the need of improved heifer management for early maturity.

Age of First Calving (AFC)

The average age at first calving in crossbred cattle was significantly lower at 29.45± 0.14 months in Chomu than 29.97± 0.13 months in Amer. The average age at first calving observed in this study aligns with of reports Manjusha *et al.* (2016) [13] and Kumari *et al.* (2019) [12], who reported AFC of 30.8 and 30.75 months, respectively. However, it is on the other hand, higher AFC at 36.4 and 34.7 months reported by Anilkumar *et al.* (2016) [2] and Priyadharshini *et al.* (2021) [17].

Service Period (SP)

The average service period of crossbred cattle was 2.91± 0.05 months in Chomu and 2.87± 0.03 months in Amer. The difference was not statistically significant. The service periods recorded in this study are notably shorter than those reported by Dev and Dahiya (2018) [7], and Sai *et al.* (2023) [19], who observed durations ranging from 107.55 to 272 days. The service periods observed in the study reflect effective reproductive management, timely heat detection, and efficient insemination practices adopted by farmers in these regions.

Dry Period (DP)

The mean dry period of crossbred cattle was 1.99± 0.03 months in Chomu and 1.98± 0.03 months in Amer. The difference was not statistically significant. The dry periods observed in this study are considerably shorter than those reported by Dev and Dahiya (2018) [7], Roy *et al.* (2020) [18], and Sangwan *et al.* (2021), who documented durations of dry ranging from 84 to 318 days. However, almost similar dry period was reported by Poudel *et al.* (2023) [16].

Calving Interval (CI)

The average calving interval of crossbred cattle was 12.15± 0.04 months in Chomu and 12.18± 0.03 months in Amer. The effect of lactation was was not statistically

significant. The calving intervals observed in this study was similar to those reported by Almensh *et al.* (2017) [1], Desai *et al.* (2017) [6] and Dev and Dahiya (2018) [7]. The CI observed in the study is almost equal to optimum. Hence, it indicate strong reproductive efficiency, timely breeding, and sound postpartum care practices in Chomu and Amer.

Gestation Period (GP)

The mean gestation period of crossbred cattle was 277.35± 1.04 days in Chomu and 279.08± 0.08 days in Amer. The difference was not statistically significant. Desai *et al.* (2017) [6] and Siddika *et al.* (2024) [21] reported equal GP of 279.14±0.30 and 278.44±0.97 days, respectively in crossbred cattle.

Table 2: Reproductive performance of Crossbred cattle

S. N.	Parameter	Chomu	Mean ± SE	SD	Amer	Mean ± SE	SD	Difference	SEd	t-Test	df	P Value
1	Age of first conception(month)	416	20.38±0.143	2.912	471	20.94±0.134	2.900	-0.56	0.195	-2.866	885	0.004
2	Age of 1st calving(month)	416	29.45±0.143	2.926	471	29.97±0.132	2.857	-0.514	0.194	-2.644	885	0.008
3	Service period (month)	416	2.91±0.0509	1.0384	471	2.87±0.0291	1.039	0.03473	0.057	0.609	885	0.543
4	Dry period(month)	416	1.99±0.0296	0.6037	471	1.98±0.0284	0.6166	0.01119	0.0411	0.272	885	0.786
5	Calving interval (month)	416	12.15±0.0357	0.7296	471	12.18±0.0292	0.6349	-0.024	0.0458	-0.524	885	0.601
6	Gestation period (days)	416	277.35±1.038	21.168	471	279.08±0.077	1.67	-1.732	0.979	-1.77	885	0.077

Conclusion

The results of the present study indicate that while the productive traits of crossbred cattle in both Chomu and Amer such as lactation yield, lactation length, daily milk yield, and peak milk yield were within satisfactory ranges and showed no significant differences between tehsils, the reproductive performance parameters warrant attention. Specifically, the age at first conception and age at first calving were significantly higher in Amer, and both the service period and calving interval across regions were slightly extended beyond the optimum values required for maximizing profitability in dairy farming. These extended reproductive intervals can adversely affect lifetime productivity and economic returns. Therefore, improving reproductive efficiency through better herd management, nutritional support, and timely veterinary interventions is essential to enhance the overall profitability of crossbred dairy cattle farming in the region.

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