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Estimation of Repeatability for Certain Reproductive Trait in Various Grade of Jersey × Red Sindhi Crosses

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ABSTRACT

Estimation of genetic parameters is important to determine the selection criterion and future breeding strategies. Jersey × Red Sindhi crosses are milk-purpose breeds of cattle and are popular among farmers for their high milk yield and efficient reproduction. The term "repeatability" refers to an animal's likelihood of performing similarly to or better than the herd average in her next lactation than she did in her previous lactation. It's usually calculated as an intra-herd correlation or a correlation between recordings from the same animal over multiple lactations. To maximize the profitability of dairy crossbred cattle, getting a better understanding of the factors that influence reproduction is critical. Skilled people raised and cared for the animals in identical feeding and management conditions. Calving interval (CI), service period (SP), dry period (DP), and days-open were the reproductive features investigated. The data revealed that the repeatability (r) with standard error (SE) for the calving interval (0.60± 0.71), service period (0.20, 0.140), dry period (0.14, ± 0.33) and days-open (0.94 0.14), had moderate repeatability. The calving interval, service period with low repeatability, dry period, and days open with high repeatability are all variables to consider.

HIGHLIGHTS

- Moderate and very high repeatability traits were selected for future selection.
- Days open blood inheritance 50% Jersey and 50% Red Sindhi crosses are for future selection.
- There was low repeatability for these traits, so farmers were advised to sell these animals on dairy farms.

Keywords: Jersey × Red Sindhi, Heritability, Correlation, Repeatability

The world's largest herd of cattle is found in India. Since 2017, India has fallen to second place among nations that produce milk globally. During the years 2021–2022, India will produce 221.06 million metric tonnes of milk. Compared to the predicted average daily consumption of 294 grammes worldwide in 2017, the country's per capita availability of milk increased from 130 grammes in 1950–1951 to 444 grammes in 2021–2022. This indicates a consistent increase in the supply of milk and milk products for our expanding population, but the average milk production per animal is incredibly low when compared to sophisticated nations. Development of high-yielding cows and buffaloes is necessary for a sustainable dairy business in order to meet the demand and supply for milk for the general public. Crossbreeding native cattle with exotic breeds known for their high milk yield have shown to be a successful and viable tactic. Research on crossbreeding throughout the world, but especially in tropical nations, has demonstrated that F1 animals perform best in terms of a variety of productive and reproductive qualities. To evaluate the total performance of the dairy cow, numerous

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characteristics are taken into consideration, including reproductive performance. There are very few studies on the reproductive efficiency of Jersey crossbreds, and they are exclusively conducted in a few northern and western regions of the country (Annual report, 2021-22).

The "Taylor" breed of cattle was created in India as early as 1875, close to Patna, using a Shorthorn bull and indigenous cows (Sinha, 1951). 5–6 litres of milk are produced on average every day. These creatures are red, grey, or black in coloring. Between 1910 and 1932, crossbreeding work was started at the Imperial Dairy Research Institute in Bangalore, the Agricultural Institute in Pusa, the Livestock Research Station in Hosur, and the Military Dairy Farms in Allahabad on more scientific lines. Using indigenous breeds like Sahiwal, Gir, Hariana, Kankrej, and Red Sindhi cows with exotic breeds like Holstein Friesian, Jersey, and Brown Swiss sires, crossbreeding work was initiated at Allahabad Agricultural Institute between 1924 and 1934. Since 1934, only Red Sindhi and Jersey had been used in crossbreeding possessing between 3/8 and 5/8 Jersey ancestry, thus the "Jersindh" breed of cow was created. In Bengaluru, Tharparkar cows and Jersey bulls were bred to create the "Jerthar" breed of cattle. A new breed of cattle known as the "Sunandini" was produced in Kerala in 1963 as a result of the bilateral Indo-Swiss initiative, which is now known as Kerala Livestock Development Board (KLDB). The Sunandini breed, which was once used for milk, draught animals, and meat, is now primarily used for milk production (Chacko, 1994).

The overall lactation milk yield is 2435 kg in 280 days with 3.89 % fat. To create a new dairy breed, Sahiwal and Red Sindhi were crossed with Brown Swiss at the NDRI in 1963 Varaprasad *et al.* (2013). The several crossbred groups, which had not demonstrated substantial heterosis for milk yield, were created from the Brown Swiss breed, which is well known for its high milk yield. Selective breeding was done after merging all the different crossbred groupings. The second-best crossbred group was made up of Sahiwal cattle with the remaining percentage of Brown Swiss heritage ranging from 50 to 75per cent (Thiagarajan, 2014).

India has a vast Bovine population (Cattle, Buffalo, Mithun and Yak) is 302.79 Million in 2019 which shows an increase of about 1% over the previous census. The total number of cattle in the country in 2019 is 192.49 million showing an increase of 0.8 % over previous Census, which includes 50.42 million crossbreds and 142.11 million Indigenous/ non-descript cattle. The number of exotic/crossbred milch cattle increased from 14.4 million to 19.42 million, an increase of 26.9 per cent (19th Livestock Census, 2012). The dairy cattle crossbreeding programme has contributed significantly to India's position as the world's leading milk producer. Crossing Indian descriptive and non-descript cattle with exotic dairy breeds, primarily Holstein Friesian, Jersey, and Brown Swiss breeds, resulted in this.

For the creation of successful breeding plans, estimate of the genetic factors repeatability, heritability, and genetic correlation is required. These factors are indicative of the population being estimated, and they could alter over time as a result of management and selection choices. Hussain *et al.* (1993) and Khan *et al*. (1988) calculated repeatability estimates of various performance metrics for the Jersey Red Sindhi crosses in Prayagraj, including calving interval, service period, dry period, and days-open. Thus, it was intended for the current study to compute reputability estimation of several performance qualities utilising the most recent analytical technique (Tomar, 2019).

MATERIALS AND METHODS

To investigate repeatability for certain reproductive traits i.e. Calving Interval, Service Period, Dry Period, Days-Open in various grades of Jersey × Red Sindhi crosses a total of 66 records were utilized in the present study. Data Pertained to present research work were collected from the history sheet maintained at the Department of Animal Husbandry and Dairying, SHUATS. Data of abnormal lactations like abortion, below 150 days milk yield were excluded from the study.

Source of data

Data for 1st, 2nd and 3rd lactations spread over a period form 1939 to 1971 maintained at SHUATS dairy farm were collected from history sheets of Jersind Crossbred cows comprising 1/2 × 1/2, 3/8 × 5/8, 1/4 × 3/4 and 1/8 × 7/8 crosses having (57), (45), (30) and (66) observations, respectively.

Parameters for estimation

1. Repeatability of Calving Interval (CI) 1/2 × 1/2, 1/4 × 3/4, 3/8 × 5/8, 1/7 × 1/8 Jersey × Red Sindhi crosses.
2. Repeatability of Service Period (SP) 1/2 × 1/2, 1/4 × 3/4, 3/8 × 5/8 1/7 × 1/8 Jersey × Red Sindhi crosses.
3. Repeatability of Dry Period (DP) 1/2 × 1/2, 1/4 × 3/4, 3/8 × 5/8, 1/7 × 1/8 Jersey × Red Sindhi crosses.
4. Repeatability of Days-Open (DO) 1/2 × 1/2, 1/4 × 3/4, 3/8 × 5/8, 1/7 × 1/8 Jersey × Red Sindhi crosses.

Data analysis

A total of 66 records were used in this study to explore repeatability for specific reproductive features such as calving interval, service period, days-open and dry period in various grades of Jersey× Red Sindhi hybrids. Data for the current study project was gathered from the SHUATS Department of Animal Husbandry and Dairying's history sheet. The repeatability values were estimation by using restricted maximum likelihood procedure as outline by Thomson (2009) fitting an individual's animal model. The data regarding productive traits were recorded and analyzed by intra class correlation method (R.A. Fisher 1921). The standard error of repeatability will calculate as per Swiger *et al*. (1964).

$$Y_{km} = \mu + b_K + e_{km}$$

Where,

Y_{km} is the M^{th} measurement on K^{th} individuals

μ is the common mean

b_k is the effect of K^{th} individuals

e_{km} is environmental deviation of the M^{th} measurement of K^{th} individual.

- No. of records per individuals (K):

$$K = \frac{1}{N-1\left[\frac{M-\sum M2I}{M}\right]}$$

- Estimation of variance components:

$$\sigma 2W = \frac{MSS(CBC) - MSS(W)}{K}$$

$$\sigma 2W = MSS(W)$$

- Repeatability value was obtained as intra-class correlation(r):

$$r = \frac{\sigma 2B}{\sigma 2B + \sigma 2W}$$

- Standard error of repeatability:

$$SE = \frac{2(M-1)(1-r)2\{1(K+1)R\}}{K2(M-N)(N-1)}$$

Where,

N Number of individuals

M - Total number of observations

GT - Grand total

Y^2, I - Sum of squares of total yield of each cow

SS - Sum of squares

K - Number of records per individuals

$\sigma^2 W$ - Error component of variance

$\sigma^2 B$ - Variance between individuals

r - Repeatability (correlation coefficient)

The various fixed effects observed to be significant sources of variation for different performance trades were fitted in the above mixed model for the estimation of repeatability. These included years of calving, lactation number, and lactation length for 305 days and lactation number of lactation length, year of calving for dry period year and seasons of service period and lactation number for service period, season of service for gestation period and season of calving, and lactation number for calving interval.

RESULTS AND DISCUSSION

There are many economic characteristics of farm animals which occur more than once in the lifetime of an animal and take different phenotypic values at different times. Such characteristics are dry periods and service period weight at first calving, another reproductive trait in dairy animals. All these characters have different values for some animals when measured at different times. The

phenotypic value of quantitative characteristics is the joint product of phenotype and the environment to which the animal is exposed. The genotype of an animal is any living thing that begins to be decided and fixed at the time of conception and does not change throughout the life of the animal except for mutation and errors in mitosis.

Calving interval

The repeatability estimation for the calving interval based on 1/2 J × 1/2 RS 45 calving records of 15 cattle were 0.22±0.17,1/4 J × 3/4 RS 66 calving records of 22 cattle were 0.47±0.12, 3/8 R × 5/8 RS 30 calving records of 10 cattle were 0.60±0.71 and 1/8 R × 7/8 RS 57 calving records of 19 cattle were 0.02±16 (Table 1). The heritability of age at first calving obtained for Jersey × Red Sindhi were 0.220±0.11 and this was higher than the values reported by Bajetha and Singh (2011) but lower than that of Dubey and Singh (2015). The overall lifetime production performance of the Jersey × Red Sindhi crossbred cows of the herd studied was abysmally lower than the available reports for Jersey crossbreds in the tropics (Singh *et al*., 2004). The estimated range of 0.12 to 0.23 repeatability for calving interval as obtained in the present study is very low as compared to those of (Eaglen, S.A.E. *et al.,* 2013).

Service period

The repeatability estimation for service period in the present study was compute to be 1/2 J× 1/2 RS 45 service period record of 15 cattle were 0.22±0.175, 1/4 J × 3/4 RS 66 service period record of 22 cattle were 0.16±0.11, 3/8 J × 5/8 RS 30 service period of 10 cattle were 0.16±0.33 and 1/8 J × 7/8 RS 57 service period record of 19 cattle was 0.11±0.13 respectively repeatability. The repeatability estimates for service period as found from these studies (Thakkar, N.K. *et al.,* 2019) ranged from 0.22±0.05 in Kankraj cattle.

Dry period

The repeatability estimation for dry period was found to be 1/2 J× 1/2 RS 45 dry period record of 15 cattle were 0.03±0.175, 1/4 J × 3/4 RS 66 dry period record of 22 cattle were 0.08±0.099, 3/8 J × 5/8 RS 30 dry period record of 10 cattle were 0.14±0.36 and 1/8 J × 7/8 RS 57

Table 1: Repeatability estimates for various performance traits of reproductive Jersey × Red Sindhi Crosses

Traits	Number of records	Number of animals	V^2B	$V^2B + V^2W$	Repeatability (r)	Stander error (SE)
Calving Interval 1/2J×1/2RS crosses	45	15	1970.6	8789.6	0.22	0.17
Calving Interval 1/4J×3/4RS crosses	66	22	51174.00	108317.8	0.47	0.12
Calving Interval 3/8J×5/8RS crosses	30	10	53315.01	87406.26	0.60	0.71
Calving Interval 1/8J×7/8RS crosses	57	16	6010.50	299314.1	0.02	0.16
Service Period 1/2J×1/2RS crosses	45	15	1970.67	8789.61	0.22	0.17
Service Period 1/4J×3/4RS crosses	66	22	1365.44	8184.38	0.16	0.11
Service Period 3/8J×5/8RS crosses	30	10	1313.40	8132.34	0.16	0.33
Service Period 1/8J×7/8RS crosses	57	16	843.96	7662.9	0.11	0.13
Dry Period 1/2J×1/2RS crosses	45	15	21.81	6840.75	0.03	0.17
Dry Period 1/4J×3/4RS crosses	66	22	430.68	4924.99	0.08	0.09
Dry Period 3/8J×5/8RS crosses	30	10	60.75	409.13	0.14	0.36
Dry Period 1/8J×7/8RS crosses	57	16	56.23	7380.28	0.08	0.07
Days-Open 1/2J×1/2RS crosses	45	15	7894.64	8310.24	0.94	0.16
Days-Open 1/4J×3/4RS crosses	66	22	1321.69	14478.72	0.09	0.12
Days-Open 3/8J×5/8RS crosses	30	10	7165.47	13198.38	0.54	0.22
Days-Open 1/8J×7/8RS crosses	57	19	2397.54	20411.05	0.11	0.14

Repeatability estimates for various performance traits of reproductive Jersey × Red Sindhi**.** Means with at least one common superscript within classes do not differ significantly (p>0.05).

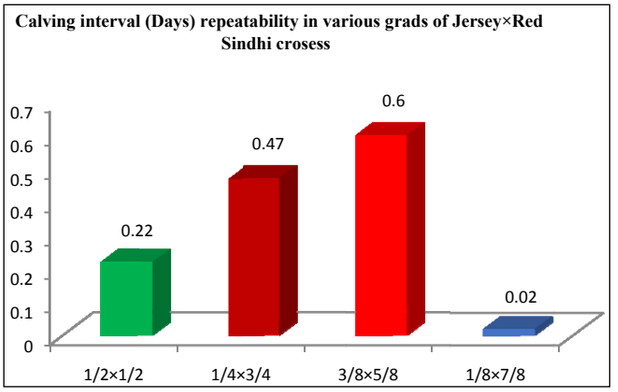

Fig. 1: Repeatability of Calving Interval (Days) in 1st, 2nd and 3rd lactation of 1/2J × 1/2RS, 1/4J × 3/4RS, 3/8J × 5/8RS and 1/8J × 7/8RS Crosses

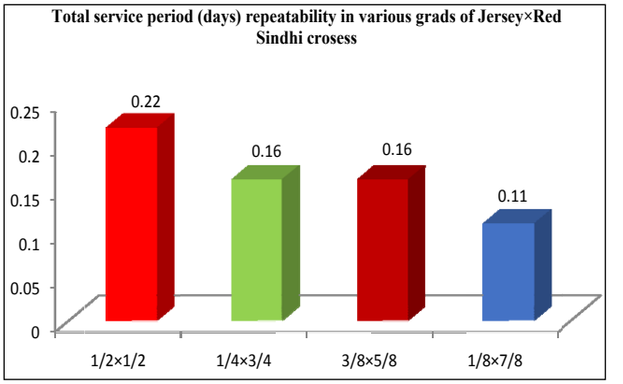

Fig. 2: Repeatability of Service Period (Days) in 1st, 2nd and 3rd lactation of 1/2J × 1/2RS, 1/4J × 3/4RS, 3/8J × 5/8RS and 1/8J × 7/8RS Crosses

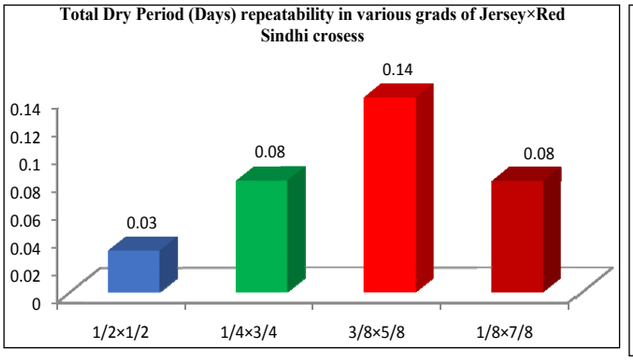

Fig. 3: Repeatability of Dry Period (Days) in 1st, 2nd and 3rd lactation of 1/2J × 1/2RS, 1/4J × 3/4RS, 3/8J × 5/8RS and 1/8J × 7/8RS Crosses

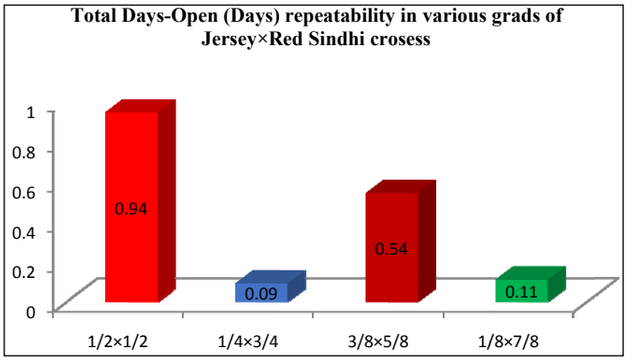

Fig. 4: Repeatability of total Days-Open (Days) in 1st, 2nd and 3rd lactation of 1/2J × 1/2RS, 1/4J × 3/4RS, 3/8J × 5/8RS and 1/8J × 7/8RS Crosses

dry period record of 19 cattle was 0.10±0.079 respectively repeatability. The repeatability estimates for dry period as found from these studies (Thakkar *et al.* 2019) ranged from 0.48±0.04 in Kankraj cattle.

Days-open

The repeatability estimation for days-open was found to be 1/2 J× 1/2 RS 45 days-open record of 15 cattle were 0.94±0.16, 1/4 J × 3/4 RS 66 days-open record of 22 cattle were 0.09±0.12, 3/8 J × 5/8 RS 30 days-open record of 10 cattle were 0.54±0.22 and 1/8 J × 7/8 RS 57 days-open record of 19 cattle were 0.11±0.14 respectively. The genetic correlation (above diagonal), heritability (diagonal), and phenotypic correlation (below diagonal) for fertility traits Days- Open reported 0.06 by (Junior *et al.*, 2021).

CONCLUSION

In this study, successfully running a dairy farm and making it more profitable for rural area farmers was helpful. Livestock provides farmers with regular, supplementary income to producers engaged in secondary and tertiary farming related to the livestock business. Besides providing manure, livestock is an important source of value-added byproducts. Small dairy farms are not properly processed and utilized as a commercial activity, but have immense future business potential. All of the characteristics' repeatability coefficients were evaluated, and it was discovered that traits with modest to moderate repetition fared better in terms of reproduction. The low repeatability for the service period was documented in 3/8J×5/8RS crosses, the extremely significant repeatability for the dry period in 3/8J×5/8RS crosses, the low repeatability

service period in 1/2J×1/2RS crosses, and the dry period in 3/8J×5/8RS crosses. When comparing all crosses for reproduction performance, point 3/8J×5/8RS crossing was judged to be the best.

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