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Research Article

Non-genetic Factors Associated with 305 Days Milk Yield in Kankrej Cattle

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ABSTRACT

The performance data of Kankrej cattle for the present study were collected from the National Dairy Development Board (NDDB), Anand, under the pedigree selection programme (PS) in Banaskantha district of Gujarat state. After the standardization of initial records, the 305DMY records of 6037 Kankrej cattle sired by 54 bulls calved during the period of 19 years from 2003 to 2022 were utilized in the study. The least squares analysis of variance to reduce the nonorthogonality after considering their villages, parity, Age at calving groups, year-month of birth groups and year-month of calving groups were used to analyze the data on 305DMY production trait. The average 305DMY for the Kankrej cow was estimated to be 2302 ± 9.01 kg. The fixed factors such as parity, villages and year month of the calving group considered in the study had significant ($p<0.05$) effects on the 305DMY traits except for the Age in the calving group (months) and year-month of the birth group. The non-significant effect of the year and month of birth highlighted the adaptive traits of the Kankrej cattle against the extreme temperature in the arid or semi-arid region of North Gujarat. The maximum estimated corrected yield and breeding value were estimated to be 3420 kg and 855 kg, respectively. The increased production performances observed in the study may be the result of the successful implementation of pedigree selection under the field conditions.

Keywords: *Kankrej, 305DMY, Pedigree selection, Milk yield, Least-squares Analysis.*

INTRODUCTION

Livestock breeds in India exhibit a remarkable diversity, ranging from excellent milch animals to those suited for extreme draught conditions and from very tall to dwarf cattle and highland grazers to those adapted for marshy climates.

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Among these, indigenous cattle are especially notable for their exceptional versatility as domesticated animals, adapting with ease to various stressful climatic conditions, including arid, tropical, and desert environments, with greater resistance to diseases and better survivability in the local ecosystem (Srivastava et al., 2019). The livestock population of India stands at a staggering 536.76 million, with cattle accounting for 193.46 million, which plays a significant role in the country's dairy industry. The contribution of total milk production in India by crossbred cattle is 29.91%. Indigenous cattle contribute 10.35% of the total milk production in the country, whereas non-descript cattle contribute 9.82% (BAHS, 2022).

Originating from Western and Northern India, the Kankrej breed of cattle is among the largest and heaviest breeds found in the region, well known for their impressive strength as draft animals and moderate milk production capacity (Joshi & Phillips, 1953). These animals possess certain characteristics, such as disease resistance, heat tolerance, adaptability to survive and reproduce in challenging conditions, low feed requirements, and the potential to enhance dairy traits (Patel et al., 2016). The Kankrej breed is primarily found in Gujarat, with small population also present in certain pockets of Rajasthan, India. These animals are integral to the livelihoods of many individuals, providing both milk and draft power. Notably, cows of this breed exhibit high genetic potential for milk production, with the ability to produce up to 4,200 kg of milk during a lactation period of 300 days (Pundir et al., 2011).

The Milk Yield is the most important economic trait that determines the financial gains of dairy farmers and is influenced by several factors. 305-day milk yield (305DMY) is one of the essential traits for bringing improvement in milk production. According to climatic conditions, non-genetic factors tend to suppress or inhibit the expressivity of the true genetic ability of the animals in various ratios. Therefore, it's crucial to calculate the model's estimate of the environmental factors' contribution to milk production in order to determine the animal's true genetic potential. By studying these non-genetic elements, breeders can create breeding protocols to improve milk production and other economic qualities. Gaining an understanding of the different climate conditions influencing these animal's production performance would help increase the animal's overall productivity and improve genetic gain. Keeping all this in mind, the present investigation was carried out to know the effect of various non-genetic factors on 305-day milk yield (305DMY) in Kankrej cattle.

MATERIALS AND METHODS

The performance data of Kankrej cattle for the present study were collected from the National Dairy Development Board (NDDB), Anand, under a pedigree selection programme from 2003 to 2022 in Banaskantha district of Gujarat state. Data containing phenotypes of 7874 Kankrej cattle sired by 54 bulls were used.

Method of Calculation of 305DMY

The total milk yield of cattle during the lactation was obtained as per the procedure suggested by the International Committee for Animal Recording (ICAR, 2020). The following equation was used to compute the 305DMY;

$$305\ \text{DMY} = I_0M_1 + \frac{I1*(M1+M2)}{2} + \frac{I2*(M2+M3)}{2} + \ldots + \frac{In-1*(Mn-1+Mn)}{2} + I_nM_n$$

Where:

M_1, M_2, M_n are the weights in kgs, of the milk produced in 24 hours of the recording day.

I_1, I_2, I_{n-1} are the intervals, in days between recording dates.

I_0 is the interval, in days between the lactation period start date and the first recording date.

I_n is the interval, in days between the last recording date and the end of the lactation period.

Standardization of Data

At the beginning, all lactation records of 7874 Kankrej cattle distributed in 120 villages of 12 tehsils were available. Since outliers and other abnormal records were not included in the analysis, 305 DMY was calculated only for those animals that had crossed 150 days of lactation. The range of 305 DMY was between 500 and 6000 kg. After the standardization, records of 6037 Kankrej cattle remained.

Classification of Data

The data were grouped and coded according to the different villages in which animals were reared, parity, Age at calving group, year-month of birth, and calving group. Based on the structure of the data, the level of each factor was decided.

Classification of Villages

The entire study area was classified into different villages. Only those villages which were having observations on at least 10 or more animals were considered under study. Observations on animals of all other villages were discarded from the study. A total of 80 levels were considered to obtain the village effect on the production performance of Kankrej cattle.

Classification of Parity

Animals under study were classified on the basis of their parity. All the animals of the study area were grouped in to three parities as described below,

Table1. Classification of parity

Group	Lactation number (parity)
Group – 1	1
Group – 2	2
Group – 3	≥3

Classification of Age at Calving Group

Age at calving in months was calculated by taking the difference between the date of birth and the date of that particular calving. The minimum Age at calving was obtained as 20 months and the maximum as 238 months. The range of Age at calving (218 months) was classified into a group of three months. The data were classified into 72 different groups. Out of that, the groups which were a minimum of 30 observations were considered under the study, and others were removed. So, finally, 40 levels for the Age at first calving group were considered.

Classification of Data for Year-Month of Birth

The year and month of birth were calculated from the data, and through concatenation, the year-month of birth was generated and coded. Only those levels having a minimum of 10 observations were considered in the study. A total of 242 levels were used to classify data according to the year and month of birth group in the present study.

Classification of Data for Year-Month of Calving

The year and month of calving were calculated from the data, and through concatenation, the year-month of calving was generated and coded. Only those levels having a minimum of 10 observations were considered in the study. A total of 161 levels were used to classify data according to the year and month of calving in the present study.

Least-squares Analysis

The least squares analysis of variance to reduce the nonorthogonality (Harvey, 1990) after considering their villages, parity, Age at calving groups, year-month of birth groups and year-month of calving groups, were used to analyze the data of 6037 animals on 305DMY production trait using the following statistical model:

$$Y_{ijklmn} = \mu + A_i + B_j + C_k + D_l + E_m + e_{ijklmn}$$

Where,

Y_{ijklmn} = n^{th} record of cattle in i^{th} village, j^{th} parity, k^{th} Age of calving group, l^{th} group of year-month of birth and m^{th} group of year-month of calving

μ = Population mean

A_i = Fixed effect of i^{th} village in which animal is reared

B_j = Fixed effect of j^{th} parity

C_k = Fixed effect of k^{th} Age of calving group

D_l = Fixed effect of l^{th} group of year-month of birth

E_m = Fixed effect of m^{th} group of year-month of calving

e_{ijklmn} = Random error assumed to be normally and independently distributed with zero mean and constant variance i. e. (NID, 0, σ^2).

RESULTS AND DISCUSSIONS

The performance of Kankrej cows for the 305DMY trait under small holder conditions is described in Table 2. In the present study, the average 305DMY for the 6037 cows was estimated to be 2302 ± 9.01 kg, which was higher than the 2,051.03 kg FL305DMY of Kankrej cattle ranged between 633.2 to 3,243.6 kg reported by Singh et al. (2020). Similarly, Rathod et al. (2020) noted the average lactation yield of the Kankrej breed in the farmers' herd as 1669.96 litres, while, the estimate for the same trait was 2682.27 litres at the livestock research station, Sardarkrushinagar, Gujarat. Gupta et al. (2019) reported the milk yield 305DMY as 2128.64 ± 18.65 litre in Kankrej cow of the same herd from the data collected over the period of 35 years.

Table 2: Performance (for 305DMY) of Kankrej cattle under PS Project

Trait	No. of observations	Mean	SE	SD
305DMY	6037	2302 kg	9.01	669

The data on 305DMY was corrected using the least squares method for the fixed effects, which are described in table 3. It shows that the majority of fixed factors had significant ($p<0.05$) effects on 305DMY except for the Age at calving (months) and year-month of birth. Non-significant effect of year month of birth highlighted the adaptive traits of the Kankrej cattle against the extreme temperature under the arid or semi-arid region of the North Gujarat. Similarly, Ekka et al. (2014) reported that the season of birth/calving had no significant effect on any of the first production and reproduction traits in Kankrej cattle. Similar observations were also reported by Kathiravan et al. (2009) and Manoj et al. (2012) in Sahiwal.

The significant effect of villages is the reflection of differences in the managemental conditions, feed and fodder availability in the different villages influencing the 305DMY. Furthermore, with the advancement in parity, milk production tended to increase significantly. This may be because the increased body weight and size of the cattle with a greater number of lactations leads to a greater availability of body reserves used to synthesise milk components. Gupta et al. (2019) also reported the significant effect of parity on 305DMY in Kankrej cattle. The nonsignificant effect of year month of birth indicated that the Kankrej is well adapted to the seasonal environmental fluctuation of the area (North Gujarat) and is not much susceptible to the changes in the temperature and humidity.

Table 3: Fixed Effects of various factors on 305DMY in Kankrej Cattle

Fixed effect	No. of levels	Range of estimates	No. of significant coefficients (p<0.05)
Intercept	1	1958.8097	1
Villages	83	-264.2445 to 1059.6749	55
Parity	3	104.4140 to 164.7920	2
Age at calving (months)	40	-750.7366 to 10.9371	-
Year-month of birth	242	-1622.4116 to 513.4986	-
Year-month of calving	161	-241.6654 to 1910.3415	6

Based on the corrected yields, the breeding values were estimated. The maximum estimated corrected yield and breeding value was estimated to be 3420 kg and 855 kg, respectively. Similarly, the breeding values of Murrah buffalo bulls were estimated to be 1402.10 kg, 1732.44 kg, 1755.98 kg and 1530.60 litre by Singh and Singh (1999), Jain and Sadana (2000), Singh et al. (2014) and Chaudhari et al. (2015), respectively.

CONCLUSION

The average 305DMY for Kankrej cow was estimated to be 2302 ± 9.01 kg. The maximum estimated corrected yield and breeding value were estimated to be 3420 kg and 855 kg, respectively. The increased production performances observed in the study may be result of successful implementation of pedigree selection under the field condition. The fixed factors (villages, parity, year-month of calving) had a significant (p<0.05) effect on 305DMY except for the Age at calving (months) and year-month of birth. Non-significant effect of year month of birth highlighted the adaptive traits of the Kankrej cattle against the extreme temperature under the arid or semi-arid region of the North Gujarat. Further, the information on non-genetic factors can be utilized for the formulation of proper breeding and management strategies in order to improve milk yield traits in Kankrej cattle.

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