Indian Journal of Animal Sciences **93** (3): 318–320, March 2023/Short Communication
https://doi.org/10.56093/ijans.v93i3.130272

Genetic evaluation of Kankrej bulls by different sire evaluation methods

UMESH SINGH[1]✉, T V RAJA[1], B S RATHOD[2] and H H PANCHASARA[2]

ICAR-Central Institute for Research on Cattle, Meerut Cantt., Uttar Pradesh 250 001 India

Received: 15 November 2022; Accepted: 31 January 2023

Keywords: Animal Model, BLUP, Breeding values, Kankrej cattle, Sire evaluation

Kankrej cattle is an important dual purpose breed of the country known for its draftability, endurance and acclimatization to the climatic conditions of its breeding tract and its milk production is comparable with the other known indigenous milch breeds of the country. Considering the advantages of indigenous cattle breeds, efforts are being made consistently for increasing their productivity through the implementation of genetic improvement programs. The Indigenous Breeds Project coordinated by ICAR-Central Institute for Research on Cattle is one of such important programs implemented under the All India Coordinated Research Project (AICRP) on Cattle since 2010. The project aims to improve the milk productivity of three important indigenous cattle breeds viz., Gir, Kankrej, and Sahiwal. The genetic improvement of Kankrej breed is undertaken in collaboration with Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat.

The Livestock Research Station of the University maintains the germplasm unit or bull mother farm wherein elite Kankrej females are maintained for nominated mating with the proven bulls to produce the young male calves for induction as the test bulls for field progeny testing program. The breed's home tract lies in between 23.81° 24.70' N north latitude and 71.10° 73.00' E east latitude. The region experiences the tropical climatic condition having the temperature range of 10°C in January to 48°C in May. The data recording units cover the University herds, farmer's herds, and Gaushalas wherein the females registered are inseminated with the frozen semen doses of test bulls to produce the daughters. At present, 11 Artificial insemination (AI) centers are identified in the breeding tract to meet the breeding demand of the registered adult females.

Accurate and early selection of breeding bulls is one of the important aspects of any breed improvement program as the bulls contribute around 61% of the genetic gain (Rendel and Robertson 1950). The traditional progeny testing program is the best in predicting the real genetic worth of the bulls even though it is tedious, costly, and time-consuming. In the Indian context, considering the small herd size of 2-5 animals, the associated herd progeny testing program is recommended for the genetic evaluation of breeding bulls wherein many small-sized herds are covered for breeding and the bulls are evaluated based on the milk production performance of their daughters. There are many sire or bull evaluation methods viz., least squares (LS), simple regressed least squares (SRLS), Best Linear Unbiased Prediction (BLUP), etc., proposed for predicting the estimated breeding values (EBVs). The animal models are introduced for accurate estimation of the EBVs of all the animals included in the analysis irrespective of the presence or absence of performance records.

In view of the above facts, the present study was carried out to estimate the EBVs of 9 bulls inducted in a set during 2013. The EBVs of bulls were estimated by three different sire evaluation methods viz., BLUP, Wombat Sire Model and Wombat Animal Model using the first lactation 305-days milk records of daughters.

The data on 348 daughters born to 9 bulls inducted during 2013 were utilized for the present study. The fortnightly first lactation milk yield records of daughters calved during 2016 to 2020 were used for estimating the first lactation 305-days milk yield. Normalization of the data was done to remove the extreme values. The records of animals with the incidence of stillbirth, abortion, mastitis etc., were considered as abnormal and excluded. The incomplete records were also not considered for analysis. Finally, bulls with five or more daughter records were only included in the analysis.

The season and year of birth were considered as non-genetic factors or fixed effects while the sire was considered as random effect. According to the meteorological data, the year was divided into three seasons namely winter (November-February), summer (March-June), and monsoon (July-October). The BLUP method as proposed by Henderson (1973, 1975) was used to calculate the EBVs using the LSMLMW Models 2 and 8 as proposed by Harvey (1990).

The general form of BLUP model considered was as follows

$$Y_{ijk} = Xh_i + Zs_j + e_{ijk}$$

Present address: [1]ICAR-Central Institute for Research on Cattle, Meerut Cantt., Uttar Pradesh. [2]Sardarkrushinagar Dantiwada Agricultural University, Dantiwada, Gujarat.
✉Corresponding author email: umesh.singh1@icar.gov.in

where Y_{ijk}, Observation vector of trait with dimension (n× 1); X, Design matrix or incidence matrix for fixed effects with dimension (n × p); h_i, Vector for fixed effect of dimension (p × 1); Z, Design matrix or incidence matrix for random effects with dimension (n × q); s_j, Vector of random effect with mean zero and variance $G\sigma s^2$ with dimension (q × 1); e_{ijk}, Random error vector with dimension (n × 1) with mean zero and variance $I\ \sigma e^2$.

The animal /sire model considered for Wombat analysis was as follows:

$$Y_{ijk} = Xb_i + Zu_j + e_{ijk}$$

where Y_{ijk}, k^{th} observation of j^{th} random effect of i^{th} fixed effect; b_i, Vector of observation of fixed effects; u_j, Vector of additive genetic effect (random effect/sire effect); X, Design matrix/incidence matrix of fixed effect; Z, Design matrix/ Incidence matrix of random effect, and e_{ijk}, Vector of residual errors.

The descriptive statistics for the first lactation 305-days milk yield of Kankrej cattle was calculated. The overall average±SE was estimated as 2430.29±27.18 kg with a range of 850.30 to 4193.30 kg. The coefficient of variation was 20.86%.

The results of EBVs of 9 Kankrej bulls estimated by different sire evaluation methods are presented in Table 1. The number of observations per bull ranged from 12 to 55 and this variation in the records may be attributed to the loss of data. The frequent movement or disposal of animals before completion of their first lactation milk yield in the farmers' herds is one of the prime reasons for the loss of data under the associated herd progeny testing program.

In the Harvey BLUP method, the overall average EBV of 9 bulls for first lactation 305-days milk yield was estimated as 2414.40 kg. This estimate was higher than the average EBV of 2050.29 kg reported by Singh *et al.* (2020) for the first set of Kankrej bulls. Estimates lower than the average EBV obtained in the present study were also reported by Banik and Gandhi (2010), Raja (2010) and Girimal *et al.* (2022) in Sahiwal cattle and Pandey *et al.* (2013) in Vrindavani cattle. However, the estimate was lower than the value of 2660.70 kg estimated by the BLUP method in Frieswal cattle (Rajeev *et al.* 2021). The breeding values ranged between 2268.91 (K.8.38) to 2570.25 kg (K.8.32). The genetic superiority of the top ranked bull over the overall average was 155.85 kg (6.45%) while the inferior bull had the EBV of -145.49 kg (-6.02%).

The results of the Wombat sire model analysis revealed an overall average of 2430.29 kg and the topmost sire had the genetic superiority of 213.98 kg (8.80%) while the inferior bull had the estimate of -181.74 kg (-7.47%). Similarly, in the Wombat animal model also, the overall average EBV was obtained as 2430.29 kg and the estimates ranged from 359.13 (14.78%) to -322.92 kg (-13.287%).

Among the three methods of evaluation, the EBVs obtained by Wombat animal model discriminated the sires to a larger extent as the variation ranged to a level of 682.05 kg while the Wombat sire model discriminated the sires to an extent of 395.72 and the BLUP model had the lowest discrimination to the level of 301.34 kg. Similar to the present findings, Rajeev *et al.* (2021) reported that the BLUP method was least discriminating the bulls among the different methods studied. Contrary to this, Raja (2010) in Sahiwal cattle and Rathee (2015) in Frieswal cattle reported higher discrimination by the BLUP method than the other methods studied.

The results also revealed that out of 9 bulls, 4 bulls had EBVs higher than the overall average while the rest 5 bulls

Table 1. Comparative evaluation of Kankrej bulls by using different sire evaluation methods

Sire No.	No. of daughters	Harvey BULP Results			Wombat Sire Model Results			Wombat Animal Model Results		
		FL305 (kg)	EBVs (kg)	Ranking	FL305 (kg)	EBVs (Kg)	Ranking	FL305 (kg)	EBVs (kg)	Ranking
Overall	348	2414.40			2430.29			2430.29		
K.7.48	49	2395.35	-19.05 (-0.78)	5	2408.55	-21.74 (-0.89)	5	2389.11	-41.18 (-1.69)	5
K.8.30	30	2392.88	-21.52 (-0.89)	6	2402.19	-28.10 (-1.15)	6	2381.26	-49.03 (-2.01)	6
K.8.32	37	2570.25	155.85 (6.45)	1	2644.27	213.98 (8.80)	1	2789.42	359.134 (14.777)	1
K.8.35	55	2481.13	66.73 (2.76)	2	2513.17	82.88 (3.41)	3	2577.43	147.14 (6.05)	3
K.8.37	29	2463.19	48.79 (2.02)	4	2497.10	66.81 (2.74)	4	2542.43	112.14 (4.61)	4
K.8.38	55	2268.91	-145.49 (-6.02)	9	2248.55	-181.74 (-7.47)	9	2107.37	-322.919 (-13.287)	9
K.8.62	40	2478.25	63.85 (2.64)	3	2520.92	90.63 (3.72)	2	2579.28	148.99 (6.13)	2
K.8.13	41	2299.52	-114.88 (-4.75)	8	2275.29	-155 (-6.37)	8	2166.84	-263.45 (-10.84)	8
Manek	12	2380.09	-34.31 (-1.42)	7	2362.57	-67.72 (-2.78)	7	2339.46	-90.825 (-3.737)	7

had EBVs lower than the overall average in all the three methods. The rank correlation estimates among the EBVs estimated by different methods were very high ranging from 0.98 to 1.00. The correlation of BLUP EBVs with Wombat sire and animal models was 0.98 or 98% while the correlation between Wombat sire and animal models was almost unity indicating the similar ranking of sires. Based on the results, it may be inferred that any of the three methods can be used for the genetic evaluation of the Kankrej bulls. However, the Wombat animal model discriminates among the bulls to a larger extent indicating its superiority over the other two methods. The results revealed that the Kankrej bulls K.8.32 and K.8.62 can be declared as the best-proven bulls to use for the nominated mating of the elite females to produce the young male calves.

SUMMARY

The genetic evaluation of Kankrej bulls was done by using three different methods viz., BLUP, Wombat sire, and Wombat animal models. First lactation 305-days yields of 348 daughters born to 9 sires and calved from 2016 to 2020 were used for the analyses. For BLUP analysis, season and year of calving were considered as fixed effects, and sire was considered as random effect. The overall average estimate of 2414.40 kg was obtained in BLUP method while 2430.29 kg was obtained in both Wombat sire and animal models. The results revealed that the Wombat animal model discriminated against the sires to the maximum extent followed by Wombat sire and BLUP models. Based on the results, two Kankrej bulls viz., K.8.32 and K.8.62 can be selected as proven bulls for nominated mating for improving the milk productivity of Kankrej cattle.

REFERENCES

Banik S and Gandhi R S. 2010. Animal model versus conventional methods of sire evaluation in Sahiwal cattle. *Asian Australisian Journal of Animal Sciences* **19**(9): 1225–28.

Girimal D, Kumar D, Shahi B N, Ghosh A K and Kumar S. 2022. Sire evaluation using conventional methods and animal models in Sahiwal cattle. *Indian Journal of Animal Sciences* **92**(4): 492–96.

Harvey W R. 1990. Mixed model least squares and maximum likelihood computer program, PC-2 version, Ohio, USA.

Henderson C R. 1973. Sire evaluation and genetic trends. *Journal of Animal Science*, Vol. 1973, Issue: Symposium, 1 January 1973, Pages 10–41.

Henderson C R. 1975. Best linear unbiased prediction under a selection model. *Biometrics* **31**: 423–47.

Pandey H O, Tomar A K S and Dutt T. 2013. Comparison of sire evaluation methods in Vrindavani cattle. *Indian Journal of Animal Sciences* **83**(4): 419–22.

Raja T V. 2010. 'Part lactation records for Sahiwal Sire evaluation.' Ph.D. Thesis, NDRI, Deemed University, Karnal, India.

Rajeev, Kumar R and Singh R. 2021. Sire evaluation based on first lactation 305 day milk yield and individual part lactation records in Frieswal cattle. *Asian Journal of Dairy and Food Research*.

Rathee. 2015. 'Genetic evaluation of Frieswal cattle for life time traits.' Ph.D. thesis, National Dairy Research Institute, Karnal, India.

Rendel J M and Robertson A. 1950. Estimation of genetic gain in milk yield by selection in a closed herd of dairy cattle. *Journal of Genetics* **50**:1–8.

Singh Umesh, Raja T V, Rathod B S, Panchasara H H and Alyethodi R R. 2020. Estimation of breeding values of Kankrej bulls under associated herd progeny testing program. *Indian Journal of Animal Sciences* **90**(3): 145-47.