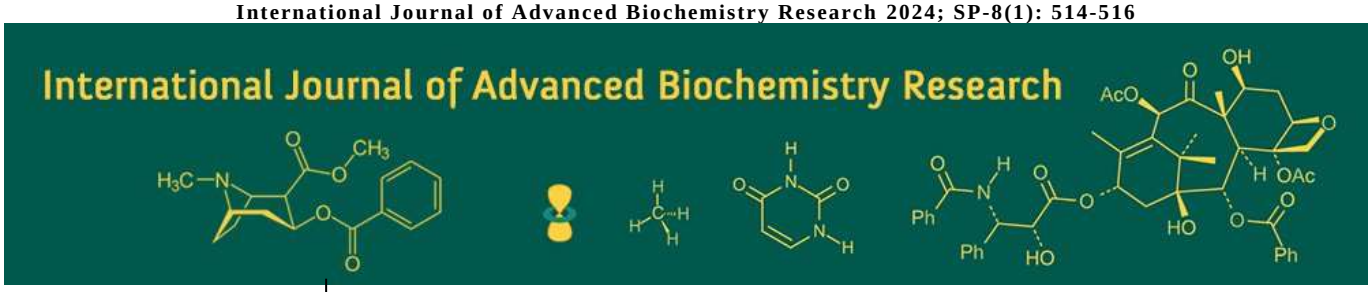

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Garima Choudhary
Department of Animal Genetics and Breeding, College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India

U Pannu
Department of Animal Genetics and Breeding, College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India

GC Gahlot
Department of Animal Genetics and Breeding, College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India

Corresponding Author:
Garima Choudhary
Department of Animal Genetics and Breeding, College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India

Comparative assessment of sire evaluation by incorporating auxiliary traits for estimation of breeding values of first lactation traits in Tharparkar cattle

Garima Choudhary, U Pannu and GC Gahlot

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Abstract
This research was aimed to estimate the breeding values of the sires using First lactation data of 91 Tharparkar dairy cows from 10 sires by using auxiliary traits along with the milk yield of daughter's. The average breeding value of sires was 1615.51, 1527.47, 1610.65, 1527.50 and 1580.47 when AFC, FSP, FCI, FDP and FLL respectively used as auxiliary trait along with the milk yield. The error variance was highest when AFC was used as auxiliary trait and error variance was lowest when FDP was used as auxiliary trait along with first lactation milk yield. Higher rank correlation (0.98 to 1) among all the traits when used as auxiliary trait indicated that there was higher degree of similarity of ranking of the sires by using all the traits as auxiliary trait along with milk yield for sire evaluation.

Keywords: Auxiliary traits, breeding value, sire evaluation, Tharparkar

Introduction
Domestic cattle are particularly adapted to the climate and environment of their breeding areas. They are heat tolerant, disease resistant and can thrive in extreme weather conditions. However, the indigenous breeds are facing competition from other breeds and are less preferred to be reared sue to various changes in the management conditions (Chand, 2011) [1]. The Thapakar cow has adapted to harsh climates such as extreme weather conditions, storms, famine and dry vegetation. In arid and semi-arid regions, This milch breed of Indian cattle derived its name from the Thar desert (Lall, 1994 and Singh, 2006) [3, 6]. Tharparkar cattle play an important role in milk production and are reared in arid regions in northwestern India. Sire selection should be made according to the breeding value of the bull. Identifying the best breeding animals is the first step towards successful selection programme. Better and effective breed improvement programme always need an accurate sire evaluation. The majority of genetic improvement comes through sires because of favorable differential and higher selection intensity. Therefore, the success of any breeding strategy depends on the identification of genetically superior sires and their maximum utilization (Tewari, 2007) [7].
The breeding value of the sires for milk yield depends on the phenotypic value of its progeny's milk yield as well as other correlated traits (Narain, 1985) [4]. Considering this principle, the sire indexing for milk production should also use auxiliary traits such as age at first calving, first calving interval, and first lactation length with milk yield of daughters. It is inferred that use of auxiliary traits reduces the number of progeny required to attain a pre-assigned level of accuracy in comparison with sire evaluation based on milk yield only.

Materials and Methods
In this study, the primary lactation reproduction traits data of ninety one Tharparkar dairy cattle, daughters of ten bulls distributed over 11 years i.e. 2006 to 2016 maintained at Livestock research station, Beechwal, Bikaner, Rajasthan are used to observe the breeding values of sires.
Narain (1985) [4] method of sire index for milk production corrected for auxiliary trait was used.

The relationship between the breeding value of sire and the average phenotypic value of progeny for (K+l) characters (milk yield and K auxiliary traits) can be expressed as:

$$E[G_{(y)}] = b_o\bar{D}_{(y)} + \Sigma b_i\bar{D}_{(xi)}$$

Where,
$E[G_{(y)}]$ is the expected breeding value of a sire for lactation milk yield;
$\bar{D}_{(y)}$ is the sire's daughter average lactation milk yield;
$\bar{D}_{(X)}$ is sire's daughter average for i^{th} auxiliary trait;
b_o and b_i (i=1,...k) are constants and are estimated by maximising the multiple correlation coefficient between the breeding value of sire and its expectation on the basis of daughters milk yield and auxiliary traits.

Relative Efficiency of Sire Evaluation Methods
The following method was used for judging the effectiveness of various sire evaluation methods:
Relative efficiency as percent error variances of a method relative to the variance of most efficient method having least error variance.

$$\text{Relative efficiency (\%)} = \frac{\text{Error variance of most efficient method}}{\text{Error variance of other method}} \times 100$$

Coefficient of determination: The coefficients of determination (R^2 - Value) of different methods was estimated for judging the accuracy of sire evaluation method. The model, which show the highest R^2–value, was most accurate.

Association among different methods of sire evaluation:
Spearman's rank correlation was also used as criteria to judge the relative efficiency of different methods.
Spearman's rank correlation:

$$r_s = 1 - 6\Sigma di^2/ [n(n^2- 1)]$$

Where, r_s= Spearman's rank correlation
n = Number of sires under observation
d_i= Difference between the ranking of a sire by the two methods.

Results and Discussion

Table 1: Estimates of breeding values of sires and their ranks for FLMY considering one auxiliary trait

Sire No.	D	Method of sire evaluation using auxiliary trait									
		AFC		FSP		FCI		FDP		FLL	
		Breeding value estimates	Rank	Breeding value estimates	Rank	Breeding value estimates	Rank	Breeding value estimates	Rank	Breeding value estimates	Rank
1997	5	1566.1	5	1483.47	5	1574.44	5	1586.60	5	1529.97	5
2081	5	1067.84	8	994.12	8	1061.25	8	1091.44	8	1041.43	8
2087	8	1943.50	3	1843.28	3	1933.58	3	1912.92	3	1881.51	3
2164	3	914.59	10	863.22	9	941.25	9	945.91	9	908.98	10
2249	5	1538.11	6	1464.32	6	1508.28	6	1555.44	6	1502.52	6
2355	13	2391.94	2	2252.78	2	2369.60	2	2196.95	1	2315.51	2
2385	27	2895.91	1	2760.12	1	2842.98	1	2170.32	2	2863.75	1
Tb-01	18	1847.12	4	1735.32	4	1838.60	4	1779.64	4	1790.54	4
Tb-02	4	1073.64	7	1017.29	7	1099.65	7	1095.20	7	1058.96	7
Tb-03	3	916.37	9	860.80	10	936.86	10	940.60	10	911.49	9

Table 2: Average and range of sire's breeding values for FLMY considering one auxiliary trait

Auxiliary traits	Average breeding value	No. of sires above average	No. of sires below average	Maximum breeding value	Minimum breeding value	Range of breeding value	Range of % of average breeding value
AFC	1615.51	4	6	2895.91 (79.26)	914.99 (43.36)	1980.92	122.62%
FSP	1527.47	4	6	2760.12 (80.70)	860.80 (43.65)	1899.32	124.34%
FCI	1610.65	4	6	2842.98 (76.51)	936.86 (41.83)	1906.12	118.34%
FDP	1527.50	6	4	2196.95 (43.83)	940.60 (38.42)	1256.35	82.25%
FLL	1580.47	4	6	2863.78 (81.20)	908.98 (42.49)	1954.8	123.68%

Figures in the parenthesis represent the percent higher/ lower than the average breeding value.

Table 3: Error variances, relative efficiency and coefficient of determination (%) of sire evaluation methods for First Lactation Traits using auxiliary traits (AFC, FSP, FCI, FDP, FLL) along with first lactation milk yield

Auxiliary Traits	Error variances	relative efficiency	Coefficient of determination (%)
AFC	442839.24	2.02	8.90
FSP	402754.82	2.22	9.44
FCI	414193.83	2.16	8.99
FDP	237498.90	3.77	10.74
FLL	421271.71	2.13	8.89

Table 4: Rank correlations among sire breeding value for FLMY using auxiliary traits (AFC, FSP, FCI, FDP, FLL)

Auxiliary traits	FSP	FCI	FLL	FDP
AFC	0.99	0.99	1	0.98
FSP		1	0.99	0.99
FCI			0.99	0.99
FLL				0.98

When auxiliary traits were used along with the milk yield of daughter, the variance, in all the cases, was higher than best linear unbiased prediction, least-squares, contemporary

comparison and daughter's average methods of sire evaluation for first lactation yield alone. Among the sire indexes incorporating auxiliary traits, the lowest error variance was found when first dry period was considered as auxiliary trait and the highest error variance was observed when age at first calving was considered as auxiliary trait along with first lactation yield. The present results are in conformity to those reported by Sahana and Gurnani (1999) [5] and Dahiya (2002) [2] except that magnitude of error was considerlably higher. However, Sahana and Gurnani (1999) [5] reported the lowest error variance with first service period and highest error variance with first dry period as auxiliary trait along with milk yield and Dahiya (2002) [2] reported lowest error variance when age at first calving was used as auxiliary trait and highest error variance when first lactation length was used as auxiliary trait along with milk yield.

The high rank correlations (0.98 to 1) of auxiliary trait method of sire evaluation is clearly indicated that there is no considerable difference of ranking of sires by incorporating different auxiliary traits.

Conclusion

From present study it can be concluded that there is a high rank correlations of auxiliary trait method of sire evaluation and there is no considerable difference of ranking of sires by incorporating different auxiliary traits.

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