Environment & Ecology 35 (3B) : 2110—2113, July—September 2017
Website: environmentandecology.com ISSN 0970-0420

Sire Evaluation Based on First Lactation Production Efficiency Traits in Crossbred Cattle

Simran Singh, Dibyendu Chakraborty, A. K. Das, R. K. Taggar

Received 5 October 2016 ; Accepted 7 November 2016 ; Published online 26 November 2016

Abstract The present investigation was undertaken on data of crossbred cattle from Military farm, Jammu Cantonment Military Dairy Farm (MDF) of Jammu. First lactation records of 119 crossbred cattle distributed over 9 years (1998 to 2006) were analyzed. The sire effects and ranks of 22 sires were estimated on the basis of their daughters performance. The progeny group size of the sires ranged from 3 to 17. The sires were evaluated for the first lactation production efficiency traits, viz. first lactation milk yield (FLMY), average milk yield per day of lactation (MY/FLL), milk yield per day of first calving interval (MCI) and milk yield per day of age at second calving (MSC). Sire's breeding values were estimated by best linear unbiased procedure (BLUP). The estimated breeding values (EBV) for FLMY, MY/FLL, MCI and MSC ranged from 2500.45 to 3653.16 kg, 8.88 to 12.65 kg, 5.94 to 9.45 kg and 2.04 to 2.80 kg, respectively. The product moment correlations among various traits were high and highly significant. The highest product-moment and rank correlations were obtained between MCI and MSC to the tune of 0.89. The results indicated that sire coding 04 and 08 were the best and can be used for future breeding purpose.

Keywords Estimated breeding values, Persistency, First lactation length, Murrah buffaloes.

Introduction

Increasing productive potential of dairy cattle is the most important thing for the animal breeder. The genetic gain associated with the production performance mainly comes through sires because of its favorable reproductive differential and higher selection intensity. Therefore, success of any breeding strategy depends on the identification of genetically superior sires and their maximum utilization. For any successful breeding strategy identification of genetically superior sires is the most important thing. The accurate, efficient and early evaluation of breeding value of sires is of prime importance. In recent past the best linear unbiased prediction (BLUP) procedure has been widely used as standard method of sire evaluation.

Selection of sires on the basis of first lactation

S. Singh
PhD Scholar, Div. AGB, FVSc and AH, SKUAST-J, R. S. Pura, Jammu 181102, India
e-mail: simranvet@gamil.com

D. Chakraborty*
Assistant Professor, Div. AGB, FVSc and AH, SKUAST-J, R. S. Pura, Jammu 181102, India
e-mail: dibyendu_vet40@yahoo.co.in

R. K. Taggar
Professor, Division of Animal Genetics and Breeding, FVSC and AH, SKUAST–J, R. S. Pura, Jammu 181102, India
e-mail: ramantaggor@gmail.com

A. K. Das
Principal Scientist, ICAR–CIRC, Grass Farm Road, Meerut, UP, India
e-mail: achintya137@yahoo.com
*Correspondence

traits increase the genetic gain as it reduces the generation interval. Milk yield per day of lactation length, milk yield per day of calving interval and milk yield per day of age at second calving may be thought of as combinations of production and reproduction and can be used as selection tool. The productive efficiency performance of dairy animal is determined by milk yields and duration of lactation. For this, the present investigation was carried out for finding the superior sires for future use based on the first lactation performance traits.

Materials and Methods

The present study was conducted on data pertaining to 119 Frieswal cattle maintained at Military Dairy Farm (MDF) of Jammu (India) over a period of 9 years from 1998 to 2006. The sire effects and ranks of 22 sires were estimated on the basis of their daughters' performance. The progeny group size ranged from 3 to 17.

The production efficiency traits recorded were: first lactation milk yield (FLMY), average yield per day of lactation (MY/FLL) = first lactation milk yield (FLMY) / first lactation length (FLL), lactation milk yield per day of first calving interval (MCI) = first lactation milk yield (FLY) / first calving interval (FCI) and lactation milk yield per day of age at second calving (MSC) = first lactation milk yield (FLY) / age at second calving [ASC = age at first caving (AFC) + first calving (FCI)]. Bulls with at least three progenies were considered for the present study. Lactations shorter than 150 days were excluded from the present study. Abnormal records like abortion, mastitis, chronic illness, physical injuries were also excluded from the present study.

Best Linear Unbiased Prediction (BLUP) was used for the estimation of breeding value of sires for different first lactation production efficiency traits by statistical software LSMLMW.

In matrix notation, the model of BLUP was as follows:

$$Y = Xb + Zu + e$$

Where, Y=vector of observations on progeny of sire in u, X = known design matrices that relate records (Y) to fixed effects, b = vector of fixed effect, Z = known design matrices that relate records (Y) to random sires, u=vector of random sire effects and e = vector of residual effects.

$$\text{Var}(u) = I\,\sigma^2 s$$
$$\text{Var}(e) = I\,\sigma^2 e$$
$$\text{Var}(Y) = Z'Z + R$$

The solution to b and u were obtained from mixed model equations given below:

$$\begin{pmatrix} X'X & X'Z \\ Z'X & Z'Z + k \end{pmatrix} \begin{pmatrix} b \\ u \end{pmatrix} = \begin{pmatrix} X'Y \\ Z'Y \end{pmatrix}$$

Where, k = ratio of residual to sire variance components.

The ratio of residual and sire variance (k) components required for BLUP was obtained from the estimate of heritability from the same data as given below.

$$k = (4 - h^2) / h^2$$

Where, h^2 = heritability of the trait.

Product moment correlation

Product moment correlation between two traits was calculated as follows:

$$r_{XY} = \sigma^2 x / (\sigma^2_X \; \sigma^2_Y)$$

Where, rxy = correlation coefficient (product moment) between X and Y traits, σ^2_{XY} = covariance between X and Y traits, $\sigma^2 x$ = variance of X traits and σ^2_Y = variance of Y traits.

Spearman's rank correlation

Sires were ranked on the basis of their estimated breeding values for various traits. Spearman's rank correlations between ranks of estimated breeding values for various traits were calculated by the formula given

Table 1. Breeding value of sires for different traits. Ranks of sires are in parentheses.

Sire code No.	No. obs.	FLMY	MY/FLL	MCI	MSC
1	5	3150.92 (04)	10.82 (08)	7.71 (05)	2.50 (06)
2	3	2930.51 (13)	10.08 (14)	6.61 (15)	2.24 (16)
3	4	3111.74 (05)	10.95 (06)	7.63 (07)	2.58 (03)
4	3	3653.16 (01)	12.65 (01)	9.11 (02)	2.50 (04)
5	4	2500.45 (22)	8.88 (22)	6.36 (19)	2.04 (22)
6	6	2800.59 (16)	10.45 (12)	7.14 (10)	2.27 (13)
7	4	2835.17 (15)	10.32 (13)	6.91 (12)	2.34 (08)
8	5	3610.40 (02)	12.18 (03)	9.45 (01)	2.80 (01)
9	5	2933.97 (12)	10.08 (15)	6.52 (17)	2.13 (18)
10	8	2892.83 (14)	9.46 (19)	6.42 (18)	2.27 (14)
11	6	2938.01 (11)	10.83 (07)	7.27 (09)	2.30 (12)
12	3	2936.16 (10)	9.23 (21)	6.84 (14)	2.31 (11)
13	6	2954.61 (09)	10.54 (11)	6.86 (13)	2.33 (10)
14	3	2532.13 (21)	9.89 (17)	6.32 (20)	2.18 (17)
15	4	2909.79 (08)	9.91 (16)	5.94 (22)	2.13 (20)
16	3	3273.54 (03)	12.44 (02)	8.60 (03)	2.58 (02)
17	9	3045.12 (06)	10.61 (10)	7.69 (06)	2.45 (07)
18	8	2692.20 (18)	11.20 (04)	7.49 (08)	2.25 (15)
19	17	2651.20 (19)	9.55 (18)	6.21 (21)	2.13 (19)
20	4	2615.20 (20)	11.10 (05)	6.93 (11)	2.33 (09)
21	5	2735.92 (17)	9.43 (20)	6.58 (16)	2.11 (21)
22	4	3004.90 (07)	10.71 (09)	7.99 (04)	2.50 (05)

below:

$$r_s = 1 - [6 \Sigma d^2 / N (N^2 - 1)]$$

Where, r_s = rank correlation between ranks of sires breeding values for two traits, Σd^2 = summation of square difference between ranks of the same sire for different traits and N = number of sires.

The standard errors of product moment and rank correlations were computed using the standard formula.

Results and Discussion

The breeding value of sires for FLMY, MY/FLL, MCI and MSC estimated by Best Linear Unbiased Prediction (BLUP) procedure were presented in Table 1. The estimated breeding values (EBV) for FLMY, MY/FLL, MCI and MSC ranged 2500.45 to 3653.16 kg ; 8.88 to 12.65 kg, 5.94 to 9.45 kg and 2.04 to 2.80 kg, respectively. A wide range of variation in FLMY was observed.

Lower estimated breeding values for MCI was reported in Sahiwal cattle [1]. Whereas, the range of breeding value of first lactation milk yield from -338.87 to 367.33 kg was reported in Sahiwal and Jersey-Sahiwal cattle [2]. On the contrary, lower breeding values for MCI and MSC traits were reported for Murrah sites [3]. Breeding value for FLMY by least squares method was reported as—1181 to 1594 kg for first lactation milk yield in Sahiwal and crossbred cattle [4]. Lower ranges for FLMY (553.86), MY/FLL (1.87) and MY/FCI (2.14) were reported in Holstein Friesian crossbred cattle [5]. The range of breeding value from 2944.47 to 3332.41 kg was reported in Sahiwal and crossbred cattle [6]. A wide range of breeding value

Table 2. Product-moment correlation (above diagonal) and rank correlation (below diagonal) for various traits. Figures above diagonal are estimates of product moment correlations, Figures below diagonal are estimates of rank correlations, $^{**}p < 0.01$.

	FLMY	MY/FLL	MCI	MSC
FLMY	–	0.75**	0.84**	0.81**
MY/FLL	0.61**	–	0.88**	0.79**
MCI	0.75**	0.86**	–	0.89*
MSC	0.80**	0.80**	0.89**	–

Table 3. Ranking of top five sires for different production efficiency traits. Codes of sires are in parentheses.

Rank	FLMY	MY/ FLL	MCI	MSC
1	3610.40 (04)	12.65 (04)	9.45 (08)	2.80 (08)
2	3273.54 (08)	12.44 (16)	9.11 (04)	2.58 (16)
3	3111.74 (16)	12.18 (08)	8.60 (16)	2.58 (03)
4	3653.16 (01)	11.20 (18)	7.99 (22)	2.50 (04)
5	3004.90 (03)	11.10 (20)	7.71 (01)	2.50 (22)

for FLMY (1153.95 kg to 2560.29 kg) in Sahiwal cattle was also reported Singh and Singh [7].

Product moment correlations

The product moment correlations among sires estimated breeding values for the first lactation production efficiency traits are presented in Table 2. The product moment correlations among various traits were high and significant. The highest product moment correlation was obtained between MCI and MSC (Table 2). On the other hand, the lowest product moment correlation was obtained between FLMY and MY/FLL (Table 2). High product moment correlations among all the production efficiency traits in except for MSC with it all the traits had negative and non-significant product-moment correlations in Murrah buffaloes [3].

Rank correlations

Sires were ranked on the basis of their breeding values estimated by BLUP procedure. The value of rank correlations among these traits ranged from 0.61 to 0.89. The highest rank correlation was obtained between MCI and MSC, whereas, the lowest rank correlation was obtained between FLMY and MY/FLL (Table 2). The rank correlations for all the traits under present study were positive and highly significant ($p < 0.01$). FLMY had highly significant rank correlations with other traits that indicate that the sire that was good for FLMY was also good for other traits.

The site evaluation is generally aimed to select first few top ranking sires. The results presented in Table 3 indicated that sire coding 04 and 08 were on top five for every trait under study. Sire code 04 was on first position for FLMY, MY/FLL, on second position for MCI and on fourth position MSC. Sire code 08 was on first position for MCI and MSC, on second position for FLMY and on third position MY/FLL. So, 04 and 08 coded sires were the best and can be used for future breeding purpose.

Selection of sires on the basis of any first lactation production efficiency traits under study would be a better choice as all the traits had the high product moment as well as rank correlations with all the traits included in the study. The high and significant product moment and rank correlations suggest that MCI can also be taken as a criterion for selecting crossbred bulls for future breeding program as it includes both production and reproduction traits.

References

1. Dhaka SS, Chaudhary SR, Raheja KL, Yadav AS, Pander BL (2004) Accuracy of different methods of sire evaluation for production efficiency trait in Sahiwal cattle. Ind J Anim Sci 74 : 296—298.
2. Shahi BN, Kumar D (2006) Sire evaluation using first lactation traits and univariate animal model in Sahiwal and Jersey-Sahiwal cattle. Ind J Anim Sci 76 : 853—854.
3. Chakraborty D (2008) Genetic studies on production efficiency attributes in Murrah buffalo. MVSc thesis. CCSHAU, Hisar, Haryana.
4. Dubey PP, Singh CV (2014) Sire evaluation considering first lactation yield for improvement of life time production in Sahiwal and crossbred cattle. Adv Anim Vet Sci 2 : 56—62.
5. Dash SK, Gupta AK, Singh A, Chakravarty AK, Madhusoodanan M, Valsalan J, Shivahre PR, Hussain A (2014) Evaluation of efficiency of sire model and animal model in Holstein Friesian crossbred cattle considering first lactation production and fertility traits. Vet World 7 : 933—937.
6. Bajetha G, Singh CV, Barwal RS (2015) Sire evaluation on the basis of first lactation traits using Best Linear Unbiased Prediction (BLUP) method in Sahiwal and Crossbred cattle. Livestock Res Int 3 : 85—88.
7. Singh J, Singh CV (2016)) Evaluation of Sires using different sire evaluation methods on the basis of first lactation traits in Sahiwal cattle. J Vet Sci Technol 7 : 296. doi:10.4172/2157—7579.1000296.