



Comparison among different conventional methods of sire evaluation in Murrah buffalo

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India is regarded as a treasure house of world's best buffalo germplasm (Gupta *et al.* 2011). Buffalo is not only a better source of milk but also provides meat and works as a draught animal in India. Indian buffalo contributes 17% of world milk production and 48% of Asian milk production (Food and Agriculture Organization 2012). Among the various buffalo breeds available in India, Murrah buffalo is the best for milk production with comparatively higher fat percentage and sustain under hot and humid climatic conditions. Keeping the importance of buffalo in India, Network Project on Buffalo Improvement was initiated with the objective to envisage and undertake progeny testing for improvement of buffalo breeds at various centres in different parts of the country.

Sire evaluation is one of the most important aspects of dairy breed improvement programme as the contribution of sire path is higher than the dam path for overall genetic improvement of a trait (Banik and Gandhi 2006, Raja and Gandhi 2012). Very intense selection can be practised in males, as few males are required for breeding purpose.

Hence, one of the main criteria for enhancing the genetic

potential of progenies in a herd is to use proven sires to transmit superior genetic potential for higher milk production (Banik and Gandhi 2010). There are several methods of sire evaluation, viz. contemporary comparison (CC), least-squares (LS) and simple regressed least-squares (SRLS) and best linear unbiased prediction (BLUP). Network Project on Buffalo Improvement is using contemporary comparison method for sire evaluation under progeny testing programme. The present study was undertaken to compare among different conventional methods of sire evaluation by studying their efficiency to discriminate amongst Murrah sires.

Information was collected from 7 sets of progeny testing under Network Project on Murrah buffalo Improvement. In 7 sets of progeny testing 95 (11, 12, 15, 14, 15, 16, and 12) Murrah bulls were evaluated. First lactation 305 days milk yield (FL305DMY) records of Murrah buffaloes during 1993 to 2010, were collected from the history-cum pedigree sheets and milk yield registers maintained at the ICAR-National Dairy Research Institute, Karnal (NDRI); ICAR-Central Institute for Research on Buffalo, Hisar

Table 1. Weighted average breeding value estimates and mean square error for first lactation 305-days or less milk yield by different methods of sire evaluation

Trait	Sire evaluation method	Weighted average breeding Value	Minimum breeding value	Maximum breeding value	Number of sires over average breeding value	Number of sires below average evaluation (% of sires)	Mean Square error of sire (% of sires) method
FL305DMY	CC	1840.53 kg	1582.08 kg	2058.11 kg	47 (49.47%)	48 (50.53%)	682994.51 kg ²
	LS	1841.76 kg	1112.59 kg	2238.69 kg	49 (51.59%)	46 (48.42%)	4354584.36 kg ²
	SRLS	1836.99 kg	1469.09 kg	2061.76 kg	46 (48.42%)	49 (51.59%)	1252390.66 kg ²
	BLUP	1847.25 kg	1630.40 kg	2022.61 kg	48 (50.53%)	47 (49.47%)	648429.95 kg ²

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(CIRB); Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana (GADVASU) and Choudhary Charan Singh Haryana Agricultural University, Hisar (CCSHAU). The records of the buffaloes with normal lactation were considered for this study. Data of buffaloes with a minimum of 500 kg of milk production in at least 100 days of lactation, calving and drying under normal physiological conditions were included in the analysis. To ensure the normal

distribution of records, the outliers were removed and data within the range of Mean $\pm$ 3 standard deviation was only considered for the study. Hence after standardization and normalization, records of 832 Murrah buffaloes were retained for analysis.

The data were adjusted for significant non-genetic factors for buffaloes calved in different farms, years and seasons of calving using fixed linear models. Since the data was

non-orthogonal, the least-squares technique suggested by Harvey (1990) was used to estimate the effect of non-genetic factors, and the means were compared using Duncan's multiple range test (Kramer 1957). The model considered was as follows:

$Y_{ijkl} = \mu + P_i + S_j + F_k + e_{ijkl}$; where, Y_{ijkl} is the l^{th} observation in K^{th} farm, j^{th} season and i^{th} year of calving; μ the overall mean; P_i the fixed effect of i^{th} year of calving; S_j the fixed effect of j^{th} season of calving; F_k the fixed effect of the k^{th} farm; and e_{ijkl} , the random error~NID (0, σ^2e).

In 7 sets of progeny testing 95 (11, 12, 15, 14, 15, 16 and 12) Murrah bulls were evaluated by four sire evaluation methods using 832 (106, 112, 106, 120, 139, 131 and 118) daughters' records. Four methods of sire evaluation viz. contemporary comparison (CC) method (Sundaresan et al. 1965), least-squares (LS) method (Harvey 1979), simple regressed least-squares (SRLS) method (Harvey 1979) and best linear unbiased prediction (BLUP) method (Henderson 1975) were used. The efficiency of sire evaluation was evaluated on the basis of (a) rank correlation method (Steel and Torrie 1960) and (b) mean square error.

The data were adjusted for significant non-genetic factors. In the present study FL305DMY was significantly affected by farm. The overall least-squares mean for FL305DMY was estimated as 1846.86 ± 35.94 kg. However, lower than that reported by Patil (2011) and Geetha (2005) and higher was reported by Katneni (2007) and Sundaram and Harharan (2013).

In the present study, the EBVs of sires were estimated by 4 different methods and they were ranked subsequently (Table 2). The estimated weighted average EBV of sires by CC method for FL305DMY was 1840.53 kg. There were 47 (49.47%) sires whose breeding values were above the average and 48 (50.53%) sires with below the average values. The estimated weighted average EBV of sires by LS method for first lactation milk yield was 1841.76 kg. 49 (51.59%) sires had EBVs above the average, while 46 (48.42%) were having values below the average breeding value. The weighted average EBV for first lactation milk yield using SRLS was 1836.99 kg. 46 (48.42%) had EBVs above the average, while 49 (51.59%) were having values below the average breeding value. The weighted average EBV for first lactation milk yield using BLUP was 1847.25 kg. 48 (50.53%) had EBVs above the average, while 47 (49.47%) were below the average breeding value (Table 1). In the present study, the EBVs of sire for first lactation milk yield by BLUP showed less mean square error than CC, LS and SRLS methods (Table 1) and therefore BLUP was considered as the most efficient method out of all 4

Table 2. Rank of sires based on estimated breeding values for first lactation 305-days or less milk yield by 4 different sire evaluation (CC, LS, SRLS and BLUP) methods

Set 1				Set 2				Set 3				Set 4				Set 5				Set 6				Set 7										
Rank	A	B	C	D	Rank	A	B	C	D	Rank	A	B	C	D	Rank	A	B	C	D	Rank	A	B	C	D	Rank	A	B	C	D					
392	4	2	3	4	93	8	8	8	8	993	10	9	10	8	1319	3	5	4	5	1485	13	13	13	13	1135	9	11	12	13	1419	8	8	7	7
896	3	3	2	2	759	3	5	4	4	1023	5	4	2	1	1341	10	10	10	12	1491	6	6	8	6	1153	1	3	1	1	1727	10	10	10	10
3098	1	1	1	1	761	4	4	3	3	1061	2	5	3	5	1360	4	8	8	8	1524	15	15	14	15	1667	12	9	9	11	1746	12	9	9	9
3108	2	4	4	3	829	1	1	1	1	1084	14	12	13	12	1363	12	12	12	11	1536	11	11	12	12	1706	11	16	15	16	1749	3	5	5	3
3117	6	6	6	6	1241	5	2	6	6	1131	3	3	5	3	1434	11	11	11	10	1555	8	8	10	10	1713	14	14	14	10	1796	1	1	1	1
3125	11	9	11	11	1253	6	6	5	5	1153	1	1	1	2	1437	5	6	7	6	1573	12	12	11	11	1717	5	5	6	6	2121	9	11	11	11
3127	10	10	10	10	1290	11	10	10	10	1165	9	10	9	9	1446	13	14	14	14	1641	5	5	5	5	1836	4	7	7	7	2133	11	12	12	12
3206	5	5	5	5	3551	2	3	2	2	1171	11	14	12	13	1451	8	4	5	2	1666	9	9	6	7	1922	8	8	8	8	2184	4	4	3	5
3294	7	7	7	7	3638	7	7	7	7	1315	7	6	6	6	1506	2	2	2	3	1749	14	14	15	14	1933	2	4	4	4	2331	5	2	4	4
3462	9	11	9	9	3689	10	11	11	11	1354	4	2	4	4	1538	14	13	13	13	1798	7	7	7	8	1944	10	12	11	14	2363	6	6	6	6
3567	8	8	8	8	3736	12	12	12	12	3865	15	15	14	14	4071	6	3	3	4	4244	3	3	3	4	2028	15	10	10	9	4807	7	7	8	8
3750	9	9	9	9	3924	12	11	11	11	4090	9	9	9	9	4245	10	10	9	9	4506	6	2	3	3	4915	2	3	2	2	3930	8	8	8	10
4124	1	1	1	1	4371	2	2	2	2	4523	7	6	5	5	3949	13	13	15	15	4188	7	7	6	9	4393	1	1	1	1	4619	3	1	2	2
3966	6	7	7	7	4395	4	4	4	4	4637	13	13	13	15	4640	16	15	16	12															

Note: Within Rank column, A, B, C and D showing ranks by CC, LS, SRLS and BLUP method respectively.

Table 3. Spearman's rank correlations for first lactation 305-days or less milk yield among different sire evaluation methods

Method 1	Method 2	Set 1	Set 2	Set 3	Set 4	Set 5	Set 6	Set 7
CC	LS	0.927**	0.944**	0.943**	0.895**	1.000**	0.844**	0.902**
CC	SRLS	0.973**	0.979**	0.957**	0.908**	0.961**	0.871**	0.923**
CC	BLUP	0.991**	0.979**	0.911**	0.829**	0.975**	0.768**	0.937**
LS	SRLS	0.955**	0.930**	0.950**	0.991**	0.961**	0.982**	0.972**
LS	BLUP	0.936**	0.930**	0.954**	0.956**	0.975**	0.926**	0.958**
SRLS	BLUP	0.991**	1.000**	0.965**	0.930**	0.982**	0.923**	0.978**

** Significant at (P< 0.01).

methods of sire evaluation. Singh and Singh (2011), Bajetha (2006), Dubey *et al.* (2006) and Banik and Gandhi (2007) also reported BLUP as best sire evaluation method when compared with other methods of sire evaluation. In general EBVs for sires did not show any systematic trend of FL305DMY. The estimated breeding values of sires for first lactation yield showed large variation between estimated breeding values of sires which revealed more genetic variation in the herd. Large genetic variation was also observed between the estimated breeding values of sires by Banik and Gandhi (2006) and Mukherjee *et al.* (2007) in Sahiwal cattle. This might be due to fact that these herds had number of genetic groups and animals with low production might not have been culled from the herd.

The Spearman's rank correlation was measured using the ranks of 95 Murrah sires based on their breeding values estimated by four different sire evaluation methods for FL305DMY and the results are presented in Table 3. The rank correlations of breeding value of sires were very high ranging from 0.768 to 1.000 and were statistically highly significant ($p < 0.01$). High rank correlations between CC, LS, SRLS and BLUP methods suggesting that these methods were more or less similar for ranking of dairy sires and could be used to estimate the breeding values for FL305DMY. The high rank correlations obtained in the present study revealed that ranking of sires on the basis of breeding values estimated by any of the above methods could result in similar ranking to the extent of 77 to 100%. Sires ranked on the basis of FL305DMY revealed that all sires would not rank same for all the methods. However, the rank of sires for different sire evaluation methods revealed that top sires almost had similar rank for all the methods. Similar results were also reported by Dalal *et al.* (1999), Bajetha (2006), Dubey *et al.* (2006), Banik and Gandhi (2007) and Moges *et al.* (2009). The rank correlation coefficients amongst ranks of sires by different methods of sire evaluation showed a reasonably high degree of agreement in the ranking of sires. BLUP method was found to be more efficient, accurate and stable with lowest genetic variation. The estimates of mean square error was also used for comparing the effectiveness of different sire evaluation methods for FL305DMY and are presented in Table 1. The best linear unbiased prediction (BLUP) method had lowest mean square error further suggests superiority of BLUP over other methods.

SUMMARY

The estimated breeding values of sires for first lactation yield showed large variation between estimated breeding values of sires which revealed more genetic variation in the herds. The rank of sires for different sire evaluation methods revealed that top sires almost had similar rank for all the methods. The rank correlation coefficients amongst ranks of sires by different methods of sire evaluation showed a reasonably high degree of agreement in the ranking of sires. After comparison of these methods of sire evaluation, BLUP method was found to be most efficient, accurate and stable with lowest mean square error.

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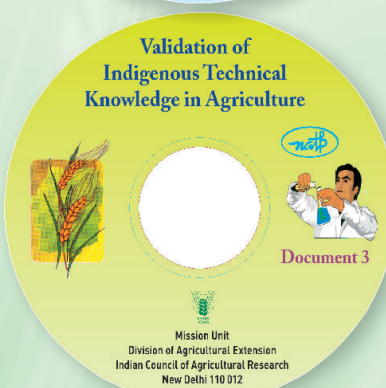
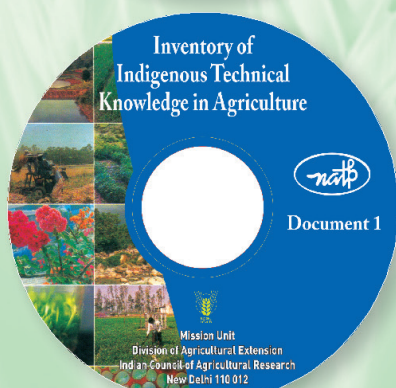
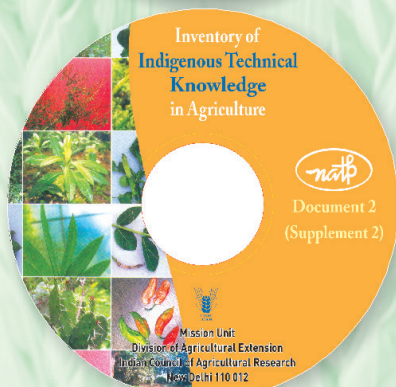
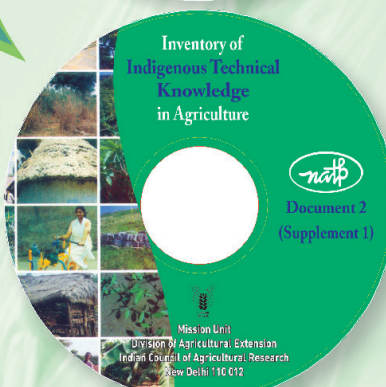
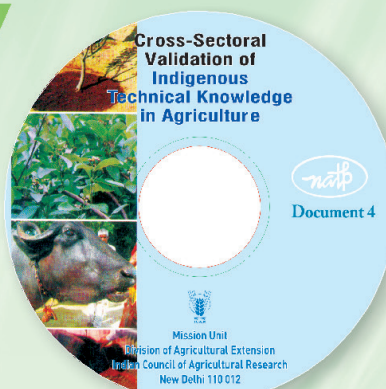
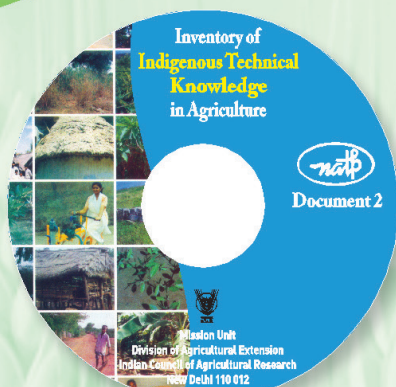
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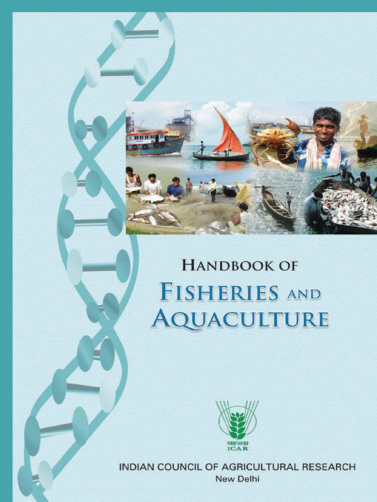
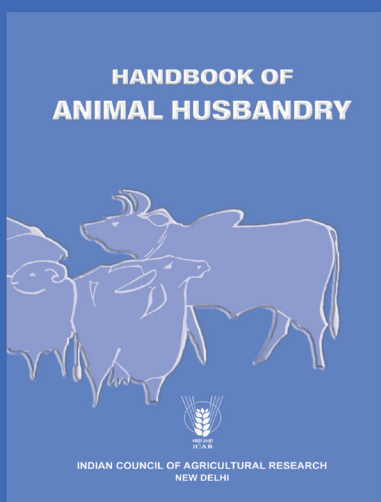
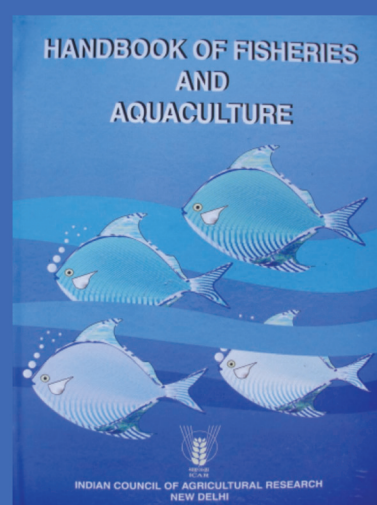
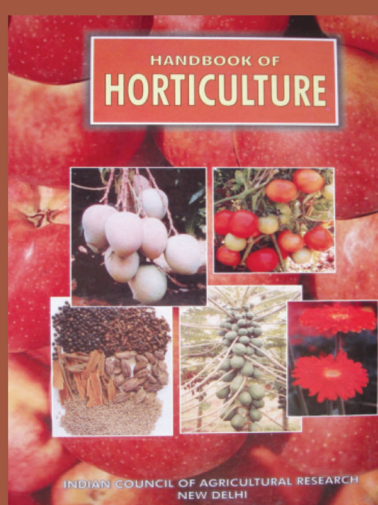
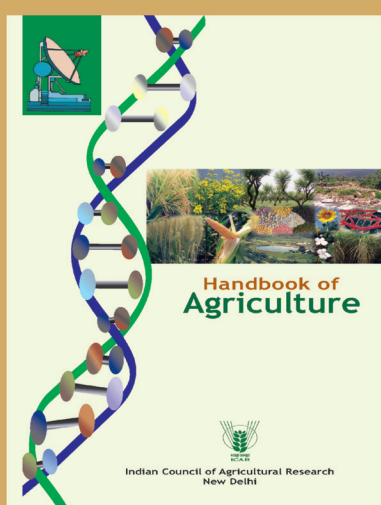


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