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Research Article

GENETIC EVALUATION OF PERFORMANCE ATTRIBUTES IN MURRAH BUFFALOES

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ABSTRACT

The present study was conducted to estimate genetic and non-genetic factors and genetic parameter of performance traits (total lactation milk yield (TLMY), 305 days or less milk yield (305DMY), peak yield (PY), lactation length (LL), dry period (DP), service period (SP) and calving interval (CI)) in Murrah buffaloes. The performance records of 1637 buffaloes, progeny of 180 sires; calved during the year 1993- 2012 and maintained at Animal Farm of Central Institute for Research on Buffaloes, Hisar, were analyzed by using mixed technique of Harvey model. The overall least squares means for TLMY, 305DMY, PY, LL, DP, SP and CI, were 2182.82±20.19 kg., 2060.93±20.22 kg., 10.08±0.96 kg., 311.68±3.35 days., 173.34±5.59 days, 187.10±5.91 days and 479.47±4.88, days respectively. Significant effect of parity was observed on all traits under study. Period of calving had a significant effect on TLMY, 305DMY and PY. Season of calving had a significant effect on LL, DP, SP and CI. The heritability estimates of TLMY, 305DMY, PY, LL, DP, SP, CI were found to be 0.471±0.08, 0.507±0.08, 0.520±0.08, 0.357±0.09, 0.230±0.07, 0.297±0.08 and 0.273±0.07, respectively. The observed genetic correlation between TLMY and 305DMY, TLMY and PY were 0.956±0.016 and 0.931±0.040 respectively. The correlations are observed as highly significant and positive, indicated that selection based on PY simultaneously will improve TLMY and 305DMY in Murrah buffaloes. Present study suggested that peak yield may be the best trait to be taken in to selection criteria for improvement of milk production in Murrah buffaloes.

Key words: Heritability, lactation period, milk yield, Murrah buffalo, peak yield

Murrah is one of the best breed of buffaloes in the world by virtue of its milk producing capacity with high potential for further genetic improvement. This breed is predominantly found in Haryana and adjoining states of Punjab, UP and Delhi. India with its 107 million heads of buffalo as reported in 18th livestock census has the largest buffalo population in world, Owing to its potential, it has short productive period in terms of milk and high unproductive life with longer inter calving period and age at first calving, which may be happened due to several genetic and non–genetic factors like parity, period of calving and season of calving. The situation gets more complicated when environment become harsh and non-supportive for exploitation of animal fullest potential in term of milk production. Evaluations of genetic value of performance traits require knowledge of several genetic parameters so that suitable breeding schemes can be developed for improvement of this species. The present study was planned to determine the influence of parity, period of calving and season of calving on several performance traits of Murrah buffaloes maintained at an organised farm.

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MATERIALS AND METHODS

The data on milk yield and certain reproductive traits obtained from 1637 lactation records from history and pedigree sheets of Murrah buffaloes born to 108 sires at Central Institute for Research on Buffaloes, Hisar for a period of 20 years (1993-2012) were obtained.

The data was recorded from first to fifth lactation on all animals which were milked more than 100 days in the herd. Records on total lactation milk yield (TLMY), 305 days milk yield (305DMY), lactation length (LL), peak yield (PY), dry period (DP), service period (SP) and calving interval (CI) were analyzed to estimate the effect of parity, period and season of calving by using mixed model technique of Harvey (1990). The duration of twenty years were divided into five period, viz. period 1 (1993-1996), period 2 (1997-2000), period 3 (2001-2004), period 4 (2005-2008) and period 5 (2009-2012). The year was divided into four seasons viz., summer (April-June); rainy (July-September); autumn (October-November) and winter (December-March). The statistical model used to explain the biology of the various performance traits in the study was:

$$Y_{ijklm} = \mu + S_i + H_j + P_k + SE_l + b_l (L_{ijklm} - L) + e_{ijklm}$$

Where, Y_{ijklm}=observation on m^{th} progeny of i^{th} sire, j^{th} parity calved in k^{th} period and l^{th} season; μ=overall mean; S_i=random effect of i^{th} sire; H_j=fixed effect of j^{th} parity (j=1, 2…..5); P_k=fixed effect of k^{th} period of calving (k = 1,2…5); SE_l=fixed effect of l^{th} season of calving (k = 1,2…4); b1=linear regression coefficient of a trait on lactation length; L_{ijklm}=lactation length in days pertaining to Y_{ijklm} th observation; L=mean lactation length and e_{ijklm}=random error assumed to be normally and independently distributed with mean zero and variance σ^2 (N~0, σ^2).

The method of paternal half sib correlation was used to estimate the genetic parameters of all the traits (Becker, 1992).

RESULTS AND DISCUSSION

Effect of Non Genetic Factors: The analysis of variance (ANOVA) and least squares means for traits are given in the Tables 1 and 2, respectively. The overall least squares means for TLMY, 305DMY, PY, LL, DP, SP and CI- were 2182.82±20.19 kg., 2060.93±20.22 kg., 10.08±0.96 kg., 311.68±3.35 days., 173.34±5.59 days, 187.10±5.91 days and 479.47±4.88 days respectively, which were in conformity with the findings of Pawar *et al.* (2012). However, Kumar *et al*. (2005) and Thiruvenkadan (2011) reported lower values for TLMY and 305DMY in Murrah buffaloes. The least squares means for TLMY in buffaloes in their second (L_2), third (L_3), fourth (L_4) and fifth (L_5) lactations were similar and was the lowest in first (L_1) lactation. The least squares means for PY in the present study were higher than the reports of Kumar (2000) and Kumar *et al.* (2005) who reported a peak yield of 7.90 and 7.92 kg in Murrah buffaloes. The fifth parity PY was the highest and there was a gradual increase in PY as the parity increased indicating optimum growth of mammary system and physiological changes in the body of the animal. Overall lactation length observed in this study was 311.68±3.35 days that was in agreement with the findings of Barman (2009) and higher than the reports of Dhar and Deshpande (1995) and Gandhi *et al.* (2009) who reported shorter lactation length of 265.57 and 273.54 days, respectively in Murrah buffaloes.

Analysis of variance revealed (Table 1) that the parity had a significant effect on all traits studied whereas-period of calving had a significant effect on TLMY, 305DMY and PY. Period of calving had a non-significant effect on service period, which are in accordance with the findings of Kumar *et al*. (2005) and Gupta *et al.* (2012) in Murrah breed. Season of calving had significant effect on LL, DP, SP and CI. Similar findings were reported by Singh *et al*. (2005) and Wakchaure *et al*. (2008). Season of calving showed non-significant effect on 305 DMY which was in accordance with the findings of Singh *et al.* (2011) in Nili-Ravi breed while contrary reports were reported by Pawar *et al.* (2012) in Murrah buffaloes. The differences in performances over different periods and seasons might be due to differential availability of green fodder, climatic conditions, stress and management practices being followed at the animal farm. The season wise least squares means (Table 2) for all the performance traits indicated that the performance of buffaloes calved during winter season was the best followed by summer season. The effect of lactation length (linear) on performance traits was highly significant indicating its vital role for overall performance of the animal.

Genetic Parameters: The heritability estimates (Table 3) for traits under study were low to high ranging from 0.23±0.07 (DP) to 0.52±0.08 (PY). The heritability estimate for TLMY was 0.47±0.08 which was supported by the earlier reports of Raheja (1992) and Dass and Sadana (2000) in the same breed. The high estimates of heritability in the present study may be due to the fact that the data was large and also introduction of elite female from the field in Central Institute for Research on Buffaloes herd. On the other hand Chander *et al*. (2004), Kangdaswamy *et al.* (1991) and Sharma (1996) reported lower values of heritability for TLMY. The study indicates that PY, 305DMY and TLMY are having high heritabilities and therefore individual selection can facilitate in improving milk production in the herd. The present estimates for

Table 1
Analysis of variance for various productive and reproductive traits

Source of variation	D.F.	Mean Squares							
		TLMY	305 DMY	PY	LL	D.F.	DP	SP	CI
Parity	4	5358824.94**	5052007.93**	246.26**	77554.03**	4	22889.55**	25956.23*	23814.74**
Period of calving	4	2829590.43**	3103881.14**	53.55**	3017.70	4	10107.36	18803.06	2046.77
Season of calving	3	187113.41	163137.23	07.73*	25148.86**	3	56974.67**	72719.35**	102622.48**
Regression on LL	1	154108027.74**	38484409.18**	32.58**	-	1	763993.01**	5644568.90**	6171098.89**
Error	1445	101811.97	96458.87	02.13	3449.27	1227	9967.33	9657.65	6913.43

**p<0.01,*p<0.05

TLMY=Total lactation milk yield; 305 DMY=305 day milk yield; Y=Peak yield, LL=Lactation length; DP=Dry period; SP=Service period; and CI=Calving interval

Table 2
Least square means (±SE) of various productive and reproductive production traits in Murrah buffaloes

Source of variation	D.F. N	Mean Squares							
		TLMY (kg)	305DMY (kg)	PY (kg)	LL (days)	N	DP (days)	SP (days)	CI (days)
Effect Overall mean	1637	2182.82±20.19	2060.93±20.22	10.08±.096	311.68±3.35	1403	173.34±5.59	187.10±5.91	479.47±4.88
Parity									
L1 (parity 1)	657	1927.48 ^{b}±25.42	1810.88^{c}±25.19	8.30^{d}±0.11	342.42^{a}±4.35	527	186.62^{a}±7.70	204.24^{a}±7.88	497.64^{a}±6.58
L2 (parity 2)	417	2192.25^{a}±24.83	2065.06^{b}±247.63	10.04^{c}±0.11	318.94^{b}±4.28	372	187.10^{a}±7.33	197.78^{b}±7.52	489.03^{b}±6.27
L3 (parity 3)	256	2255.49^{a}±27.21	2128.91^{a}±26.90	10.52^{b}±0.12	298.89^{c}±4.71	227	167.06^{b}±8.33	180.27^{c}±8.47	473.04^{c}±7.08
L4 (parity 4)	180	2272.20^{a}±31.36	2156.88^{ab}±30.88	10.78^{a}±0.14	297.61^{c}±5.52	167	158.47^{b}±9.63	171.08^{c}±9.72	466.61^{c}±8.15
L5 (parity 5)	127	2266.66^{a}±36.53	2142.91^{a}±35.87	10.76^{a}±0.16	300.58^{c}±6.51	110	167.69^{b}±11.83	182.13^{c}±11.84	471.05^{c}±9.96
Period of calving									
P1 (1993-1996)	148	2050.11^{c}±58.96	1961.75^{c}±57.59	9.62^{d}±0.27	310.16^{a}±10.73	92	205.53^{a}±21.35	235.36^{a}±21.12	492.026^{a}±17.84
P2 (1997-2000)	356	2145.73^{b}±33.78	2031.09^{b}±33.22	9.99^{b}±0.15	304.47^{b}±5.99	313	167.50^{b}±10.56	181.19^{c}±10.61	476.36^{b}±8.91
P3 (20001-2004)	488	2121.98^{b}±27.96	1984.51^{b}±27.62	9.59^{c}±0.13	310.44^{a}±4.88	440	163.05^{b}±8.46	175.05^{c}±8.60	474.36^{b}±7.19
P4 (2005-2008)	355	2102.56^{b}±34.78	1961.39^{b}±34.18	9.82^{c}±0.16	318.47^{a}±6.19	314	163.66^{b}±10.97	175.05^{b}±11.009	475.77^{a}±9.25
P5 (2009-2012)	290	2493.70^{a}±48.62	2365.99^{a}±47.56	11.38^{a}±0.22	314.89^{a}±8.81	244	166.95^{b}±15.87	168.44^{b}±15.77	478.61^{a}±13.3
Season of calving									
Summer	127	2173.72^{b}±35.05	2063.60^{b}±34.44	9.95^{b}±0.16	311.38^{a}±6.25	103	173.75^{ab}±11.47	191.13^{a}±11.49	471.43^{b}±9.66
Rainy	647	2164.39^{c}±22.63	2047.96^{b}±22.53	10.11^{b}±0.10	304.20^{b}±3.82	559	159.74^{c}±6.53	171.65^{b}±6.78	463.73^{c}±5.63
Autumn	429	2178.35^{bc}±24.21	2043.03^{b}±24.03	9.96^{b}±0.11	308.42^{b}±4.15	370	169.52^{bc}±7.13	180.04^{b}±7.3	478.13^{bc}±6.11
Winter	434	2214.81^{a}±24.36	2089.13^{a}±24.18	10.29^{a}±0.11	322.96^{a}±4.18	371	190.33^{a}±7.29	205.57^{a}±7.49	504.61^{a}±6.24
Regression on LL		5.44±0.14	2.66±0.14	0.0017±.006			0.44±.051	1.22±.050	1.25±.042

Means with different superscript differ significantly.
N=No. of observation; TLMY=Total lactation milk yield; 305DMY=305 days milk yield; PY=Peak yield; DP=Dry period

heritability for various performance traits were in close agreement with the results of Tailor *et al.* (1998), Dass and Sadana (2000) and Kumar (2000) in buffaloes.

The heritability values were 0.297±0.080 and 0.273±0.078 for SP and CI, respectively. These two traits were found to be moderately heritable in the present study which was in conformity with the findings of Chander *et al.* (2004) and Kumar *et al.* (2005). These two traits are mainly influenced by environment and managemental factors and can be improved by providing better management and feeding as well as selection based on progeny testing coupled with collateral relatives.

Genetic and Phenotypic Correlations: Higher genetic correlations were observed between TLMY and 305DMY (0.95±0.01), TLMY and PY (0.93±0.04), TLMY and LL (0.79±0.05) and 305DMY and PY (0.87±0.04). Similar results were also reported by Vij and Tiwana (1986) in the same breed. The study revealed stronger relationship among PY, TLMY and 305 DMY. The PY had high significant and positive genetic correlation with TLMY (0.93±0.04) and 305 DMY (0.874±0.046). Similar association was observed among lactation length and lactation milk yield.

The phenotypic correlation among production traits was mostly positive except between DP and TLMY/

Table 3
Heritabilities (diagonal), genetic (above diagonal) and phenotypic (below diagonal) correlation for production and reproduction traits

	TLMY	305DMY	PY	LL	DP	SP	CI
TLMY	**0.471±0.085**	0.956±0.016	0.931±0.040	0.795±0.059	-0.055±0.19	0.147±0.106	0.072±0.024
305DMY	0.904±0.85**	**0.507±0.087**	0.874±0.046	0.631±0.095	0.060±0.18	0.228±0.110	0.194±0.120
PY	0.669±0.412**	0.674±0.462**	**0.520±0.088**	0.151±0.041	-0.045±0.18	0.217±0.170	0.101±0.176
LL	0.722±0.686**	0.482±0.376**	0.107±0.0270*	**0.357±0.095**	0.137±0.112	0.748±0.08	0.779±0.075
DP	-0.114±-0.151*	-0.118±0.220**	-0.080±-0.105*	0.258±0.172**	**0.230±0.075**	.0706±0.010	0.695±0.107
SP	-0.057±-0.182*	-0.059±-0.250*	-0.023±-0.182*	0.587±0.470**	0.837±0.887**	**0.297±0.080**	0.849±0.061
CI	-0.036±-0.100*	-0.057±-0.214*	-0.052±-0.148*	0.662±0.583**	0.789±0.822**	0.817±0.805**	**0.273±0.078**

*p<0.05, **p<0.01.
TLMY=Total lactation milk yield; 305DMY=305 Days milk yield; PY=Peak yield; LL=Lactation length; DP=Dry period; SP=Service period; CI=Calving interval

305DMY/ PY. The value was high (0.90±0.08) between TLMY and 305DMY. High phenotypic correlations similar to present study were also reported by Gajbhiye and Tripathi (1988) and Singh *et al.* (2011). These values of performance traits with dry period were found to be low and negative in magnitude in the present study. The study revealed that TLMY had positive and significant phenotypic correlation with LL and PY. These results are also supported by Suresh *et al.* (2004) in buffaloes.

The high positive genetic and phenotypic correlations of PY and LL with TLMY and 305 DMY and negative genetic and phenotypic correlation with DP indicated the fact that the selection on the basis of PY and LL would not only reduce the unproductive life in the form of DP but also increases the TLMY in this breed. The high positive genetic and phenotypic correlation of PY with TLMY and other performance traits indicate that there are some common genes which govern the expression of these attributes. Therefore, selection on the basis of earliest possible traits that is first peak yield is highly recommended and it may improve other performance traits through their correlated response.

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