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Research Article

PHENOTYPIC AND GENETIC EVALUATION OF MURRAH BUFFALOES USING PHASE AND STAYABILITY LIFE ATTRIBUTES

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ABSTRACT

The data pertaining of 344 Murrah buffaloes maintained at the Buffalo Research centre of this University over a period of 20 years from 1993 to 2012 were analysed. The overall mean of Ascending phase (APY), Peak phase (PPY) and Descending phase (DPY) were 280.22, 117.41 and 1634.78 kg, respectively. Average stayability life (STAYAB) was found to be 1199.37±57.10 days. Period of calving had significant effect on PPY and STAYAB, whereas season of calving had significant influence on APY and PPY. The effect of age at first calving (linear) was statistically significant for APY and PPY. The estimates of heritability were observed as moderate (0.205±0.025 to 0.358±0.176) for all the traits under study. The phenotypic and genetic correlations among phase traits were high and positive but not with stayability traits. The phenotypic correlations between phase and stayability traits were found to be negative.

Key words: Correlations, heritability, Murrah buffalo, phase traits

The phenotypic expression of an animal in term of production and reproduction is much affected by genetic and environmental fluctuations surrounding the animal (Collier *et al.*, 2006). Moreover, the detailed studies of various phases of a lactation and stayability life of an animal in the herd enable the breeder to draw true potential of the animal and are also essential for further defining the appropriate selection strategies for higher productivity and efficient management. The ability of a buffalo to maintain production (persistency) following peak is a stage of interest for higher milk production. Genetic evaluation procedures that account for genetic differences in different phases of the lactation have been developed in the past based on test-day and part lactation records (Jamrozik *et al.*, 1997). However, persistency is also a trait that is of direct economic interest because of its relationship with reproduction, health and feed costs (Solkner and Fuchs, 1987). Moreover, the phase traits and stayability are good indicators of the overall efficiency in dairy animals. Hence, knowledge of genetic variability for each trait and co-variability existing among different traits are necessary for planning appropriate selection and breeding strategies for genetic improvement. Therefore, the present investigation was planned to study genetic and non-genetic factors affecting phase and stayability traits in Murrah buffaloes.

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MATERIALS AND METHODS

The data were collected on 344 Murrah buffaloes maintained at Buffalo Research Centre, Department of Livestock Production and Management, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar over a period of 20 years from 1993 to 2012. The lactation records of animals with yield less than 500 kg per lactation or with lactation length shorter than 150 days were considered as abnormal and were not included in the study. The phase traits considered were ascending phase i.e. milk yield from first day of lactation upto peak phase (APY), peak phase i.e. milk yield from 45th day to 60th day of lactation (PPY) and descending phase i.e. milk yield from peak phase till dry off. The stayability trait under study was stayability life i.e. total number of days from date of first calving till last day in the herd (STAYAB). The entire period of 20 years was divided into five periods each consisting of four consecutive years. Each year was further delineated into three seasons viz., summer (March to June), monsoon (July to October) and winter (November to February). Abnormal records from the animals having abortion, mastitis, chronic illness, physical injuries etc. were also excluded from the present study. The genetic and non genetic factors affecting the traits were analyzed by mixed model for non-orthogonal data (Harvey, 1990).

$$Y_{ijkl}=\mu + S_i + h_j + C_k + b_1 (X_{ijkl} -X) + b_2 (X_{ijkl}-X)2 + e_{ijkl}$$

Where Y_{ijkl}=is the lth record of individual of the ith

sire calved in j^{th} period and k^{th} season; μ= is the overall population mean; s_i=is the random effect of ith sire; h_j= is the fixed effect of jth period of calving; C_k=is the fixed effect of kth season of calving; b_1 and b_2=are linear and quadratic partial regression coefficients of age at first calving; X_{ijkl}=is the age at first calving; $\bar{X}$=is the mean of age at first calving; e_{ijkl}=is the error associated with each observation and assumed to be normally and independently distributed with mean zero and variance $ó^2$ e.

The least-squares and maximum likelihood computer program (Harvey, 1990) was used to estimate the effect of various tangible factors on different traits. Duncan's multiple range test was used for making possible pair-wise comparison of means. Heritability estimates for different traits were obtained by paternal half-sib correlation method and genetic and phenotypic correlations were calculated from variance-covariance analysis and their standard errors by using the formula given by Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

The analysis of variance (Table 1) revealed that effect of period of calving was significant (P<0.05) for PPY and highly significant (P<0.01) for STAYAB. The effect of season was highly significant for APY and PPY with no effect on DPY and STAYAB. Effect of age of first calving (linear) was highly significant for traits such as APY and PPY. Non-significant effect of age of first calving (quadric) was observed for all the traits under study indicating that the age at first calving may also determine the length of early stages of lactation in Murrah buffaloes.

The least square means of phase traits and stayability traits are presented in Table 2. The overall mean value of APY, PPY, DPY and STAYAB were 280.22±4.36 kg, 117.41±2.09 kg, 1634.78±39.60 kg and 1199.37±57.10 day, respectively. Higher estimates of STAYAB were reported by Dubey and Singh (2005) and Goshu *et al.* (2014) in Sahiwal and HF cows. The period-wise least-squares means for APY (Table 2) indicated that it was the highest in the buffaloes calved during fifth period (2009-2012) and the lowest during the second period (1997-2000). The animals calved during 2009-2012 had significantly higher PPY followed by 1993-1996, 2001-2004, 1997-2000 and 2005-2008 calvers, respectively. STAYAB was also found to be affected by the period of calving, and was the highest during the period 1993-1996. This difference might be due to variations in the climate, nutrition and management practices followed during those years.

The effect of season of calving was statistically significant (p<0.01) on APY. The winter calvers had significantly lower milk yield than monsoon and summer calvers (Table 2). Season of calving had a significant influence on APY and PPY (Table 2). In winter, APY and PPY were found to be significantly lower than those of summer and monsoon season calvers. The performance of summer calvers was better than the other season calvers for all the traits under study except for STAYAB. The season-wise least-square means for APY indicated that it was the highest in the buffaloes calved during summer season and the lowest in buffaloes calved during the winter season and similar results were obtained for PPY. Seasonal differences on phase traits revealed the favourable climatic conditions and abundant availability of green fodder during these seasons.

The heritability estimates for various traits were observed as 0.358±0.176, 0.347±0.168, 0.294±0.079 and 0.205±0.025 for APY, PPY, DPY and STAYAB, respectively (Table 3). Moderate to high estimates of heritability were reported by Raja and Gandhi (2012) and Dubey and Singh (2005) for various phase and stayability traits in Sahiwal cattle. Moderate estimates of heritability indicated that there is limiting scope for improvement in these traits through individual selection and it requires information from other sources and also improvement in management practices for overall improvement in this breed.

The phenotypic correlation ranged from 0.121±0.054 (APY and STAYAB), 0.121±0.054 (PPY and STAYAB), 0.653±0.041 (APY and PPY). The phenotypic correlations

Table 1

Least-squares analysis of variance for various phase and stayability life trait

Source of variations	d.f.	Mean squares			
		APY	PPY	DPY	STAYAB
Period	4	4228.16	1602.57*	264192.43	3386973.79**
Seasons	2	21648.99**	3538.43**	340688.82	133265.11
AFC (L)	1	35658.37**	6636.76**	8214.15	590861.49
AFC (Q)	1	3577.32	251.51	17043.91	1329049.02
Error	275	2889.53	666.34	238360.70	495623.64

*P<0.05; **P<0.01.

Table 2

Least-square (mean±SE) for various phase and stayability life traits

Effects	Year/Season	No.	APY (Kg)	PPY (Kg)	DPY (Kg)	STAYAB (Days)
Overall		344	280.22±4.36	117.41±2.09	1634.78±39.60	1199.37±57.10
Period of calving				*		**
	1993-1996	76	283.17±14.68	123.70^{b}±7.05	1702.65±133.36	1506.71^{a}±192.30
	1997-2000	57	255.33±12.14	111.09^{b}±5.83	1451.96±110.25	1445.91^{b}±158.98
	2001-2004	78	287.42±10.86	119.12^{b}±5.21	1632.50±98.61	1429.57^{b}±142.19
	2005-2008	62	280.43±10.94	106.88^{c}±5.25	1705.12±99.33	1082.38^{b}±143.23
	2009-2012	71	294.76±11.32	126.26^{a}±5.44	1681.65±102.84	532.28^{c}±148.30
Season of calving			**	**		
	Summer (Mar-June)	129	295.96^{a}±6.25	124.62^{a}±3.00	1705.45±56.76	1222.15±81.84
	Monsoon (July-Oct)	137	282.33^{a}±5.60	115.43^{ab}±2.69	1603.24±50.87	1225.85±73.35
	Winter (Nov-Feb)	78	262.37^{b}±7.40	112.18^{b}±3.56	1595.65±67.25	1150.11±96.97

Means with different superscripts for a parameter differ significantly, *P<0.05; **P<0.01

Table 3

Estimates of heritability (diagonal), genetic (above diagonal) and phenotypic (below diagonal) correlation for different phase and stayability life traits

Traits	APY	PPY	DPY	STAYAB
APY	**0.358±0.176**	0.468±0.076	0.653±0.087	-0.037±0.101
PPY	0.653±0.041	**0.347±0.168**	0.590±0.081	-0.297±0.193
DPY	0.433**±0.049	0.461±0.048	**0.294±0.079**	-0.032±0.102
STAYAB	0.121±0.054	0.121±0.054	0.246±0.052	**0.205±0.025**

**Significance at 1% level.

of all phase traits were high except with STAYAB which were observed on lower side. However, significant phenotypic correlation was also obtained between DPY and PPY. The genetic correlations ranged from -0.297±0.193 (PPY and STAYAB) to 0.653±0.041 (APY and DPY). High phenotypic and genotypic correlations among phase traits were also reported by Raja and Gandhi (2012) in Sahiwal cattle. The genetic correlation between stayability life and different phase traits were observed as negative indicating that with the production of animal decrease as stayability life of the animal increases.

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