Indian Journal of Animal Sciences **86** (7): 831–833, July 2016/Short communication

Phenotypic and genetic evaluation of production efficiency and life time milk production attributes in Murrah buffaloes

KAMALDEEP[1], A S YADAV[2], S S DHAKA[3], ANKIT MAGOTRA[4], ANIKA MALIK[5] and VIJAY KUMAR[6]

Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana 125 004 India

Received: 5 February 2015; Accepted: 4 January 2016

Key words: Correlations, Heritability, Murrah, Production efficiency

India is a treasure house of the world's best buffalo germplasm. Indian buffalo contributes 17% of world milk production and 48% of Asian milk production (Food and Agriculture Organization 2012). The Indian Murrah buffalo produces good quantity of milk and now it is well established to that it represents a unique breed in terms of feed conversion ability with low grade feeds, ability to sustain under adverse climatic conditions, resistance to diseases and production of high value milk containing a higher fat per cent. The knowledge of genetic variability for each trait and covariability existing among different traits are necessary for planning appropriate selection and breeding strategies for the genetic improvement. The present investigation was made to study non-genetic and genetic factors affecting the production efficiency traits and life time milk production traits in Murrah buffaloes.

The data were collected on 344 Murrah buffaloes maintained at the university over a period of 20 years from 1993 to 2012. The lactation records of animals with yield less than 500 kg in lactation or with lactation length shorter than 150 days were considered as abnormal and were not included in the study. The production efficiency traits considered were milk yield per day of first lactation length (MYLL), milk yield per day of first calving interval (MYFCI), milk day per day of age at second calving (MYASC), milk day per day of first age at conception after first calving (MYAC). The total milk yield in the first four lactations (LMY4) and herd life milk yield (TMY) were considered as measure of lifetime milk production. Total milk yield from first lactation to last day in herd is taken as herd life milk yield. The entire period was divided into 5 periods each consisting of 4 consecutive years. Each year was further delineated into 3 seasons, viz. summer (March to June), monsoon (July to October) and winter (November to February) depending on the geo-climatic conditions of the region. Abnormal records like abortion, mastitis, chronic illness, physical injuries etc. were also excluded from the present study. The genetic and non-genetic factor affecting the production efficiency traits and lifetime milk production traits were analyzed using the following mixed model for non-orthogonal data (Harvey 1990)

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

where, Y_{ijkl}, l^{th} record of individual of the i^{th} sire calved in j^{th} period and k^{th} season; μ, overall population mean; s_i, random effect of i^{th} sire; h_j, fixed effect of j^{th} period of calving; C_k, fixed effect of k^{th} season of calving; b_1 and b_2, linear and quadratic partial regression coefficients of age at first calving; X_{ijkl}, age at first calving; $\bar{X}$, mean of age at first calving; e_{ijkl}, error associated with each observation and assumed to be normally and independently distributed with mean zero and variance $\sigma^2 e$.

The effect of various tangible factors on different traits under study were estimated using least-squares and maximum likelihood computer programmes (Harvey 1990), all possible pair-wise comparison of means by Duncan's multiple range test, heritability estimates for different traits by paternal half-sib correlation method, genetic and phenotypic correlations from variance-covariance analysis, and standard error of phenotypic correlations as per Snedecor and Cochran (1988).

The overall mean value of MYLL, MYFCI, MYASC, MYAC, were 6.52±0.09, 4.20±0.09, 1.06±0.02 and 1.27±0.02kg/day, respectively (Table 1). Murali Dhar and Deshpande (1995), Kumar *et al*. (2000) and Chakraborty *et al*. (2010) reported lower estimates of MYLL, MYFCI and MYASC in Murrah buffaloes. Total milk yield in the first 4 lactation and herd life milk yield of the population is averaged to be 5459.50±242.56 and 6177.78±350.14 kg, respectively. The effect of period of calving is highly significant on milk day per day of first lactation length (Table 1). The animals which calved in the period 2009–12

Present address: [1]Ph.D Scholar (kamaldeepdhundwal@gmail.com), [2]Professor (yadavas.62@gmail.com), [3]Associate Professor (zuludhaka@gmail.com), [4]Assistant Professor (ankitoms@gmail.com), Department of Animal Genetics and Breeding, [5]Ph.D Scholar (anikadhundwal@gmail.com), Department of Veterinary and Animal Husbandary Extension Education. [6]Assistant Professor (jaisvet@gmail.com), Department of Animal Genetics and Breeding, Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go Anusandhan Sansthan, Mathura.

had significantly higher average MYLL followed by 1993–96, 2005–08 and 2001–04. Period of calving also affected LMY4 and TMY. During the period 2009–12, LMY4 and TMY were significantly lower than other periods (Table 1). This difference might be due to variations in the climate, nutrition and management prevailed in those years. But in MYFCI, MYASC and MYAC effect of period of calving was non-significant (Table 1). Chakraborty *et al*. (2010) reported significant effect of period on MYLL in Murrah buffaloes.

Season of calving had significant influence on MYFCI and MYASC only (Table 1). Non-significant effect of season of calving on production and its efficiency traits were also reported by Shabadi *et al*. (1993) and Chakraborty *et al*. (2010). In winter, MYFCI and MYASC were significantly lower than summer and monsoon season calvers. The performance of summer calvers was better than the other 2 season calvers for all the traits under study except for MYFCI, LMY4 and TMY (Table 1). Seasonal effect on production efficiency traits may be due to the favourable climatic conditions and abundant availability of green fodder. The regression on age at first calving (linear) was statistically significant ($P<0.05$) for all the traits except MYFCI, LMY4 and TMY while it was non-significant on AFC (quadratic) for all the traits (Table 1). This is confirmed with the results of Shabadi *et al*. (1993), Dhaka *et al*.(2002) and Chakraborty *et al*. (2010).

The estimates of heritability were moderate to high and ranged from 0.118 to 0.473 (Table 2). Low to moderate estimates of heritability were reported by Kandasamy *et al*. (1991), Murali Dhar and Deshpande (1995), Dhaka *et al*. (2002), Macciotta *et al*. (2006) and Chakraborty *et al*. (2010) for various production efficiency traits. Higher estimates of heritability were also reported by Dutt and Taneja (1994) as

Table 1. Least-square means and their standard error for production efficiency and lifetime milk production traits

Effects	Number	MYLL (kg/day)	MYFCI (kg/day)	MYASC (kg/day)	MYAC (kg/day)	LMY4 (kg)	TMY (kg)
Overall	344	6.52± 0.09	4.20± 0.09	1.06± 0.02	1.27± 0.02	5459.50± 242.56	6177.78± 350.14
Period of calving		**				*	*
1993–96	76	6.77^{b}± 0.30	4.91± 0.25	1.03± 0.06	1.24± 0.08	6111.65^{a}± 816.86	7226.16^{a}± 1179.15
1997–2000	57	5.95^{c}±	3.82± 0.25	1.00± 0.21	1.22± 0.05	5963.33^{ab}± 0.07	7601.38^{a}± 675.32
974.83							
2001–04	78	6.24^{b}±	4.28± 0.22	1.09± 0.19	1.31± 0.05	6157.52^{a}± 0.06	6975.63^{a}± 604.01
871.90							
2005–08	62	6.70 ^{b}±	4.32± 0.22	1.13± 0.19	1.34± 0.05	5435.46^{b}± 0.06	5534.58^{a}± 608.43
878.27							
2009–12	71	6.93^{a}± 0.23	4.44± 0.20	1.05± 0.05	1.26± 0.06	3629.55^{b}± 629.95	3551.13^{b}± 909.33
Season of calving			**	*			
Summer (Mar- June)	129	6.58± 0.13	4.32^{a}± 0.11	1.12$^{a\pm}$ 0.03	1.33± 0.04	5405.41± 347.66	6134.81± 501.84
Monsoon (July-Oct)	137	6.55± 0.11	4.39^{a}± 0.10	1.06^{a}± 0.02	1.28± 0.03	5243.49± 311.58	6215.30± 449.77
Monsoon (Feb-Oct)	78	6.42± 0.15	3.92^{b}± 0.13	1.01^{b}± 0.03	1.21± 0.04	5729.61± 411.93	6183.22± 594.62

Means with different superscripts differ significantly, *$P<0.05$; **$P<0.01$.

Table 2. Estimates of heritability (diagonal), genetic (above diagonal) and phenotypic (below diagonal) correlation with standard error for different production efficiency and lifetime milk production traits

Traits	MYLL	MYFCI	MYASC	MYAC	LMY4	TMY
MYLL	0.118±0.086	0.553±0.049	0.477±0.070	0.530±0.058	0.410±0.114	–0.034±0.196
MYFCI	0.677±0.040**	0.473±0.101	0.747±0.047	0.703±0.033	–0.003±0.108	–0.062±0.189
MYASC	0.593±0.044**	0.743±0.036**	0.214±0.091	0.676±0.035	0.296±0.196	0.147±0.189
MYAC	0.611±0.043**	0.775±0.034**	0.912±0.022**	0.270±0.094	0.222±0.101	0.102±0.190
LMY4	0.200±0.053	0.220±0.053	0.262±0.052	0.249±0.052	0.295±0.111	0.959±0.039
TMY	0.194±0.053	0.213±0.053	0.249±0.052	0.227±0.053	0.865±0.027**	0.407±0.125

*$P<0.05$; **$P<0.01$.

in the present study. Higher estimates of heritability in MYFCI and TMY indicated that sufficient genetic variability was available in these two traits for improvement through selection. In other traits which are moderately heritable there is limiting scope for improvement in these traits through individual selection and it requires information from other relatives and improvement in management practices to improve these traits.

The phenotypic correlation (Table 2) ranged from 0.194±0.053 (MYLL and TMY) to 0.912±0.022 (MYAC and MYASC). The phenotypic correlations of all production efficiency traits were high and significant except LMY4 and TMY which were low and non-significant. The genetic correlations ranged from –0.003 (LMY4 and MYFCI) to 0.959 (LMY4 and TMY). High phenotypic and genetic correlations existed among production efficiency traits and between TMY and LMY4. But the correlations between production efficiency traits with either LMY4 or TMY are low or negative. This clearly illustrated that production efficiency traits based on first lactation milk yield cannot be considered as an indication of total milk yield of an animal in her lifetime or herd life. High phenotypic correlations among production efficiency traits were already reported to be high and significant by Yadav (1988), Dutt and Taneja (1994), Dhaka *et al*. (2002) and Chakraborty *et al*. (2010) among production efficiency traits in Haryana breed of cattle and Murrah buffaloes.

SUMMARY

The data of 344 Murrah buffaloes maintained at the university over a period of 20 years from 1993 to 2012 were analysed. From these results, in view of higher heritability estimated for milk yield/day of first calving interval selection on basis of these traits would result in higher genetic improvement in first lactation milk. High genetic and phenotypic correlations of MYFCI with other production efficiency traits also substantiate that, this can be used as a selection criterion. Therefore, selection based on MYFCI would result in improvement in desirable direction through positive correlated response in all the traits under study.

REFERENCES

Chakraborty D, Dhaka S S, Pander B L and Yadav A S. 2010. Genetic studies on production efficiency traits in Murrah buffaloes. *Indian Journal of Animal Sciences* **80**: 891–901.

Dhaka S S, Chaudhary S R, Pander B L, Yadav A S and Singh S. 2002. Genetic studies on production efficiency traits in Haryana cattle. *Asian Australasian Journal of Animal Sciences* **15**: 466– 69.

Dutt T and Taneja V K. 1994. Phenotypic and genetic parameters of age at first calving, first lactation milk yield and some measures of efficiency of production in Murrah buffaloes. *Indian Journal of Animal Sciences* **64**: 384–87.

Food and Agriculture Organization. 2012. Buffalo production and research. (www.fao.org.com).

Harvey W R. 1990. Users guide for LSMLMW and MIXMDL, PC2 version mixed model least squares and maximum likelihood computer programme, U.S.A. ARS.

Kandasamy N, Ulaganathan V and Krishnan A R. 1991. Genetic analysis of milk yield per day of second calving of Murrah buffaloes. *Indian Journal of Dairy Sciences* 44: 519–21.

Kumar D, Singh H and Singh C V. 2000. Genetic studies of different components of milk production efficiency in Murrah buffaloes. *Indian Journal of Animal Sciences* **70**: 82–83.

Macciotta N P, Vicario D and Cappio-Borlino A. 2006. Use of multivariate analysis to extract latent variables related to level of production and lactation in dairy cattle. *Journal of Dairy Sciences* **89**: 3188–94.

Murali Dhar Y and Deshpande K S. 1995. Factors affecting production efficiency in Murrah buffaloes. *Indian Journal of Dairy Sciences* **48**: 40–42.

Shabadi N S, Jagtap D Z and Behla N D. 1993. Factors affecting production and production efficiency traits of first lactation in Murrah buffaloes. *Indian Journal of Animal Sciences* **63**: 1212–13.

Snedecor G W and Cochran W G. 1988. *Statistical Methods*. 7th edn. Oxford and IBH Publishing Co., Mumbai.

Yadav A S. 1988. 'Appraisal of lactation curves in zebu cattle using different mathematical functions.' Ph.D. Thesis. CCS Haryana Agricultural University, Hisar. India.