Non-Genetic Factors Affecting Production Traits in Murrah Buffaloes

Dibyendu Chakraborty[1,*] and S.S. Dhaka[2]

[1]*Animal Genetics and Breeding, Faculty of Veterinary Sciences & Animal Husbandry, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu (SKUAST-Jammu), R. S. Pura, Jammu-181102, India*

[2]*Animal Genetics and Breeding, College of Animal Sciences, Lala Lajpat Rai University of Veterinary and Animal Sciences (LUVAS), Hissar- 125 004, Haryana, India*

Abstract: The present investigation was undertaken to estimate the effect of non-genetic factors on different production traits of Murrah buffaloes maintained at Buffalo Research Centre, Chaudhary Charan Singh Haryana Agricultural University, Hisar, India. A total of 1128 lactation records of 326 Murrah buffalo were targeted to explore the effect of non-genetic factors. The production traits considered for the present study were lactation yield (LY), lactation length (LL), 305 days milk yield (305 MY), peak yield (PY), and days to attain peak yield (DAPY). The highest CV (%) was obtained for PY. The overall least squares means were 2118.10 ± 25.54 kg, 296.60 ± 3.23 days, 2053.88 ± 21.80 kg, 11.08 ± 0.08 kg, and 61.72 ± 1.02 days for LY, LL, 305 MY, PY and DAPY, respectively. The period of calving revealed a highly significant ($P<0.01$) effect on targeted traits except for LL. Animals in the fourth lactation revealed significantly the highest LY and PY. The effect of the season of calving was highly significant ($P<0.01$) on all the traits under study. Performances of animals calved during summer seasons were excellent for the traits under the present study. The effect of parity was highly significant ($P<0.01$) for all the traits under study except for DAPY where it was non-significant. The significant effects of different non-genetic factors like period of calving, the season of calving, and parity of animals on different production traits of Murrah buffaloes indicate that adjustment of effect of non-genetic factors is important for accurate and unbiased estimates of genetic parameters and selection of superior animals.

Keywords: Lactation Yield, Peak Yield, Lactation Length, Parity, Season of calving, Murrah buffaloes, India.

INTRODUCTION

Buffalo is the prime dairy animal of India and the current population in India is 109.85 million [1]. Murrah breed is one of the renowned breeds of buffaloes in India by virtue of its milking capacity combined with tremendous potential for further genetic improvement [2]. This breed is predominantly found in Haryana and the adjoining states of Punjab, UP, and Delhi. There are many non-genetic factors, which influence the phenotypic expression of performance traits of buffaloes like the period of calving, the season of calving, parity, etc. An accurate genetic evaluation can be done after adjusting the data for the best estimates of genetic parameters in the evaluation of Murrah buffaloes [3]. Therefore, the present study was planned to investigate the influence of various non-genetic factors on production performance traits and to suggest suitable management practices, selection, and breeding strategies for the genetic improvement of Murrah buffaloes.

*Address correspondence to this author at the Animal Genetics and Breeding, Faculty of Veterinary Sciences & Animal Husbandry, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu (SKUASTJammu), R.S. Pura, Jammu- 181102, India;
E-mail: v.dr.dibyendu@gmail.com

MATERIALS AND METHODS

The present study was conducted on data pertaining to 1128 lactation records of 326 Murrah buffaloes maintained at Buffalo Research Centre (BRC), Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana (India) over a period of 20 years from 1987 to 2006. The duration of 20 years was divided into 4 periods of five years each. The three seasons were delineated as summer (March to June), monsoon (July to October), and winter (November to February) on the basis of geo-climatic conditions prevailing in the region. The production traits recorded were: lactation yield (LY), lactation length (LL), 305 days milk yield (305 MY), peak yield (PY), and days to attain peak yield (DAPY). Lactations shorter than 150 days were excluded from the present study. Abnormal records like abortion, mastitis, chronic illness, physical injuries, etc. were also excluded from the present study. The descriptive statistics were calculated using the suitable formula [4].

The least-squares solutions were obtained using the model given below:

$$Y_{ijkl} = \mu + P_i + S_j + Pa_k + e_{ijkl}$$

ISSN: 1927-5196 / E-ISSN: 1927-520X/23

Where,

Y_{ijkl}= l^{th} lactation record of individual of the i^{th} period in the j^{th} season of k^{th} parity

μ=overall population mean

P_i= fixed effect of an i^{th} period of calving

S_j= fixed effect of j^{th} season of calving

Pa_k =fixed effect of k^{th}parity

e_{ijkl}= error associated with each observation and assumed to be normally and independently distributed with mean zero and variance σ^2_e.

The least-squares and maximum likelihood computer programs [5] were used to estimate the effect of various tangible factors on different traits under study. Duncan's multiple range test (DMRT) was used for making all possible pairwise comparisons of means [6].

RESULTS AND DISCUSSION

The descriptive statistics of different production traits of Murrah buffaloes have been presented in Table **1**. The overall mean values were 1968.76±23.37 kg, 289.89±3.46 days, 1925.88±33.36 kg, 11.12±0.25 kg, and 61.11±0.78 days for LY, LL, 305 MY, PY, and DAPY, respectively. Higher estimates of 305 MY and lower estimates of TMY and LL were reported in Egyptian buffaloes [7].

The coefficient of variation (CV) (%) was the lowest for LY and the highest for PY. The moderate to high CV indicates that there is moderate to high variability in the production traits of Murrah buffaloes. Therefore, these traits can be improved by selection strategies along with better management practices. Lower CV (%) for 305 MY and total lactation milk yield was reported in Murrah [8] and Nili-Ravi buffaloes, respectively [9]. Lower CV (%) values for total lactation milk yield, 305 MY, and LL were reported in Egyptian buffaloes [7].

The least squares means were presented in Table **3**. The overall least squares means were 2118.10 ± 25.54 kg, 296.60 ± 3.23 days, 2053.88 ± 21.80 kg, 11.08 ± 0.08 kg, and 61.72 ± 1.02 days for LY, LL, 305 MY, PY and DAPY, respectively. Similar values of LL and lower values for TMY were reported in Egyptian buffaloes [10]. Higher values were reported for TLMY & 305 d MY in Murrah buffaloes [11]; 305 days MY & PY in Murrah buffaloes [12]; TLMY, 305DMY & LL in Murrah buffaloes [13]; TLMY & 305MY in Murrah buffaloes [3]; LY, LL, 305 days MY, PY & DAPY in Murrah buffaloes [14]; LL in Surti buffaloes [15]; first lactation length & peak yield in Murrah buffaloes [16]. However, lower estimates were reported for LY and LL in Nili-Ravi buffaloes [12]; PY in Murrah buffaloes [13, 3]; first lactation 305 MY in Murrah buffaloes [16].

In the present model, the R^2 values were found to be 0.080, 0.080, 0.118, 0.248, and 0.034 for LY, LL, 305 MY, PY, and DAPY, respectively. Lower estimates of R^2 values for TLMY and 305d MY in Murrah buffaloes [11].

Effect of Period of Calving

Analysis of variance (Table **2**) revealed that the period of calving had a highly significant effect (P<0.01) on all the production traits under the present study in Murrah buffaloes except for the LL, where it was non-significant. There were no definite increasing or decreasing trends found in Murrah buffaloes which may be due to the environmental variations present in different periods. However, least squares means depicted in Table **3** showed that performances of animals of the 4^{th} period of calving i.e. 2001-2006 were the best for LY and PY and it was significantly higher than the other periods. This result indicates that due to effective breeding, selection strategies, and other

Table 1: Descriptive Statistics of Production Traits in Murrah Buffaloes

Traits	No. of Obs	Mean	SD	SE	CV (%)
LY (Kg)	1128	1968.76	784.99	23.37	39.87
LL (Days)	1128	289.89	116.21	3.46	40.09
305MY (Kg)	1126	1925.88	1119.50	33.36	58.13
PY (Kg)	1111	11.12	8.33	0.25	74.92
DAPY (Days)	1103	61.11	26.01	0.78	42.57

LL: Lactation Yield; LL: Lactation Length; 305 MY: 305 days milk yield; PY: peak yield; DAPY: days to attain peak yield; SD: Standard Deviation; SE: Standard error: CV: Coefficient of Variation.

Table 2: Analysis of Variance for Various Production Traits in Murrah Buffaloes

Source of variation	df	MSS				
		LY	LL	305 MY	PY	DAPY
Period of calving	2	2904316.27**	60690.34	1706914.56**	18.09**	1959.29**
Season of calving	3	2468944.62**	3802.36**	2387929.79**	64.29**	2785.11**
Parity	6	1914446.69**	26711.15**	2687711.64**	86.66**	361.83
Error	1030	252309.06	4046.97	183848.64	2.19	403.79

**P<0.01.

Table 3: Effect of Non-Genetic Factors on Milk Production Traits in Murrah Buffaloes

	No. of obs	LY (Kg)	LL (days)	305MY (Kg)	PY (kg)	DAPY (Days)
Overall	1042	2118.10 ± 25.54	296.60 ± 3.23	2053.88 ± 21.80	11.08 ± 0.08	61.72 ± 1.02
Period of calving		**	NS	**	**	**
1987-1991	112	2069.42^{a} ± 53.23	298.11 ± 6.74	1989.40^{a} ± 45.43	10.80^{a} ± 0.16	68.20^{b} ± 2.13
1992-1996	273	2096.39^{a} ± 34.47	295.75 ± 4.37	2051.45^{a} ± 29.43	10.80^{a} ± 0.10	58.33^{a} ± 1.38
1997-2001	302	2056.71^{a} ± 33.80	300.37 ± 4.28	1991.86^{a} ± 28.85	10.94^{a} ± 0.10	61.10^{b} ± 1.35
2001-2006	355	2249.87^{b} ± 32.65	292.18 ± 4.13	2182.81^{b} ± 27.87	11.76^{b} ± 0.10	59.25^{ab} ± 1.31
Season of calving		**	**	**	**	**
Summer	230	2183.56^{b} ± 40.65	308.13^{b} ± 5.15	2104.25^{b} ± 34.70	11.18^{b} ± 0.12	58.58^{a} ± 1.63
Monsoon	550	2016.50^{a} ± 28.00	282.19^{a} ± 3.55	1976.01^{a} ± 23.90	10.83^{a} ± 0.08	63.52^{b} ± 1.12
Winter	262	2154.23^{b} ± 35.45	299.49^{b} ± 4.49	2081.38^{b} ± 30.26	11.23^{b} ± 0.10	63.05^{b} ± 1.42
Parity		**	**	**	**	NS
1	369	1934.87^{a} ± 26.80	320.33^{c} ± 3.39	1822.81^{a} ± 22.87	9.68^{a} ± 0.08	61.12 ± 1.07
2	252	2137.25^{b} ± 32.99	310.19^{bc} ± 4.18	2046.04^{b} ± 28.16	10.74^{b} ± 0.10	61.18 ± 1.32
3	166	2184.21^{b} ± 40.71	299.50^{ab} ± 5.16	2121.52^{b} ± 34.75	10.96^{bc} ± 0.12	62.72 ± 1.63
4	109	2192.16^{b} ± 50.13	297.08^{ab} ± 6.35	2122.08^{b} ± 42.79	11.58^{d} ± 0.15	61.56 ± 2.01
5	72	2129.79^{b} ± 61.59	293.53^{ab} ± 7.80	2080.69^{b} ± 52.58	11.56^{d} ± 0.18	62.27 ± 2.46
6	49	2081.73^{b} ± 73.44	273.09^{a} ± 9.30	2050.46^{b} ± 62.69	11.27^{cd} ± 0.22	56.61 ± 2.94
7	25	2166.66^{b} ± 101.98	282.49^{a} ± 12.92	2133.57^{b} ± 87.05	11.75^{d} ± 0.30	66.57 ± 4.08

Means with different superscripts differ significantly.
NS- Non-Significant.
**P<0.01.

management strategies, there was a significant improvement for LY and PY over the periods.

Similar findings were also reported in Murrah buffaloes, where, the period of calving had a highly significant effect on 305DMY and PY [12]; a highly significant effect on TLMY, 305DMY & PY, and a non-significant effect on LL [13; 14]; highly significant effect on TLMY& PY [3]; significant effect of year on milk yield in indigenous buffalo in Nepal [17]. The year of calving had a highly significant effect on TMY and LL in Egyptian buffaloes [10].

In contrast to the present findings, a non-significant effect of a period of calving on TLMY and 305 dMY [11]; a significant effect on LL [15]; non-significant effect on DAPY [14] were reported in Murrah buffaloes.

Effect of Season of Calving

Analysis of variance (Table **2**) showed that the season of calving had a highly significant effect (P<0.01) on all the production traits under the present study in Murrah buffaloes. The summer calvers were excellent for the different production traits. After the

summer season, there was rainy/monsoon season and there was the availability of plenty of lustrous green fodders. Also during their advanced pregnancies in the winter season, the summer calves got plenty of lust green fodders to buffaloes. Due to these possible reasons, there were increased performances of summer calvers. Similarly, better performances of summer calvers for first lactation milk yield and peak yield were also reported in Murrah buffaloes [18].

Similar to the present findings, a highly significant effect of season of calving on PY and LL in Murrah buffaloes were also reported [13]. Significant effects of season of calving were also reported on TLMY & 305 dMY in Murrah buffaloes [15]; PY in Murrah buffaloes [14]; highly significant effect on TLMY, 305DMY & PY in Murrah buffaloes [3]; TMY in Egyptian buffaloes [19]; PY & DAPY in Murrah buffaloes [14]; first lactation 305 MY, FLL and FPY in Murrah buffaloes [16]; TMY and LL in Egyptian buffaloes [10].

Contrary to present findings, the non-significant effect of season of calving on 305 DMY in Murrah buffaloes [12]; non-significant effect on TLMY & 305DMY in Murrah buffaloes [13]; non-significant effect on LL in Surti buffaloes [15]; non-significant effect on LY, LL & 300 MY in Murrah buffaloes [14] were also reported.

Effect of Parity

Analysis of variance (Table **2**) revealed that parity had a highly significant effect ($P<0.01$) on all the production traits under the present study in Murrah buffaloes except for DAPY where the effect of parity was non-significant. The production performances during the first lactation were inferior compared to all other lactation. This may be due to the fact that during the first parity, the body system of the individual was not fully matured and mammary glands were not fully grown. Performances during the 4th parity were superior for many production traits in Murrah buffaloes. Attainment of physiological maturity and regularization of cyclic rhythms in reproduction after the first lactation is generally attributed to reasons for differences in lactation yield in first vs. later parties [20]. Higher first lactation milk yield and peak yield compared to present findings were reported in Murrah buffaloes [18].

Similar to the present findings, highly significant effect of parity on 305DMY & PY in Murrah buffaloes [12]; TLMY, 305DMY, LL & PY in Murrah buffaloes [13, 14]; TLMY, 305DMY & PY [3]; TMY in Egyptian buffaloes [19]; TMY and LL in Egyptian buffaloes [10]; significant effect on LL in Surti buffaloes were reported [15].

Contrary to the present findings, the non-significant effect of parity on TLMY and 305 DMY in Murrah buffaloes [12]; non-significant effect on TMY in Murrah buffaloes [14]; significant effect on DAPY in Murrah buffaloes [14]; milk yield in indigenous buffalo in Nepal was reported [17].

The variations in results from other reports might be due to the differences in the studied breeds, periods of time, size of data sets, management practices in different farms, climatic changes, methods of estimation, the level of productivity, etc.

CONCLUSION

In the present study, non-genetic factors such as the period of calving, the season of calving, and the parity of animals showed a significant effect on most of the production traits in the present study in Murrah buffaloes barring a few exceptions. The highest and significant LY and PY for the 4th period of calving indicate substantial improvement in the herd over the period for LY & PY, although no definite trend was obtained. The differences in production traits over different periods and seasons might be attributed to differences in breeding animals, feeding mainly the availability of green fodder, climatic conditions, stress, and other management practices being followed at the animal farm.

REFERENCES

[1] Anonymous. 20th Livestock Census. Department of Animal Husbandry, Dairying, and Fisheries, Govt. of India, 2019.

[2] Chakraborty D. Genetic studies on production efficiency attributes in Murrah buffalo. MVSc thesis submitted to CCSHAU, Hisar, Haryana, India, 2008.

[3] Jakhar V, Yadav AS, Dhaka SS. Analysis of Different Non-Genetic Factors on Production Performance Traits in Murrah Buffaloes. Int J Curr Microbiol App Sci 2017; 6(12): 4265-4272. https://doi.org/10.20546/ijcmas.2017.611.501

[4] Snedecor GW, Cochran WG. Statistical methods. 8th Ed. Iowa State University Press, Ames, USA 1994.

[5] Harvey WR. User's Guide for LSMLMW. Mixed model least squares and maximum likelihood computer program. PCVersion2. 1990, Ohio State University, Columbus, USA.

[6] Kramer CY. Extension of multiple range tests to group correlated adjusted means. Biometrics 1957; 13: 13-18. https://doi.org/10.2307/3001898

[7] Easa AA, El-Aziz AHA, El Barbary ASA, Kostomakhin NM, Nasr MAF, Imbabi TA. Genetic parameters of production and reproduction traits of Egyptian buffaloes under subtropical conditions. Tropical Animal Health and Production 2022; 54: 270. https://doi.org/10.1007/s11250-022-03251-2

[8] Patil CS, Chakravaraty AK, Kumar V, Sharma RK, Kumar P. Average performance of various first lactation 305 days and test day milk yield in Murrah buffaloes. Indian J Anim Res 2012; 46(3): 310-312.

[9] Bashir MK, Khan MS, Lateef M, Mustafa MI, Khalid MF, Rehman S, Farooq U. Environmental Factors Affecting Productive Traits and their Trends in Nili-Ravi Buffaloes. Pakistan Journal of Life and Social Sciences 2015; 13(3): 137-144.

[10] Ayad AA, Abd-Allah M, Kamal MA. Non-genetic factors affecting phenotypic parameters of milk production and reproduction performance in lactating Egyptian buffaloes. Archives of Agriculture Sciences Journal 2022; 5(10): 10-24. https://doi.org/10.21608/aasj.2022.230030

[11] Pawar HN, Kumar Ravi GVPPS, Narang R. Effect of year, season and parity on milk production traits in Murrah buffaloes. Journal Buff Sci 2012; 1: 122-125. https://doi.org/10.6000/1927-520X.2012.01.01.22

[12] Pareek NK, Narang R. Effect of Non-Genetic Factors on Persistency and Milk Production Traits in Murrah Buffaloes. Journal Anim Res 2015; 5(3): 493-495. https://doi.org/10.5958/2277-940X.2015.00084.4

[13] Jakhar V, Vinayak AK, Singh KP. Genetic evaluation of performance attributes in Murrah buffaloes. Haryana Vet 2016; 55 (1): 66-69.

[14] Kaur R, Malhotra P, Kashyap N, Dash SK, Kaur S. Analysis of different non-genetic factors affecting production performance of Murrah buffaloes. Indian J Anim Res 2020; 54 (4): 517-519.

[15] Pawar V, Dangar N, Pandya G, Brahmkshtri B, Kharadi V. Non-Genetic Factors Affecting Lactation Length in Surti Buffaloes. International Journal of Livestock Research 2019; 9(1): 318-323. https://doi.org/10.5455/ijlr.20180729090659

[16] Kour G, Narang R. Estimates of Genetic Parameters of Economic Traits in Murrah Buffaloes. Journal of AgriSearch 2021: 8 (2): 173-176. https://doi.org/10.21921/jas.v8i2.7304

[17] Paneru U, Dhungana KP, Kanu S, Sharma P. Genetic and Non-Genetic Factors on Productive and Reproductive Performance of Indigenous Buffalo. Journal of Nepal Agricultural Research Council 2021; 7: 83-91. https://doi.org/10.3126/jnarc.v7i1.36925

[18] Chakraborty D, Dhaka SS, Pander BL, Yadav AS. Genetic studies on production efficiency traits in Murrah buffaloes. Indian Journal of Animal Sciences 2010; 80(9): 898-901.

[19] Ramadan SI. Effect of some genetic and non-genetic factors on productive and reproductive traits of Egyptian buffaloes. Journal of Advanced Veterinary and Animal Research 2018; 5 (4): 374-380. https://doi.org/10.5455/javar.2018.e287

[20] Tulloh NM, HolmesJHG. Buffalo Production.Elsevier Publications, 1992, London, UK.

Received on 04-11-2022 Accepted on 09-02-2023 Published on 08-03-2023

https://doi.org/10.6000/1927-520X.2023.12.02