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GENETIC PARAMETERS AND EFFECT OF NON GENETIC FACTORS ON EARLY PERFORMANCE TRAITS OF MURRAH BUFFALO: A REVIEW

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ABSTRACT

The success of Indian dairy industry is much dependent on productivity and efficient reproduction performance of Murrah buffaloes. .It is a established fact that first lactation yield is a good indicator of lifetime performance but still there is further need to study the relationship between first, later lactations and lifetime performance traits for overall better evaluation of genetic worth of the female individual's own performance and for ranking of sires. The literature pertinent to genetic and phenotypic parameters of early performance traits viz. first lactation milk yield, first peak milk yield, first lactation milk yield per day of first lactation length, first service period, first calving interval and non genetic factors affecting were reviewed. All the early productive and reproductive traits were affected by herd, year, season of calving and age at first calving (linear and quadratic effects).

INTRODUCTION

India, with its 108.70 million heads of Buffalo has the largest buffalo population in the world, out of which 20% of population is comprised of Murrah buffaloes (19th livestock census) Although the proportion of buffaloes to cattle is 1:2,buffaloes contribute around 57 percent of the total milk production. Buffaloes also occupy third place as meat producing animal by contributing about 21.2 percent of total meat production Moreover, buffalo contribute about 30 per cent of the draft power for agricultural operations and in the year 2013, India became the world's largest exporter of Carabeef (BAHS, 2012). Although lactation records are widely used in assessing the genetic merit of buffaloes but selection of dairy sires is invariably based on the first one or two lactation records in most of the breeding programmes (Kuralkar and Raheja, 1997). There are several non-genetic factors which introduce biasness in the estimation of genetic value of performance traits. Therefore, the present investigation was undertaken to evaluate genetic parameters of early performance production traits in Murrah buffaloes. The non-genetic factors such as management, amount and quality of feed, season etc. also influence milk yield and lactation length, and need to be assessed in a production set up.

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This will help to formulate suitable evaluation procedures especially in organised farms for improving economic traits of this breed. The literature pertinent to the genetic and phenotypic parameters of early performance production traits and non genetic factors affecting can be reviewed as under

Genetic and phenotypic parameters of early performance traits

(A) Averages of early performance production traits and factors affecting early performance traits

1. First lactation milk yield

Milk production has major contribution towards the income of dairy farm. Milk yield varies from place to place depending upon the management practices and environmental condition under which animals are reared. The averages of first lactation milk yield (FLMY) presented in Table 1 ranged from 1686.20±44.40 kg (Thiruvenkadan, 2011) to 2229.87± 93.70 kg (Pawar *et al.*, 2012).

Effect of period of calving

Significant ($P < 0.05$) effect of period of calving on first lactation milk yield was reported by many workers (Singh *et*

al., 1990, Dhara, 1994, Sharma, 1996, Jain and Sadana, 1998, Gajbhiye and Tripathi, 1999, Dass and Sharma, 2000, Kumar, 2000, Kumar *et al.*, 2003, Sarkar et al., 2006, Thiruvenkadan *et al.*, 2014, Dev *et al.*, 2015). However, non-significant effect of period of calving on first lactation milk yield was reported by many workers (Neog *et al.*, 1993, Shabade *et al.*, 1993, Chakraborty *et al.*, 2010).

Effect of season of calving

Significant (P<0.05) effect of season of calving on first lactation milk yield (El-arian, 1986, Chikara, 1993, Nath, 1998, Dass and Sharma, 2000) whereas, non-significant effect of season of calving on first lactation milk yield was reported by many like (Sahana, 1997, Sharma, 1996, Sethi and Khatkar, 1997, Gajbhiye and Tripathi, 1999, Chakraborty *et al.*, 2010, Dev *et al.*, 2015).

Effect of age at first calving

Significant effect of age at first calving (AFC) (linear) on FLMY was reported by Chakraborty *et al*. (2010) and Gupta *et al.* (2012). However, non-significant effect of AFC on FLMY was reported by Gajbhiye and Tripathi (1999), Dass and Sharma (2000), Dev *et al.* (2015)

2. First peak yield

Attainment of peak yield by a buffalo reflects the manifestation of milk secretion at its maximum in a lactation. Review of first peak yield (FPY) indicated that the variability ranged from 8.87±0.05 kg/day (Thiruvenkadan *et al.*,2014)) to 12.11±0.27 kg/day (Tanpure *et al,* 2013) in Murrah buffaloes (Table-1)

Effect of period of calving

The trait shows considerable variability within breed. Highly significant effect of sire on PY was reported by Gorcha and Tiwana (1980) in Murrah buffaloes and Singh *et al.* (2011) for Nili-ravi buffaloes. Thiruvenkadan (2011) reported the highly significant (p<0.01) effect of period of calving on peak yield in Murrah buffaloes. Singh *et al.* (2011) reported highly significant (p<0.01) effect of period of calving on PY in Nili-ravi buffaloes. Also Dev *et al.* (2015) reported significant effect of period of calving.

Effect of season of calving

Thiruvenkadan (2011) reported the highly significant (p<0.01) effect of season of calving on peak yield in Murrah buffaloes. Singh *et al.* (2011) reported highly significant (p<0.01) effect of season of calving on PY in Nili-ravi buffaloes. Non-significant effect of season of calving was reported by Prakash and Tripathi (1987a) and Dev *et al.* (2015) in Murrah buffaloes and Chowdhary (1981) in Mehsana buffaloes.

Effect of age at first calving

Effect of age at first calving found to be significant (linear) on first lactation peak milk yield reported by Dhaka et al. (2002 in Haryana cattle. While effect of AFC (quadratic& linear) reported to be non-significant by Chakraborty *et al.* (2010) in Murrah buffaloes.

3. First lactation milk yield per day of first lactation length

It is a production efficiency traits. Studies pertaining to first lactation milk yield per day of first lactation length (FLMY/FLL) reported by various workers are presented in Table 1 revealed that FLMY/FLL ranged from 5.33±0.12 kg/day (Suresh *et al*., 2004) to 6.80 ±0.20 kg/day (Singh *et al.*, 2011).

Effect of period of calving

Significant effect of period of calving on FLMY/FLL was reported by Chakraborty *et al*. (2010), Thiruvenkadan *etal.* (2014) and Dev *et al.* (2015), while non-significant effect of period of calving on this trait was reported by Yadav *et al.* (1994) in Tharparkar cattle.

Effect of season of calving

Significant effect of season of calving on FLMY/FLL was reported by Kumar (1997) and Thiruvenkadan *et al*. (2014), whereas non-significant effect of season of calving on FLMY/FLL was reported by Pathodiya and Jain (2004) Chakraborty *et al*. (2010) and Dev *et al.* (2015)

Effect of age at first calving

Yadav (1988) and Singh (1992) reported significant effect of AFC on FLMY/FLL. Likewise, Chakraborty *et al*. (2010) reported that the effect of AFC (linear) had statistically significant effect on FLMY/FLL whereas, the effect of AFC (quadratic) was non-significant.

4. First service period

It is the period between calving and the subsequent successful conception. Generally, an optimum period of 60 days is allowed as post-partum rest. Reports available in literature (Table-1) indicated that least-square means for first service period (FSP) in Murrah buffaloes ranged from 112.25±2.87 days (Gandhi *et al*., 2009) to 253.7±17.3days (Thiruvenkadan *et al*., 2010). There is a wide variability observed in the first service period in Murrah buffaloes. Prakash *et al.* (1989) reported the average first service period in Murrah buffaloes was minimum (133 days) whereas the highest average (291 days) of the same trait was reported by Sharma (1996).

Effect of period of calving

Suresh *et al*. (2004), Godara *et al*. (2004), Wakchure *et al.* (2008) and Barman (2009) observed significant effect of period of calving on SP in Murrah buffaloes. While Kumar (2000), Saha and Sadana (2000), Kumar *et al.* (2005) Gupta *et al.*(2012) and Dev *et al.* (2015) reported non-significant effect of period of calving on SP in different breeds of buffaloes.

Effect ofseason of calving

Significant effect of season of calving on dry period was reported by Kumar (2000), Dhirendra *et al.* (2003), Suesh *et al.* (2004), Kumar *et al*. (2005) and Dev *et al.* (2015) in Murrah buffaloes, Nagda *et al.* (2007) in Surti buffaloes and Barman (2009) in Murrah buffaloes. However, non-significant effect of season of calving on FSP was reported by Dhara (1994) and Nath (1996).

Effect of age at first calving

Significant effect of AFC on FSP was reported by Kanaujia *et al.* (1974). Contrarily, Thiruvenkadan *et al.* (2010) reported non-significant effect of AFC on service period.

5. First calving interval

Calving interval has direct bearing both on reproduction and production efficiencies. Persual of Table 1 shows that calving interval may be as long as 428.30±3.54 days (Gandhi *et al*., 2009) to as long as 559.60±17.30 days (Thiruvenkadan *et al*., 2010). The Table revealed a considerable variability in this trait and hence a pointer of improvement for calving interval in Murrah breed.

Effect of age at first calving

Significant effect of AFC (linear) on FCI was reported by Kanaujia *et al.* (1975) and Gupta *et al.* (2012). Moreover, Kaushik (2000) reported that quadratic regression of AFC was significant ($p<0.05$) on FCI.Non-significant effect of AFC on FCI was reported by Chakraborty *et al.* (2010) and Thiruvenkadan (2011).

(B) Heritability

Knowledge about the magnitude of heritability gives an indication about the scope for affecting genetic improvement through selection or culling of animals Estimates of heritability for various early performance traits of Murrah buffaloes have been summarized in Table 1.

Table 1. Least square means and heritabilities of various early performance traits

Traits	N	Means ± SE	h2±S.E	References
First lactation milk yield (kg)	326	1937.88±28.56	0.29±0.25	Chakraborty *et al.* (2010)
	395	1686.20± 44.40	---------	Thiruvenkadan (2011)
	330	1942.75± 53.79	----------	Gupta *et al.* (2012)
	1213	1761.57±506.91	0.28±0.08	Singh and Barwal (2012)
	515	2229.87± 93.70	----------	Pawar *et al.* (2012)
	832	2034±47.97	----------	Kumar *et al.* (2014)
	435	----------	0.20±0.18	Pareek and Narang (2014)
	479	2086.17±44.66	0.39±0.14	Dev *et al.* (2015)
First peak yield (kg)	326	10.16±0.26	0.19±0.11	Chakraborty *et al.* (2010)
	1479	10.50±0.30	----------	Singh *et al.* (2011) Nilli-Ravi
	395	9.09±0.07	----------	Thiruvenkadan (2011)
	--	12.11±0.27	---------	Tanpure *et al.* (2013)
	435	---------	0.48±0.17	Pareek and Narang (2014)
	1980	8.87±0.05	----------	Thiruvenkadan *et al.* (2014)
	479	9.96±0.11	0.37±0.13	Dev *et al.* (2015)
First lactation milk yield per day of lactation length (Kg/day)	560	6.09±0.03	0.36±0.20	Godara (2003)
	624	5.33±0.12	---------	Suresh *et al.* (2004)
	326	6.09±0.07	0.19±0.23	Chakraborty *et al.* (2010)
	462	6.80±0.20	0.22±0.08	Singh and Barwal (2012)
	1980	6.16±0.04	--------	Thiruvenkadan *et al.* (2014)
	479	6.85±0.09	0.36±0.12	Dev *et al.* (2015)
First service period (days)	289	177.83±4.70	0.11±0.06	Kumar *et al.* (2005) (Hariana)
	3610	193.44±4.23	----------	Nagda *et al.* (2007) (Surti)
	1200	151.46±3.38	----------	Wakchaure *et al.* (2008)
	1200	112.25±2.87		Gandhi *et al.* (2009)
	326	199.04±7.08	0.23±0.25	Chakraborty *et al.* (2010)
	698	253.7±17.3	----------	Thiruvenkadan *et al.* (2010)
	330	208.23±9.78	----------	Gupta *et al.*(2012)
	1213	179.54±125.6	0.17±0.07	Singh and Barwal 2012)
	479	151.40±4.86	0.32±0.12	Dev *et al.* (2015)
First calving interval (days)	1200	428.30±3.54	----------	Gandhi *et al.* (2009)
	326	506.55±7.27	0.17±0.25	Chakraborty *et al.* (2010)
	698	559.6±17.3	0.09±0.13	Thiruvenkadan *et al.* (2010)
	1213	481.86±126.21	0.25±0.08	Singh and Barwal (2012)
	1980	-----	0.18±0.05	Thiruvenkadan *et al.* (2014)
	479	472.64±6.84	0.38±0.12	Dev *et al.* (2015)

Effect of period of calving

Significant effect of period on FCI was reported by Dhara (1994) in Murrah buffaloes and Patel and Tripathi (1998) in Surti buffaloes. Contrarily, non-significant effect of period of calving on FCI was reported by Barman (2009), Thiruvenkadan (2011) and Gupta *et al.* (2012).

Effect of season of calving

Significant effect of season of calving was reported by Dhirendra *et al*. (2003), Grewal *et al.* (2003), Suresh *et al*. (2004), Kumar *et al.* (2005), Lundstrom *et al*. (2007) Barman (2009) and Dev *et al.* (2015) in Murrah buffaloes. Non-significant effect of season of calving on FCI was reported by Saha and Sadana (2000) and Gupta *et al.* (2012).

The heritability estimates of FLMY ranged from 0.20±0.18 (Pareek and Narang, 2014) to 0.39 ± 0.14 (Dev *et al.* 2015). The heritability estimates of FPY ranged from 0.19±0.11 (Chakraborty *et al.*, 2010) to 0.48±0.17 (Pareek and Narang, 2014). The heritability estimates of (FLMY/FLL) ranged between 0.19±0.23 (Chakraborty *et al.*, 2010) to 0.36±0.12 (Dev *et al*. 2015). The heritability estimates of FSP ranged from 0.11±0.06 (Kumar *et al*., 2005) to 0.32±0.12 (Dev *et al*. 2015). The heritability estimates of FCI ranged between 0.09±0.13 (Thiruvenkadan *et al.*, 2010) to 0.38±0.12 (Dev *et al*. 2015).

(C) Genetic and phenotypic correlations

Phenotypic correlation gives an idea about the nature and magnitude of the relationship between two traits Critical evaluation of these results Table-2 revealed that genetic and

Table 2. Genetic and phenotypic correlations among early performance traits in Murrah buffaloes

First lactation milk yield (FLMY) with FPY				
Correlation		Observations	Refrences (Year)	Breed
R_g±s.e	R_p±s.e			
0.71±0.10	0.56±0.05	326	Chakraborty *et al. (*2010)	Murrah
0.89±0.40	0.53	1213	Singh and Barwal *(*2012)	Murrah
0.53±0.10	0.59	435	Pareek and Narang (2014)	Murrah
FLMY with first lactation milk yield per day of first lactation length (FLMY/FLL)				
0.78±0.13	0.63±0.04	1303	Vij and Tiwana (1987)	Murrah
0.80±0.11	0.56±0.11	2107	Kuralkar and Raheja (1997)	Murrah
First lactation milk yield (FLMY) with FSP				
0.12±0.11	0.33±0.03	506	Chander (2002)	Murrah
-	0.33	624	Suresh *et al (*2004)	Murrah
0.919±0.222	0.222	1213	Singh and Barwal *(*2012)	Murrah
First lactation milk yield (FLMY) with FCI				
0.07±0.40	0.42±0.04	506	Chander (2002)	Murrah
-	0.36	624	Suresh *et al.(* 2004)	Murrah
0.892±0.290	0.290	1312	Singh and Barwal (2012)	Murrah
FPY with FLMY/FLL				
----	0.62	624	Suresh *et al.*(2004)	Murrah
0.82±0.07	0.66±0.04	324	Chakraborty *et al.(*2010)	Murrah
0.762	0.522	462	Singh and Barwal *(*2012)	Murrah
FPY with FSP				
0.98±0.42	0.08±0.04	506	Chander (2002)	Murrah
-----	-0.08	624	Suresh *et al.*(2004)	Murrah
0.25±0.19	-0.04±0.06	324	Chakraborty *et al.(*2010)	Murrah
FPY with FCI				
0.41±0.57	0.08±0.04	506	Chander (2002)	Murrah
------	-0.08	624	Suresh *et al* (2004).	Murrah
0.39±0.18	-0.11±0.06	324	Chakraborty *et al.(*2010)	Murrah
0.80±0.11	0.56±0.11	2107	Kuralkar and Raheja (1997)	Murrah
FLMY/FLL with FSP				
-0.01±0.27	-0.33	2107	Kuralkar and Raheja (1997)	Murrah
----	-0.23	624	Suresh *et al.*(2004)	Murrah
-0.29±0.21	-0.19±0.06	324	Chakraborty *et al.*(2010)	Murrah
FLMY/FLL with FCI				
0.05±0.22	-0.25±0.22	2107	Kuralkar and Raheja (1997)	Murrah
-	-0.24	624	Suresh *et al.*(2004)	Murrah
-0.41±0.20	-0.23±0.06	324	Chakraborty *et al.* (2010)	Murrah
FSP with FCI				
0.35±0.24	0.68±0.02	506	Chander (2002)	Murrah
-	0.99	624	Suresh *et al.* (2004)	Murrah
0.91±0.04	0.94±0.02	324	Chakraborty *et al.*(2010)	Murrah
0.767±0.818	0.804	1312	Singh and Barwal (2012)	Murrah

phenotypic correlations among various performance traits observed as low and positive to high and positive, respectively indicating that there existed considerable co variability among these performance traits and could be exploited through selection. While genetic and phenotypic correlation among reproduction traits and with production traits were low. These correlation results on these performance traits are suggestive of the fact that more exhaustive study must be conducted for carrying out correlation studies among these performance traits to arrive at a meaningful conclusion.

Conclusion

Murrah is one of the seventeen documented buffalo breeds of India that has gained international recognition but the productivity of Murrah buffalo has been reported to vary within countries. The variations in performance traits may be more of environmental nature as opposed to genetics; sampling of population and data edits might have widened these ranges. It was also noted that buffaloes calving in winter season produced higher milkyield as compared to those calving in summer seasondue to more availability of fodder and comfortable temperature than in summer. The age at first calving in Murrah was affected by herd, year and season of birth.

The low to moderate estimates of heritability for early performance traits indicated that selection based on progeny performance coupled with performance of collateral relatives would help in improvement of these traits. The high genetic and phenotypic correlations of FLMY with other early production traits indicate that there are some common genes which govern the expression of these traits. Selection on the basis of first peak milk yield would bring desirable improvement in these early performance traits because it also take care of other production efficiency traits as it had moderate estimates of heritability and high and positive genetic correlations with these traits.

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