Evaluation of non-genetic factors on phase traits in Murrah buffaloes

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Abstract
The data on performance records of 2959 Murrah buffaloes at Buffalo Research Center, Department of Livestock Production and Management, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar and Animal farm, CIRB Hisar, spread over a period of 24 years (1992-2015) were utilized for the present study. The overall mean of Lactation length (LL), Dry period (DP), Service period (SP) and Calving interval (CI) were 292.71±3.99 days, 117.41±2.09 days, 135.05±5.10 days and 445.05±5.10 days, respectively. Effect of parity, Period of calving and Season of calving were studied on different phase traits. Period of calving had highly significant effect on all the phase traits under study. Season of calving also had significant effect on different phase traits. Parity and farm also had significant effect on different phase traits.

Keywords: Parity, farm, season of calving, period of calving, Phase traits, Murrah buffaloes

Introduction
The knowledge of milk production parameters during various phases of lactation would help the breeder to have early and preliminary information for sire and buffalo evaluation, and early timely culling of poor performing animals. 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) [3]. The aim of any selection programme in dairy buffalo is to improve milk production and to reduce cost of milk production. Knowledge of genetic and non-genetic factors influencing the performance traits is essential to obtain unbiased estimates of genetic parameters. Therefore, the present investigation was planned to study non-genetic factors affecting phase traits in Murrah buffaloes.

Materials and Methods
In the proposed study breeding information spread over a period of 24 years from 1992 to 2015 was collected from the pedigree, breeding and performance records of Murrah buffaloes maintained at Buffalo Research Centre (BRC), Lala Lajpat Rai University of Veterinary and Animal Sciences and Central Institute for Research On Murrah Buffaloes (CIRB) Hisar. The lactation records of animals with yield less than 500 kg per lactation or with lactation length shorter than 100 days were considered as abnormal and were not included in the study. The phase traits considered were i.e. Lactation Length (LL), Dry period (DP), Service Period (SP) and Calving Interval (CI). The entire period of 24 years was divided into Six periods each consisting of four consecutive years. Each year was further delineated into four seasons viz., summer (April to June), Rainy (July to September), Autumn (October to November) and winter (December to March) depending on the ambient temperature and relative humidity. Abnormal records from the animals having abortion, mastitis, chronic illness, physical injuries etc. were also excluded from the present study. In order to overcome non-orthogonality of the data due to unequal subclass frequencies, least squares and maximum likelihood computer program of Harvey (1990) [7] using Henderson method 111 (Handerson, 1973) [8] will be utilized to estimate the effect of various tangible factors on various traits under study

\[ Y_{ijkl} = \mu + s_i + h_j + c_k + b_1(X_{ijkl} - \bar{X}) + b_2(X_{ijkl} - \bar{X})^2 + e_{ijkl} \]
Where

\[ Y_{ijkl} = \] is the \( i \)th record of individual of the \( j \)th sire calved in \( k \)th period and \( l \)th season

\[ \mu = \] is the overall population mean

\[ s_i = \] is the random effect of \( i \)th sire

\[ b_j = \] is the fixed effect of \( j \)th period of calving

\[ c_k = \] is the fixed effect of \( k \)th season of calving

\[ b_1, b_2 = \] are linear and quadratic partial regression coefficients of

\[ \text{age at first calving}. \]

\[ X = \] is the mean of age at first calving.

\[ e = \] is the error associated with each observation and assumed to be normally and independently distributed with mean zero and variance \( \sigma^2 \).

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) \(^{[14]}\).

Results and Discussion

The analysis report on least square means and analysis of variance for different phase traits is tabulated in tables 1 and 2.

Lactation length (LL): It is the period of economic returns to animal breeder. It is an important trait as it reflects the periodicity of milk production and influences the milk yield to greater extent. The overall least-squares mean for LL was estimated as 292.71±3.99 days. The estimate obtained in the present study was in close agreement with Patel and Tripathi (1998) and Chaudhari, M. (2015) \(^{[2]}\) in Surti and Murrah buffaloes, respectively. However, Gandhi et al. (2009) and Thiruvenkadan et al. (2010) reported lower least-squares means (273.54±2.64 and 289.06±2.37, respectively) in Murrah buffaloes. The analysis of variance revealed highly significant \((<0.01)\) effect of farm on LL. The lactation length was highest on farm 2 as compared to farm 1. Similarly results were reported by Cady et al. (1983) and Kumar, V. (2015). The analysis of variance revealed significant \((p<0.05)\) effect of period of calving on LL. The lactation length showed decreasing trend across the periods. Suresh et al. (2004) and Thiruvenkadan et al. (2010) reported highly significant influence of period of calving on LL in Murrah buffalo. Aziz et al. (2001) and Chaudhari, M. (2015) \(^{[2]}\) also found highly significant \((p<0.01)\) effect of period of calving on LL in Egyptian buffalo and Murrah buffaloes, respectively. While, Kangdasamy (1987) and Aziz et al. (2001) reported non-significant effects of period of calving on LL in buffaloes. The effect of season of calving on LL was highly significant \((<0.01)\). The lactation length was highest in summer calvers and lowest in rainy calvers. Patel and Tripathi (1998), Aziz et al. (2001) and Chaudhari, M. (2015) \(^{[2]}\) reported that season of calving significantly affect the DP in Surti buffalo, Egyptian buffalo and Murrah buffaloes respectively. However, Suresh et al. (2004) reported non-significant effect of season of calving on dry period in Murrah buffaloes. The analysis of variance revealed highly significant \((<0.01)\) effect of parity on DP. The dry period was highest in 1st parity followed by 2nd parity and lowest in 4th parity. There was decrease in DP from 1st to 4th parity. Suresh et al. (2004) and Chaudhari, M. (2015) \(^{[2]}\) reported non-significant effect of parity on DP in Murrah buffaloes. However, Aziz et al. (2001) and Bharat et al. (2004) reported significant effect of parity on DP in Egyptian buffalo and light breed of buffaloes (Surti, Mehsana, Surti×Mehsana), respectively. Similarly, Patel and Tripathi (1998) reported highly significant effect of parity on DP in Surti buffaloes. Effect of age at first calving (linear as well as quadratic) was found to be non-significant on DP. Thiruvenkadan (2011) reported non-significant effect of AFC on DP in Murrah buffaloes. However, Chaudhari, M. (2015) \(^{[2]}\) reported non-significant effect of regression of AFC on DP in Murrah buffaloes.

Service period (SP): It is the period between calving and subsequent successful conception. Generally, an optimum period of 60 days is allowed as post-partum rest. Besides, managemental and environmental factors, it is generally regarded as the function of initiation and regularity of estrus and number of service per conception. The overall least-squares mean for SP was estimated as 135.05±5.10 days. However, Thiruvenkadan et al. (2010) and Chaudhari, M. (2015) \(^{[2]}\) reported higher least-squares means (253.70 days
and 171.04 days) in Murrah buffaloes. Gandhi et al. (2009) reported lower least-squares mean (112.25±2.87) in Murrah buffaloes. The service period in buffaloes is generally reported to be very long because of various causes like silent heat, an-ovulatory heat, seasonal ovarian inactivity, embryonic mortality and infertile services etc. The analysis of variance revealed highly significant (<0.01) effect of farm on SP. The service period was highest on farm 2 as compared to farm 1. Similar results was reported by Kumar, V. (2015). The analysis of variance revealed highly significant (<0.01) effect of period of calving on SP. Chaudhari, M. (2015) [2] reported non-significant effect of period of calving on SP in Murrah buffaloes. While, Suresh et al. (2004) and Thiruvenkadan et al. (2010) observed significant effect of period of calving on SP in Murrah buffaloes. The effect of season of calving on SP was highly significant (p<0.01). The service period was highest in winter calvers and lowest in rainy calvers. A significant effect of season of calving on SP was also reported by Suresh et al. (2004), Thiruvenkadan et al. (2010) and Chaudhari, M. (2015) [2] in Murrah buffaloes. However, Hussain et al. (2006) reported non-significant effect of season of calving on SP in Nili-Ravi buffaloes. The analysis of variance revealed highly significant effect (p<0.01) of parity on SP. The service period was highest in 1st parity and lowest in 4th parity. There was decrease in SP from 1st to 4th parity. Chaudhari, M. (2015) [2] reported significant effect of parity on SP. The service period was highest in 1st parity and lowest in 4th parity and 5th parity in Murrah buffaloes. However, Suresh et al. (2004) and Hussain et al. (2006) reported non-significant effect of parity on SP in Murrah and Nili-Ravi buffaloes. Effect of age at first calving (linear as well as quadratic) was found to be non-significant on SP. Kamaldeep (2014) reported similar result regarding regression of AFC on SP in Murrah buffaloes.

**Calving interval (CI):** Calving interval is the period between two consecutive calvings. Calving interval has direct bearing on both reproduction and production efficiencies. Short calving interval along with early age at first calving are required for better efficiency of milk production. The overall least-squares mean for CI was estimated as 445.05±5.10 days. However, Patel and Tripathi (1998) and Chaudhari, M. (2015) [2] reported higher least-squares mean (556.0±11.90 days, 479.83±5.90 days respectively) in Murrah buffaloes. Gandhi et al. (2009) reported lower least-squares mean (428.30±3.54) in Murrah buffaloes. The calving interval has a great economic bearing on the lifetime production of dairy animal. In order to reduce the unproductive period and to enhance calf crop during the lifespan of dairy animals, reduction in the length of calving interval seems most important. The calving interval in farm animals mainly determined by service period. In general, better management to reduce service period will significantly shorten the calving interval. The analysis of variance revealed highly significant (<0.01) effect of farm on CI. The calving interval was highest on farm 2 as compared to farm 1. Cady et al. (1983) and Kumar, V. (2015) reported significant effect of farm on calving interval. The analysis of variance revealed highly significant (<0.01) effect of period of calving on CI. Dass and Sadana (2000), Suresh et al. (2004) and Thiruvenkadan et al. (2010) reported significant effect of period of calving on CI in Murrah buffaloes. However, Chaudhari, M. (2015) [2] reported non-significant effect of period of calving on CI in Murrah buffaloes. The effect of season of calving on CI was highly significant (p<0.01). The calving interval was highest in winter calvers and lowest in rainy calvers. Longer CI in winter season might be due to better feeding, management and seasonality of calving in buffaloes as winter calver wait longer to rebreed as compared to summer or rainy calver. Aziz et al. (2001), Lundstrom et al. (2007) and Chaudhari, M. (2015) [2] reported significant influence of season of calving on CI in Egyptian and Murrah buffaloes, respectively. On the contrary, Hussain et al. (2006) reported non-significant effect of season of calving on CI in Nili-Ravi buffaloes. The analysis of variance revealed highly significant (p<0.01) effect of parity on CI. The calving interval was highest in 1st parity and lowest in 4th parity. There was a consistently decrease in CI from 1st to 5th parity. Aziz et al. (2001), Bharat et al. (2004) and Chaudhari, M. (2015) [2] reported significant effect of parity on CI in Egyptian buffalo, light breed of buffaloes (Surti, Mehsana, Surti×Mehsana) and Murrah respectively. Similarly, Patel and Tripathi (1998) reported highly significant effect of parity on CI in Surti buffaloes. However, Suresh et al. (2004) reported non-significant effect of parity on CI in Murrah buffaloes. Effect of age at first calving (linear as well as quadratic) was found to be non-significant on CI. Kamaldeep (2014) reported similar result regarding regression of AFC on CI in Murrah buffaloes.

### Table 1: Least squares analysis of variance for different Phase traits.

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>d.f.</th>
<th>LL squares</th>
<th>DP squares</th>
<th>SP squares</th>
<th>CI squares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sire</td>
<td>219</td>
<td>6017.15</td>
<td>5342.22</td>
<td>10237.02</td>
<td>10237.02</td>
</tr>
<tr>
<td>Period</td>
<td>5</td>
<td>10281.97**</td>
<td>14291.73**</td>
<td>36809.79**</td>
<td>36809.79**</td>
</tr>
<tr>
<td>Season</td>
<td>3</td>
<td>86348.27**</td>
<td>125365.98**</td>
<td>226486.71**</td>
<td>226486.71**</td>
</tr>
<tr>
<td>Regression Linear</td>
<td>1</td>
<td>25551.81**</td>
<td>841.10</td>
<td>139.39</td>
<td>139.39</td>
</tr>
<tr>
<td>Regression Quadratic</td>
<td>1</td>
<td>498.13</td>
<td>78.00</td>
<td>2119.41</td>
<td>2119.41</td>
</tr>
<tr>
<td>Remaider</td>
<td>2721</td>
<td>3819.96</td>
<td>3477.08</td>
<td>7164.75</td>
<td>7164.75</td>
</tr>
</tbody>
</table>

* p<0.05 and ** p<0.01
Table 2: Least-squares means and their standard errors for different Phase traits

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Obs.</th>
<th>LL (Days)</th>
<th>DP (Days)</th>
<th>SP (Days)</th>
<th>CI (Days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall mean</td>
<td>2939</td>
<td>292.71±3.99</td>
<td>137.42±3.74</td>
<td>135.05±5.10</td>
<td>443.05±5.10</td>
</tr>
<tr>
<td>P (1996-99)</td>
<td>454</td>
<td>288.32±5.70</td>
<td>140.48±5.39</td>
<td>133.37±7.55</td>
<td>443.37±7.55</td>
</tr>
<tr>
<td>P (2000-03)</td>
<td>766</td>
<td>286.35±4.70</td>
<td>128.11±4.43</td>
<td>119.29±6.13</td>
<td>429.29±6.13</td>
</tr>
<tr>
<td>P (2004-07)</td>
<td>677</td>
<td>292.16±4.94</td>
<td>137.35±4.66</td>
<td>130.52±6.47</td>
<td>440.52±6.47</td>
</tr>
<tr>
<td>P (2008-11)</td>
<td>605</td>
<td>298.57±5.31</td>
<td>133.09±5.02</td>
<td>139.42±7.60</td>
<td>449.42±7.60</td>
</tr>
<tr>
<td>P (2012-15)</td>
<td>333</td>
<td>286.82±5.69</td>
<td>128.32±6.24</td>
<td>123.74±8.80</td>
<td>433.74±8.80</td>
</tr>
<tr>
<td>Seasons: Summer</td>
<td>428</td>
<td>305.08±5.05</td>
<td>136.00±4.77</td>
<td>139.50±6.63</td>
<td>449.50±6.63</td>
</tr>
<tr>
<td>Rainy</td>
<td>1167</td>
<td>283.36±4.24</td>
<td>124.48±3.98</td>
<td>117.19±5.46</td>
<td>427.19±5.46</td>
</tr>
<tr>
<td>Autumn</td>
<td>741</td>
<td>280.91±4.40</td>
<td>132.62±4.14</td>
<td>124.86±5.70</td>
<td>434.86±5.70</td>
</tr>
<tr>
<td>Winter</td>
<td>623</td>
<td>301.49±4.59</td>
<td>156.50±4.32</td>
<td>158.64±5.97</td>
<td>468.64±5.97</td>
</tr>
</tbody>
</table>

Means superscripted by different letters differ significantly among themselves

Conclusion

From the above study it can be concluded that environmental factors like season, period and parity are significantly influencing most of the reproduction traits. The differences in the reproductive performances over different periods and seasons may be attributed to the differences in feeding and managerial practices at the farm as well as differences in the heat expression and detection in different seasons and periods. It is therefore important to emphasize the amelioration of husbandry practices, proper feeding of the animals in adverse environmental conditions and proper heat detection especially in summer.

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References