Effect of non-genetic factors on age at first freezing and age at first use in Murrah bulls

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ABSTRACT
In present investigation, the effect of non-genetic factors on age at first freezing and age at first use in Murrah breeding bulls has been studied. The data on reproduction traits of 57 Murrah bulls under NDRI (National Dairy Research Institute) centre belonging to 14 sets of Network Project on Buffalo Improvement at ICAR-NDRI, Karnal (Haryana), India during 20 years (1993-2013) were analysed using fixed linear model. The data were classified into various sub-classes for season of freezing and use, period of freezing and use, parity, stages of lactation and age groups of buffalo for age at first freezing and age at first use of Murrah breeding bulls. The average age at first freezing and use of Murrah bulls was estimated as 3.46 ± 0.08 years and 4.05 ± 0.13 years with the coefficient of variation of 14.43 % and 12.27%. The overall least-squares means for age at first freezing of Murrah bulls was estimated as 3.38 ± 0.01 years. Period and season of freezing had significant effect (P<0.01) on age at first freezing. The overall least-squares means for age at first use was estimated as 3.96 ± 0.03 years in Murrah breeding bulls. Period (P<0.01) and season (P<0.05) of use of bulls had significant effect on age at first use of breeding bulls.

Keywords: Age at first freezing, Age at first use, Least-squares means, Murrah bull, Non-genetic factor.

INTRODUCTION
In India, livestock is an integral component of agriculture and dairy sector plays a vital role in agricultural economy with an annual growth rate of 4.97% (Anonymous, 2012-2013) India ranks first in milk production (132.4 million tonnes) and the contribution of buffaloes to the total milk production of India is around 51.1 per cent (Anonymous, 2012-2013) and Buffalo is thereby considered as India’s milking machine although the number of buffaloes (108.7 million) is less than cattle (190.90 million) in India (Anonymous, 2012). The home tract of Murrah breed is in Rohtak, Jind and Hisar districts of Haryana and the breed is extensively used to upgrade the non-descript buffaloes in India.

Bulls are considered to be “more than half of the herd” because the contribution of male in genetic improvement of herd is more than female. Male fertility is regulated by animal’s genetic disposition and environmental factors. The term fertility denotes ability of an animal to produce young ones. Bull fertility helps in improving the productive and reproductive performance in the herd. In contrast to genetic evaluations for performance and conformation traits, only a bull’s own records contribute to his male fertility evaluation. Tanabe and Salisbury (1946) reported peak AI bull fertility at 2 year of age, whereas Bishop (1970) reported highest bull fertility at somewhat older ages of 3 to 4 year. In general, research on bull’s age effects on fertility support the general pattern which is increasing fertility to an age of 3 to 5 year, followed by some decline thereafter. Service sire age have been found to affect conception rate in dairy cattle (Kuhn et al., 2006).

The age of breeding bulls in relation to their fertility will help in the selection and use of breeding bulls at right age thereby will improve the herd efficiency for reproduction. Kuhn and Hutchison (2008) found that the age of the bull at the time of mating was the major factor and the variation of conception rate and thereby fertility was maximum at five years of age, then decreased somewhat approximately up to age of 9 or 10 years. The purpose of the present study was to examine the effect of non-genetic factors on age at first freezing and age at first use of Murrah bulls, which would aid in designing more effective breeding programmes.

MATERIALS AND METHODS
The study was conducted on records of 57 Murrah bulls maintained under 14 sets of Network Project on Buffalo improvement at ICAR-NDRI, Karnal. On standardization and
normalization of traits the number of bulls remained in the analysis were 57 for age at first freezing and 56 for age at first use. Each year was sub-classified into four seasons, depending on prevalent meteorological factors as recorded in CSSRI, Karnal (Singh, 1983). The traits under study were Age at First Freezing (AAFF) and Age at First Use (AAFU).

The effect of non-genetic factors on reproduction traits were studied by least-squares analysis for non-orthogonal data, using fixed linear model (Harvey, 1990). The following models were used with assumptions that different components being fitted into the model were independent and additive.

The model for Age at First Freezing was considered as

\[ Y_{ijk} = \mu + P_i + S_j + e_{ijk} \]

where, \( Y_{ijk} \), observation on the \( k \)th bull in \( i \)th period and \( j \)th season; \( \mu \), overall mean; \( P_i \), fixed effect of \( i \)th period of freezing (1 to 14); \( S_j \), fixed effect of \( j \)th season of freezing (1 to 4) and, \( e_{ijk} \), random error ~ NID (0, \( \sigma_e^2 \)).

The model for Age at First Use was considered as

\[ Y_{ijklm} = \mu + P_i + S_j + P_{A} + S_{L} + b(\text{AF}_{m} - \bar{\text{AF}}) + e_{ijklm} \]

where, \( Y_{ijklm} \), observation on the \( n \)th bull in \( i \)th period of first used, \( j \)th season of first used, \( k \)th parity, \( l \)th stages of lactation and \( m \)th age of buffalo; \( \mu \), overall mean; \( S_j \), fixed effect of \( j \)th season of use (1 to 4); \( P_i \), fixed effect of \( i \)th period of use (1 to 14); \( P_{A} \), fixed effect of \( k \)th parity (1 to 5); \( S_{L} \), fixed effect of \( l \)th stage of lactation (1 to 3); \( b \), regression of age of female on the trait; \( \text{AF}_{m} \), Age of mth buffalo; \( \bar{\text{AF}} \), average age of buffalo; and \( e_{ijklm} \), random error ~ NID (0, \( \sigma_e^2 \)). The difference of means between subclasses of periods, seasons, parity and stage of lactation were tested for significance using Duncan’s Multiple Range Test (Kramer, 1957).

**RESULTS AND DISCUSSION**

The objective of the present study was to assess the age at maturity of bulls when the semen is collected for first freezing and the time when the bull was first used in the herd. The study was not to observe the influence of non-genetic factors on seminal parameters. Though many literature reported that there is variation of seminal parameters between seasons and periods owing to the extreme stress on bull. Under progeny testing programme bulls are evaluated based on the daughter performance. A set of bulls are used in Network Project on Buffalo Improvement and the duration of each set (test cycle) is around 18 months. In the present study, 14 sets of bulls were used at NDRI herd. Freezing of semen is one of the important criteria for selecting a bull and the objective is to get the required number of frozen semen doses from a bull at the start of the set. The purpose of using frozen semen for A.I in breeding programme is to use the bulls randomly and all bulls should be used from the beginning of the set. The overall least-squares mean of AAFF was 3.38 ± 0.01 years. The mean obtained was in accordance with the values reported by other workers in Murrah bulls (Mukhopadhy et al., 2010). The analysis of variance for season and period of freezing and use, stage of lactation, age of female and parity affecting AAFF and AAFU under model are presented in Table 1. Period and season of freezing had significant effect (P<0.01) on age at first freezing (Figure 1 and 2). Similar findings were reported by other workers in Murrah bulls (Mukhopadhy et al., 2010). The overall least-squares mean of AAFU was 3.96 ± 0.03 years. No literature is available on age at first use of Murrah bulls under progeny testing programme. Period (P<0.01) and season (P<0.05) of use had significant effect on age at first use of Murrah bulls (Figure 1 and 2). The effect of parity, stage of lactation and age of female was found non-significant in age at first use. Till now no literature is available regarding the effect of these non-genetic factors on age at first use.

In the first seven periods i.e., July 1993-December 2003, the AAFF and AAFU was higher but thereafter AAFF and AAFU was found declined which indicates that management of animals were improved significantly from 2003 in the herd. This may be due to the fact that silage based feeding system was replaced by a more efficient energy based feeding system from December, 2003 in the herd. It was also observed that AAFF was almost similar in all seasons irrespective of birth/raising of the bulls in different seasons. Winter and summer seasons were having the same AAFF inspite of the fact that Murrah bulls were raised randomly in different seasons. The AAFF was ranging from 3.30 years in rainy season (July-September) to 3.45

<table>
<thead>
<tr>
<th>Sources of variation</th>
<th>AAFF(years)</th>
<th>Sources of variation</th>
<th>AAFU(years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period of freezing</td>
<td>42.29** (13)</td>
<td>Period of use</td>
<td>42.77** (13)</td>
</tr>
<tr>
<td>Season of freezing</td>
<td>1.44** (3)</td>
<td>Season of use</td>
<td>1.92* (3)</td>
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<td>-</td>
<td>-</td>
<td>Parity</td>
<td>0.35 (4)</td>
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<tr>
<td>-</td>
<td>-</td>
<td>Stage of lactation</td>
<td>0.49 (2)</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>Age of female</td>
<td>0.31 (1)</td>
</tr>
<tr>
<td>Error</td>
<td>0.12 (40)</td>
<td>Error</td>
<td>0.56 (32)</td>
</tr>
</tbody>
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Figures in parentheses indicate respective degrees of freedom. *P < 0.05, **P < 0.01
years in autumn season (October - November), with a minimum variation of 0.08 years (rainy–summer and rainy - winter) and maximum variation of 0.15 years (rainy and autumn). Similarly, the gap between AAFF and AAFU of Murrah bulls was almost similar for winter (December-March), summer (April-June) and autumn (October-November) season with a minimum variation of 0.6 years and maximum variation of 0.71 years was found in the rainy season (July-September). This is due to different date of birth of bulls and as a result some bulls do not fulfill the required target of frozen semen doses before starting of the use of bulls in each set as, the number of bulls allotted from the centre in each set is very small.

CONCLUSION

The average age at first freezing and age at first use of Murrah bulls were estimated as 3.38 ±0.01 and 3.96 ± 0.03 years, respectively. The age at first freezing and use of Murrah bull’s semen were significantly influenced by period and season of freezing and use of bulls. The AAFF of bulls in each set was similar irrespective of their age at puberty and date of birth. The energy levels should be taken into consideration to achieve an earlier age at first freezing and use of the bulls at the same time randomly in each set under progeny testing programme.

REFERENCES