Genetic analysis of reproductive traits of Tharparker cattle at organized farms in Rajasthan

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ABSTRACT
The present study was carried out from the data obtained on the reproduction performance of 95 Tharparker cattle over the period 1995-2014. The overall least squares mean and standard error for age at first calving, service period, gestation period, dry period and intercalving period were 1769.07± 29.80, 117.53± 2.39, 281.62± 0.37, 105.03 ± 2.09 and 399.97 ± 2.44 days, respectively. The Least Squares Analysis of Variance has revealed that there was a significant effect of sire (P<0.01) and period (P<0.05) on age at first calving and the service period is significantly influenced by period and parity of the animal. Similarly the gestation period was affected by parity, dry period was affected by period of study and intercalving period was substantially influenced by period and parity of the animal. The observed correlation coefficients among different reproductive traits were significant to highly significant whereas the estimates of heritability for the same traits were low to moderate. The significant effect of several non-genetic factors on most of the reproductive traits suggesting that they are low heritable and cannot be improved by conventional selection methods but can only be improved through effective management practices, nutrition, health etc..

Key words: Age at first calving, Dry period, Gestation period, Intercalving period, Reproduction performance, Service period.

INTRODUCTION
Animal husbandry is an integral part of Indian agriculture. Cattle and buffaloes are basically more important to our national economy among all livestock. India represented by 41 cattle breeds evolved in different agro climatic regions. Sahiwal, Red Sindhi, Tharparkar and Gir have averaged from 1900 to 2700 liters of milk in a 305 days (Dubey and Singh, 2005).

Tharparker is an important indigenous milch breed (Bos Indicus) with lyre -horns, derived its name from the Thar Desert (Lall, 1994). The animals are very well adapted to desert vagaries due to their capacity to thrive on poor quality forage, and highly heat tolerant. Due to indiscriminate breeding, cross breeding and frequent extreme climatic conditions and mechanization of agriculture led to the dilution of the breed and the population of pure bred animal is decreasing day by day. Hence there is an urgent need to conserve this contribute substantially to economy, genetic diversity, animal genetic resources of this country as a milch breed and well adapted to harsh climatic conditions. The productivity of this breed can further be increased by providing proper environmental conditions in terms of nutrition, health care in their adaptive breeding tract.

MATERIALS AND METHODS
The present study was designed by including different reproductive traits to evaluate the reproductive performance and the factors (non genetic) affecting them in Tharparker cattle during the period 1995-2014 at Livestock Research Station, Chandan, Jaisalmer, Rajasthan, India.

The 20 years data of different reproductive traits were obtained from records maintained at Livestock Research Station, Chandan, Jaisalmer, Rajasthan. The history sheets belong to cows with different sires, belonging to different periods viz.: P1 (1995-1999), P2 (2000-2004), P3 (2005-2009), P4 (2010-2014), six parities (Ith to VIth) and four seasons (winter, summer, monsoon, Post monsoon) viz. S1 (Dec to Feb), S2 (Mar to Jun), S3 (July to Sep), S4 (Oct to Nov) were utilized for obtaining data and analysis. The data pertaining to individual cow’s reproduction performance and the factors influencing them (sire, parity, period and season) were studied in the present study. The incomplete data of individual cows were eliminated from the present study.

The reproduction parameters for which the data was obtained were Age at first calving, Service period, Gestation Period, Dry period and Inter calving period.

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The data pertaining to the reproductive traits was subjected to the Least Squares Analysis Technique as per standard procedure outlined by Harvey (1976) of variance. The corrected data was used for estimation of genetic correlations. The genetic correlations (rG) were estimated by using following formula as below,

\[ r_G(XY) = \frac{\text{Cov}_{XY}}{\sqrt{[\sigma^2_s(X) \cdot \sigma^2_s(Y)]}} \]

Where,
- X and Y are the traits of the same individual
- \( \text{Cov}_{XY} \) = Sire component of Covariance between traits X and Y
- \( \sigma^2_sX \) and \( \sigma^2_sY \) = Sire component of variance for traits X and Y, respectively.

The phenotypic correlations (rP) were obtained for various reproduction traits with following formula:

\[ r_P(XY) = \frac{\text{Cov}_{(X)+\text{Cov}_{e}(XY)}}{\sqrt{[\sigma^2_s(X) + \sigma^2_e(X)] \cdot [\sigma^2_s(Y) + \sigma^2_e(Y)]}} \]

Where
- \( \text{Cov}_{(X)} \) = Sire component of covariance between traits X and Y
- \( \text{Cov}_{e}(XY) \) = Error component of covariance between traits X and Y
- \( \sigma^2_e(X) \) and \( \sigma^2_e(Y) \) = Error component of variance for traits X and Y, respectively.
- \( \sigma^2_s(X) \) and \( \sigma^2_s(Y) \) = Sire component of variance for traits X and Y, respectively.

Based on corrected data the heritabilities were estimated by Paternal Half-Sib correlation method as outlined by Hazel and Terril (1945).

**RESULTS AND DISCUSSION**

**Age at first calving:** The observed overall LSMs for age at first calving (Table 1) was 1769.07±29.80 days which was in close agreement with the earlier findings of Thombre et al., (2002) as 1777.64 ±50.24 days in Deoni cattle and Bhadoria (2002) 1719.09±8.11 days in Gir cattle.

In contrary to the above findings, Kamal Kishore (2012) and Chand (2011) reported as the values for the trait were 1821.86±37.02 and 1876.17 ± 40.66 days respectively in Tharparkar, however lower age at first calving was reported by Gahlot (1999) 1388.18±8.97 days in the same breed.

The sire effect was significantly (P<0.01) affected the age at first calving but seasonal effect was not significant (Table 2). These findings are in accordance with the reports of Kamal Kishore (2012); and with Bhutkar et al. (2014).

The lowest age at first calving was observed for Sire K5, period P4 and summer season where as it was higher for those born to sire K3, in period 3 and during period 3. As the sire component of variation is contributing substantially for the trait selection based on of Dam’s age at first calving may definitely improve the trait.

The period has significantly affected the age at first calving may be indicative of the fact that the trait was improved over the periods by selection for age at first calving from period P1 to P4.

The season of calving had no influence on age at first calving concluding that this non-genetic factor doesn’t have any significant role in expressing this trait.

**Service period:** The overall LSMs for service period (Table 3) was 117.53±2.39 days which was in agreement with reports of Kuralkar et., al. (2014) who reported the value as 116.04±3.21 days in Deoni where as higher values(122.04 ±4.264 , 203.73±12.47and 261.26±26.15 days reported by Kamal Kishore (2012), Bhutkar et al. (2014) and Kumar et al. (2016) in Tharparker, Deoni and Ongole cattle in respectively as breed differences exist for trait naturally among breeds.

**Table 1:** Least Squares Means and standard errors for age at first calving of Tharparkar cattle.

<table>
<thead>
<tr>
<th>Sources of variation</th>
<th>Code</th>
<th>N</th>
<th>Age at first calving (days) Mean±S.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population mean</td>
<td>μ</td>
<td>95</td>
<td>1769.07±29.80</td>
</tr>
<tr>
<td>Sire</td>
<td>S1</td>
<td>25</td>
<td>1820.24±65.17</td>
</tr>
<tr>
<td></td>
<td>S2</td>
<td>12</td>
<td>1826.37±78.97</td>
</tr>
<tr>
<td></td>
<td>S3</td>
<td>18</td>
<td>2051.38±68.63</td>
</tr>
<tr>
<td></td>
<td>S4</td>
<td>16</td>
<td>1870.14±68.73</td>
</tr>
<tr>
<td></td>
<td>S5</td>
<td>11</td>
<td>1530.48±79.09</td>
</tr>
<tr>
<td></td>
<td>S6</td>
<td>13</td>
<td>1907.63±73.17</td>
</tr>
<tr>
<td>Period</td>
<td>S1</td>
<td>23</td>
<td>1755.85±50.66</td>
</tr>
<tr>
<td></td>
<td>S2</td>
<td>15</td>
<td>1801.04±54.82</td>
</tr>
<tr>
<td></td>
<td>S3</td>
<td>34</td>
<td>1855.89±44.14</td>
</tr>
<tr>
<td></td>
<td>S4</td>
<td>23</td>
<td>1654.52±43.73</td>
</tr>
<tr>
<td>Winter (Dec- Feb)</td>
<td>S1</td>
<td>34</td>
<td>1768.97±37.33</td>
</tr>
<tr>
<td>Summer (Mar-Jun)</td>
<td>S2</td>
<td>35</td>
<td>1706.98±38.67</td>
</tr>
<tr>
<td>Monsoon (July-Sep)</td>
<td>S3</td>
<td>10</td>
<td>1792.99±64.82</td>
</tr>
<tr>
<td>Post Monsoon (Oct-Nov)</td>
<td>S4</td>
<td>16</td>
<td>1807.33±49.94</td>
</tr>
</tbody>
</table>

Note: Means connected by same superscripts do not differ significantly within the column.
Table 4: Least Squares Analysis of Variance (ANOVA) for different reproductive traits.

<table>
<thead>
<tr>
<th>Service period</th>
<th>Gestation period</th>
<th>Dry period</th>
<th>Intercalving period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source</td>
<td>d.f.</td>
<td>MSS</td>
<td>F-value</td>
</tr>
<tr>
<td>Parity</td>
<td>5</td>
<td>7663</td>
<td>3.82**</td>
</tr>
<tr>
<td>Period</td>
<td>3</td>
<td>26170</td>
<td>12.53**</td>
</tr>
<tr>
<td>Season</td>
<td>3</td>
<td>5044</td>
<td>2.51</td>
</tr>
<tr>
<td>Error</td>
<td>489</td>
<td>2008</td>
<td>47.80</td>
</tr>
</tbody>
</table>

**P<0.01, (significant at 1% level),  *P<0.05 (Significant at 5% level)
The dry period being the trait mostly governed by the managerial practices and very less by the genetic and physiological factors. It can be better controlled with proper herd management practices only at Livestock Research Station, Chandan, Rajasthan.

**Inter calving period:** The overall LSM (Table 3) for Intercalving period was 399.97 ± 2.44 days which was according to the findings of Gahlot *et al.* (2002) who estimated it as 398.25±3.09 days in Tharparkar. How ever Kamal kishore (2012), Chand (2011) and Dangi *et al.* (2013) reported the higher values for the same trait as 414.16± 5.314 and 437.69 ±4.29 and 427.44±12.30 days in Tharparkar , and Rathi cattle, respectively. The lower Intercalving period was observed by Kuralkar *et al.* (2014) as 395.87± 3.38 days in Deoni cattle. Period (P<0.01) and parity effects were significant in contrast to the season (Table 4) on Intercalving period which was in agreement with the findings of Patel *et al.* (2000) and Kamal Kishore (2012) in Tharparkar cattle.

The highly significant effect of parity and period on Intercalving period of Tharparkar cattle may be attributed to the physiological stability and improved set of management practices over the time. The higher Intercalving period for the winter calvers may be attributed to harsh climatic conditions experienced by Tharparkar cattle during summer and monsoon in their fag end of completion of lactation and gestation.

**Genetic and phenotypic correlations:** The estimated values for genetic correlations of Age at first calving (Table 5) with service period and with gestation period were 0.305 and 0.217 respectively which were positive and significant.

Whereas the same value of Service period with other traits including gestation period, dry period and Intercalving period were -0.137, +0.476 and +0.984 respectively. The gestation period was negatively (-0.644) correlated with dry period but positively (0.110) with intercalving period. The genetic correlation coefficient of dry period with intercalving period (0.441) was positive and highly significantly correlated. The most of traits were positive highly significant suggesting that the correlated response will be observed among these traits if selection is practiced for single trait.

The phenotypic correlation (Table 5) coefficient of age at first calving with service period (0.114), gestation period (0.122) and Intercalving period (0.115) were positive. where as with dry period (-0.007) it was negative .The phenotypic correlation coefficient of service period with gestation period (-0.057) was negative and with dry period (0.340) and Intercalving period (0.971) were positive . The same values of gestation period with dry period (0.118) and Intercalving period (0.091) were positive and highly significant .The phenotypic correlation coefficient of dry period with Intercalving period (0.348) was positive and highly significant.

**Heritability:** The heritability (Table 5) estimate for age at first calving was 0.70±0.21 which was in agreement with Chand (2011) and Kamal Kishore (2012) in Tharparkar as 0.74±0.22 and 0.76±0.285, respectively and the estimate for service period was 0.15±0.08 which was in close agreement with Pandir (2007) in Red Sindhi ; Kamal Kishore (2012) as 0.12 ±0.066 in Tharparkar and Kumar *et al.* (2016) as 0.16±0.04 in Ongole.

The estimated values for gestation period, dry period and Intercalving period were 0.15±0.06, 0.07±0.020 and 17±0.08, respectively. These values indicating that except age at first calving all the traits showing low heritable values which can only be improved by providing better environment in turns of nutrition and shelter and health care.

**CONCLUSION**

The significant effect of non-genetic factors (parity, period and seasons) play important role in performance of Tharparkar indicative of the fact that higher emphasis on management practices, nutrition, health cover will help in improving the reproduction of these animals. The overall improved reproductive performance over a period of last 20 years may be attributed to rigorous selection of elite animals and culling of poor producers at Livestock Research Station, Chandan, Jaisalmer, RAJUVAS, Bikaner, Rajasthan hence this herd may be recommended for practice open nucleus breeding scheme and provide proper environmental conditions for further improvement of the breed. The low to moderate heritability observed in most of the traits under study indicated that improvement in management practices can further enhance the better expressibility of these reproduction traits.

## Table 5: Genetic , Phenotypic correlations and heritability of various reproductive traits.

<table>
<thead>
<tr>
<th>Trait</th>
<th>Age at first calving</th>
<th>Service period</th>
<th>Gestation period</th>
<th>Dry period</th>
<th>Intercalving period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at first calving</td>
<td>0.70±0.21</td>
<td>0.305***(95)</td>
<td>0.217*(95)</td>
<td>-0.123(95)</td>
<td>0.205*(95)</td>
</tr>
<tr>
<td>Service period</td>
<td>0.114(95)</td>
<td>0.15±0.08</td>
<td>-0.137**(501)</td>
<td>0.476**(501)</td>
<td>0.984**(501)</td>
</tr>
<tr>
<td>Gestation period</td>
<td>0.122(95)</td>
<td>-0.057(501)</td>
<td>0.15±0.06</td>
<td>0.110**(501)</td>
<td>0.110**(501)</td>
</tr>
<tr>
<td>Dry period</td>
<td>-0.007(95)</td>
<td>0.340**(501)</td>
<td>0.118**(501)</td>
<td>0.07±0.02</td>
<td>0.535**(501)</td>
</tr>
<tr>
<td>Intercalving period</td>
<td>-0.065(95)</td>
<td>0.971**(501)</td>
<td>0.091**(501)</td>
<td>0.348**(501)</td>
<td>0.17±0.08</td>
</tr>
</tbody>
</table>

(Heritability estimates were shown on diagonal and genotypic and phenotypic correlation were shown off diagonally.)

**P<0.01 (significant at 1% level) *P<0.05 (Significant at 5% level)**
REFERENCES


Harvey (1976). Least square techniques of Variance using following mathematical model.


