CHAPTER IV
RESULTS AND DISCUSSION

The analysis of 3236 lactation records of 700 Gir cows maintained at Cattle Breeding Farm, Junagadh Agricultural University, Junagadh for the period of 1965 to 2016 (51 Years) was carried out and the results pertaining to means and variances are discussed as under.

General means and standard error for various first lactation traits are presented in Table: 4.1

**Table - 4.1 General means and SE for various first lactation production and reproduction traits of Gir Cattle.**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of Trait</th>
<th>N</th>
<th>Mean</th>
<th>SE</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>AFC (days)</td>
<td>674</td>
<td>1558.3</td>
<td>8.42</td>
</tr>
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<td>2</td>
<td>LL (days)</td>
<td>700</td>
<td>375.79</td>
<td>3.66</td>
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<tr>
<td>3</td>
<td>LY (Lit)</td>
<td>700</td>
<td>2174.02</td>
<td>30.01</td>
</tr>
<tr>
<td>4</td>
<td>LY300 (Lit)</td>
<td>700</td>
<td>1814.47</td>
<td>19.81</td>
</tr>
<tr>
<td>5</td>
<td>MPY (Lit)</td>
<td>700</td>
<td>241.78</td>
<td>2.62</td>
</tr>
<tr>
<td>6</td>
<td>CI (days)</td>
<td>700</td>
<td>454.82</td>
<td>8.81</td>
</tr>
<tr>
<td>7</td>
<td>DP (days)</td>
<td>700</td>
<td>104.34</td>
<td>3.43</td>
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<tr>
<td>8</td>
<td>LY/LL (Lit)</td>
<td>700</td>
<td>5.64</td>
<td>0.06</td>
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<tr>
<td>9</td>
<td>LY/CI (Lit)</td>
<td>700</td>
<td>3.60</td>
<td>0.08</td>
</tr>
</tbody>
</table>
Table - 4.2 Least squares means for various first lactation production and reproduction traits in Gir cattle

<table>
<thead>
<tr>
<th>Effect</th>
<th>N</th>
<th>LL (days)</th>
<th>LY (Lit.)</th>
<th>LY300 (Lit.)</th>
<th>MPY (Lit.)</th>
<th>LY/LL (Lit.)</th>
<th>LY/CI (Lit.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>μ</td>
<td>700</td>
<td>371.2 ± 8.31</td>
<td>2174.1 ± 62.56</td>
<td>1809.8 ± 43.06</td>
<td>243.0 ± 5.84</td>
<td>5.7 ± 0.11</td>
<td>3.7 ± 0.15</td>
</tr>
<tr>
<td>Periods</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1 (&gt;1971)</td>
<td>5</td>
<td>416.0 ± 48.17</td>
<td>2170.3 ± 422.64</td>
<td>1498.3 ± 280.51</td>
<td>209.8 ± 36.26^a</td>
<td>5.3 ± 0.81^b</td>
<td>4.0 ± 1.05^a</td>
</tr>
<tr>
<td>2 (1971-1975)</td>
<td>41</td>
<td>388.5 ± 31.31</td>
<td>2189.0 ± 273.22</td>
<td>1775.9 ± 181.55</td>
<td>227.0 ± 23.51^a</td>
<td>5.6 ± 0.52^b</td>
<td>4.9 ± 0.68^b</td>
</tr>
<tr>
<td>3 (1976-1980)</td>
<td>84</td>
<td>370.2 ± 23.51</td>
<td>2014.1 ± 203.63</td>
<td>1746.3 ± 135.53</td>
<td>239.2 ± 17.59^a</td>
<td>5.7 ± 0.39^b</td>
<td>4.3 ± 0.50^b</td>
</tr>
<tr>
<td>4 (1981-1985)</td>
<td>93</td>
<td>379.3 ± 23.51</td>
<td>2061.3 ± 144.97</td>
<td>1778.6 ± 96.83</td>
<td>233.0 ± 12.62^a</td>
<td>5.8 ± 0.28^b</td>
<td>3.2 ± 0.36^b</td>
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<tr>
<td>5 (1986-1990)</td>
<td>126</td>
<td>367.9 ± 17.01</td>
<td>1955.7 ± 153.58</td>
<td>1555.0 ± 102.50</td>
<td>210.0 ± 13.35^a</td>
<td>5.1 ± 0.29^b</td>
<td>2.9 ± 0.38^c</td>
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<tr>
<td>6 (1991-1995)</td>
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<td>401.5 ± 23.15</td>
<td>2290.9 ± 200.37</td>
<td>1833.6 ± 133.37</td>
<td>252.2 ± 17.31^c</td>
<td>5.5 ± 0.38^b</td>
<td>3.0 ± 0.49^c</td>
</tr>
<tr>
<td>7 (1996-2000)</td>
<td>49</td>
<td>340.0 ± 24.44</td>
<td>1970.7 ± 211.97</td>
<td>1773.8 ± 141.04</td>
<td>249.9 ± 18.29^a,c</td>
<td>5.5 ± 0.40^b</td>
<td>2.1 ± 0.52^d</td>
</tr>
<tr>
<td>8 (2001-2005)</td>
<td>33</td>
<td>342.3 ± 29.72</td>
<td>2356.0 ± 259.03</td>
<td>2020.4 ± 172.16</td>
<td>285.6 ± 22.30^b</td>
<td>6.8 ± 0.50^c</td>
<td>4.4 ± 0.64^de</td>
</tr>
<tr>
<td>9 (2006-2010)</td>
<td>81</td>
<td>351.4 ± 30.40</td>
<td>2064.7 ± 265.15</td>
<td>1812.3 ± 176.2</td>
<td>219.7 ± 22.82^a</td>
<td>4.8 ± 0.51^a</td>
<td>3.8 ± 0.66^e</td>
</tr>
<tr>
<td>10 (2011-2016)</td>
<td>54</td>
<td>354.7 ± 43.33</td>
<td>2667.7 ± 379.86</td>
<td>2303.5 ± 252.17</td>
<td>303.1 ± 32.60^b</td>
<td>6.4 ± 0.73^c</td>
<td>4.8 ± 0.94^e</td>
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## Results and discussion

<table>
<thead>
<tr>
<th>Effect</th>
<th>Economic traits</th>
<th>Season of calving</th>
<th>AFC groups</th>
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<td></td>
<td>N</td>
<td>LL (days)</td>
<td>LY (Lit.)</td>
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<td>Rainy</td>
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<td>356.6 ± 11.02^a</td>
<td>2146.2 ± 89.40</td>
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<td>Winter</td>
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<td>372.9 ± 10.03^c</td>
<td>2218.9 ± 79.79</td>
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<td>Spring</td>
<td>260</td>
<td>388.0 ± 9.67^b</td>
<td>2285.4 ± 76.26</td>
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<td>Summer</td>
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<td>367.3 ± 11.28^a,c</td>
<td>2045.7 ± 91.89</td>
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<td>&lt;1201</td>
<td>128</td>
<td>374.5 ± 11.29^a</td>
<td>2166.3 ± 91.98^a,b</td>
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<td>1201-1400</td>
<td>115</td>
<td>371.1 ± 11.69^a</td>
<td>2218.9 ± 95.76^a</td>
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<tr>
<td>1401-1600</td>
<td>191</td>
<td>361.3 ± 10.24^a</td>
<td>2092.9 ± 81.84^b</td>
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<tr>
<td>1601-1800</td>
<td>175</td>
<td>389.0 ± 10.10^b</td>
<td>2346.9 ± 80.53^a</td>
</tr>
<tr>
<td>1801-2000</td>
<td>91</td>
<td>360.0 ± 12.27^a</td>
<td>2229.6 ± 101.26^a</td>
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</tbody>
</table>

Mean of a trait bearing different superscript differ significantly (P<0.05)
Results and discussion

Table 4.3 Analysis of variance for various first lactation production traits of Gir cattle

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Source</th>
<th>D.F.</th>
<th>Mean squares</th>
<th>LL</th>
<th>LY</th>
<th>LY300</th>
<th>MPY</th>
<th>LY/LL</th>
<th>LY/CI</th>
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<td>1</td>
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<td>14235.6628</td>
<td>867241.7537</td>
<td>403256.7735</td>
<td>7247.5167</td>
<td>3.1927</td>
<td>5.1739</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Period</td>
<td>9</td>
<td>10256.7272</td>
<td>625541.4497</td>
<td>458327.4451</td>
<td>9393.3467*</td>
<td>4.5125*</td>
<td>8.4231*</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Season</td>
<td>3</td>
<td>26640.9108*</td>
<td>1416173.8811</td>
<td>588716.2404</td>
<td>13553.5236*</td>
<td>3.3150</td>
<td>4.5125</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>AFC group</td>
<td>4</td>
<td>18983.7225*</td>
<td>1818840.0310*</td>
<td>433577.2518</td>
<td>7138.4354</td>
<td>2.5372</td>
<td>6.7867</td>
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</tr>
<tr>
<td>5</td>
<td>Error</td>
<td>627</td>
<td>7390.0085</td>
<td>573493.1330</td>
<td>252208.4870</td>
<td>4204.7060</td>
<td>2.1493</td>
<td>3.5848</td>
<td></td>
</tr>
</tbody>
</table>

*P < 0.05; **P < 0.01
General means for Lactation length, Lactation yield and 300 days lactation yields was observed as 375.89 ± 3.66 days, 2174.02 ± 30.01 Lit and 1814.47 ± 19.81 Lit respectively. Monthly peak yield which was recorded as total yield of milk for a particular month reaching to peak after calving was 241.78 ± 2.62 Lit, Lactation yield per day of Lactation length and lactation yield per day of Calving interval averaged 5.64 ± 0.06 and 3.60 ± 0.08 Lit, respectively (table - 4.1).

Age at first calving in Gir cattle in general was observed as 1558.3 days, which was towards higher side. Lactation length in general was towards higher side with persistent milk production befitting to the breed character.

The Gir breed of cattle are late maturing breed is once again corroborated with earlier results obtained by number of workers. The average calving interval and dry period were 454.8 ± 8.81 and 104.3 ± 3.43 days, respectively in the Gir herd.

4.1 Effect of non-genetic factors on first lactation production traits:

Least squares analysis of variance was carried on the 700 first lactation records of Gir cows using LSML, mixed model (Harvey, W R. 1990) for estimation of significance of effects of non-genetic factors such as period of calving, season of calving and effect of age at first calving on first lactation production and reproduction traits in Gir cattle.

The least squares analysis of variance and least squares means for first lactation production and reproduction traits of Gir cattle are presented in table - 4.3 and table - 4.2.

4.1.1 First lactation length (FLL)

The overall least-squares mean for first lactation length (FLL) in Gir Cows was 308.9 + 8.4, days (Table - 4.2). Averages reported in the literature for lactation length by various workers were all higher than that observed in the present study. (Shukla and Prasad 1970, Gajbhiye and Dhanda 1987, Kalawadia 1994, Vataliya et al. 2013, Gajbhiye et al. 2016 in Gir cows).

The least–squares analysis of variance results indicated that lactation length (LL) was significantly (P<0.05) influenced by season of calving and age at first calving (AFC Group) (Table-4.3). Highest average lactation length was observed in cows those calved in season – spring (Jan-March) and lowest lactation length (LL) was observed in cows those calved in rainy season (July-Sept), the averages being 388.0 ± 9.67 and 356.6 ±
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11.02 days, respectively. The cows those calved in the comfortable months of the year (spring) produced for longer period. While, those calved during uncomfortable climatic season i.e. rainy season produced for short duration. Graphical presentation indicates that (Figure - 4.1) cows calved in spring season had longer lactation length.

**Figure - 4.1 First lactation length in different season in Gir cattle**

![Bar graph showing lactation length in different seasons](image)

Similar significant influence of season of calving on lactation length was also observed by Shukla and Prasad (1970), Gajbhiye and Dhanda (1987), Kalawadiya (1994) in Gir cows, Tomar and Sharma (1986), Nagare and Patel (1997) in Gir crosses.

Contrary to this Ulmek (1990) and Dangar, (2012), obtained non significant differences among lactation length due to season of calving in Gir cattle.

First lactation length was also found to be affected by AFC Group, significantly (P<0.05). Cows calved with age at first calving ranging between 1601 - 1800 days had maximum FLL (389.0 ± 10.10 days) while those calved with AFC ranging between 1801-2000 days had lowest FLL (360.0 ± 12.27 days) Table - 4.2. This indicated that higher age at first calving did not favor for producing for longer duration. However cows
in AFC group with AFC ranging between 1401-1600 days also produced significantly (P<0.05) for lesser lactation length (361.3 ± 10.2 days) (Figure - 4.2).

**Figure - 4.2 Lactation length in different AFC group in Gir cattle in first lactation**

4.1.2 **First lactation yield (FLY):**

Overall Least square mean for First Lactation Yield (FLY) in Gir cattle was found as 2174.1 ± 62.56. Lit. (Table- 4.3). Kalawadiya (1994), recorded average first lactation yield close to the present average in Gir cattle.

First lactation yield (FLY) was significantly affected by AFC group only (P<0.05) Table – 4.3. Cows having age at first calving between 1601-1800 days had highest FLY (2346.9 ± 80.53 Lit), while cows having age at first calving between 1401-1600 days had lowest FLY (2092.9 ± 81.8 Lit.) the difference being significant (P< 0.05). Thus it can be concluded that, cows having AFC between 16001-1800 days, a late maturing cows produce higher FLY than early maturing one.
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Figure - 4.3 Lactation yield in different AFC group in Gir cattle in first Lactation

First lactation yield (FLY) in Gir cattle was not found to be influenced by period of calving and season of calving (table – 4.3)

Similar non significant effects of season of calving were also reported by Mishra and Prasad (1994), Kannan and Gandhi (2004), Kumar (2003), Bajetha (2006) in Sahiwal cattle. Divya et al. (2014) and Singh et al. (2016) in Karan Fries cows.

Contrary to this significant effect of period of calving were reported by Raja (2004), Kumar (2007), Manoj (2009), Raja (2010) in Sahiwal cattle.

Significant influence of period calving on 305 FLY was also reported by Taneja and Sikka (1981) in Sahiwal, Tharparkar and Red Sindhi cows.

4.1.3 **300-day first Lactation yield (FLY-300):**

Overall least squares mean for 300-day first lactation yield was obtained as 1809.8 ± 43.06 Lit. First lactation 305 day milk yield in Gir cattle as obtained by Ramani (2016) was 1517.3 ± 65.14 Lit which was lower than that obtained in the present study.

300-day first lactation milk yield (LY-300) was not influenced by either of the factors like period of calving, season of calving and AFC group, at all. These results are in agreement with results obtained by Ramani (2016) in Gir cattle.
4.1.4 Monthly Peak Yield (MPY):

First lactation Monthly Peak Yield i.e. peak production of the month during lactation as observed averaged 243.0 + 5.84 Lit. (Table - 4.2), This trait indicates the production potential of the animal during progression of lactation. As is well known the Gir cows reaches their peak in the third or fourth month of the commencement of lactation. Thus monthly peak production in Gir cattle, exhibits production potential of animals as an indicator to producing ability.

Monthly peak yield (Peak milk yield of the month during the lactation) was again found to be significantly (P<0.05) affected by period of calving and seasonal of calving (figure - 4.4). Thus period to period variation in the milk production in Gir cows indicated the change in the genetic structure of the herd in each period. Seasonal variation can be attributed to availability of nutrition and feed and fodder in a particular season after calving.

Figure - 4.4 Monthly pick yield in different period in Gir cattle in their first Lactation

Significantly (P<0.05), highest MPY (303.1 ± 32.60 Lit) was observed in the cows which calved during the period 10 (Year 2011-2016) while lowest MPY was observed in the cows which calved in the period 01 (Year <1971). The difference being
significant (P<0.05), this also indicates periodical genetic improvement in production potential in Gir cows from 1971 to 2016 (figure - 4.4).

Season of calving exerted significant (P < 0.05) effect on monthly peak yield (MPY) in the first lactation as revealed by least squares analysis of variance (Table - 4.3). The cows calving in the winter season (October –December) produced MPY maximum (250.7 ± 7.21 Lit) while those calved during summer season (April-June) produced MPY minimum (226.5 ± 8.20 Lit). These differences could be attributed to seasonal availability of feed and fodder in the herd (figure - 4.5).

**Figure - 4.5 Monthly pick yield in first lactation of Gir cattle calved in different seasons**
4.1.5 First Lactation yield per day of lactation length (FLY/LL):

General mean for first lactation yield per day of lactation length (FLY/LL) was obtained as 5.64 ± 0.06 Lit (Table - 4.1). The overall least squares means for first lactation yield per day of lactation length was 5.7 ± 0.11 (table - 4.1). Ulmek (1991) and Kalavadia (1994) obtained higher average FLY/LL in Gir cattle than that of observed in the present study.

First lactation yield per day of lactation length (FLY/LL) was significantly (P<0.05) affected by period (table-4.3). The highest Lactation yield per day of lactation length was observed in period 8 i.e. from 2001-2005 was 6.8 ± 0.50. While lowest Lactation length per day of lactation yield was observed in period -9 i.e. 2006-2010 was 4.8 ± 0.51 Lit (Fig.-4.6).

**Figure -4.6 lactation yield per day of lactation length in first lactation of Gir cattle calved in different periods**

![Figure -4.6 lactation yield per day of lactation length in first lactation of Gir cattle calved in different periods](image)

The similar significant effect of period on first lactation yield per day of lactation length (LY/LL) was recorded by Kalavadia (1994).

The season of calving had no significant on First lactation yield per day of lactation length (FLY/LL) in the present study (Table – 4.3).
4.1.6 First lactation yield per day of calving interval (FLY/CI):

General means for first lactation yield per day of calving interval (FLY/CI) was observed as 3.60 ± 0.08 Lit (table - 4.1). The overall least square means for first lactation yield per day of calving interval (FLY/CI) was 3.7 ± 0.15 Lit. (table – 4.2). Ulmek (1991) and Kalavadia (1994) obtained lower average for first lactation yield per day of calving interval (FLY/CI) in Gir cattle.

First lactation yield per day of calving interval (FLY/CI) was significantly (P<0.05) affected by period of calving (table - 4.3). The highest first lactation yield per day of calving interval (FLY/CI) was observed as 4.9 ± 0.68 Lit. It was recorded in period - 2 i.e. in 1971-1975. While the lowest first lactation yield per day of calving interval (FLY/CI) was observed as 2.1 ± 0.52. It was recorded in period - 7 i.e. in years of 1996-2000. Period to period variation in FLY/CI was attributable to genetic change in the herd structure from period to period (Fig – 4.7).

**Figure -4.7 lactation yield per day of calving interval in first lactation of Gir cattle calved in different periods**
The similar results is recorded by Ulmek (1991) and kalavadia (1994), they reported significant effect of period on first lactation yield per day of calving interval in Gir cattle.

4.2 Effect of non-genetic factors on first lactation reproduction traits:

Least squares analysis of variance was carried on the 700 reproduction records of Gir cows using LSML, mixed model (Harvey, W R. 1990) for estimation of significance of effects of non-genetic factors such as period of calving, season of calving and effect of age at first calving on first lactation reproduction traits in Gir cattle.

4.2.1 Age at first calving (AFC):

The least squares means for age at first calving are summarized in table. 4.4 The overall least squares mean for AFC was observed as 1570.0 ± 16.93 days (Table - 4.4). Ulmek (1990) reported age at first calving was 1690.7± 33.9 in Gir cattle which is higher than that obtained in present study. Similarly Singh et al. (2016) reported higher average for age at first calving as 1709.04 ± 51.92 in Gir cattle.

Averages reported in some literature for age at first calving by various workers were lower than that observed in the present study. (Dangar and Vataliya (2014), Gajbhiye et al. (2016), Savaliya et al. (2016).
Table - 4.4 Least squares means for age at first calving of Gir cattle

<table>
<thead>
<tr>
<th>Effect</th>
<th>N</th>
<th>Mean ± SE (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>μ</td>
<td>674</td>
<td>1570.0 ± 16.93</td>
</tr>
<tr>
<td>Period</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (&gt;1971)</td>
<td>13</td>
<td>1507.8 ± 100.27&lt;sup&gt;b,c&lt;/sup&gt;</td>
</tr>
<tr>
<td>2 (1971-1975)</td>
<td>52</td>
<td>1356.8 ± 71.25&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>3 (1976-1980)</td>
<td>77</td>
<td>1453.4 ± 56.58&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>4 (1981-1985)</td>
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</tr>
<tr>
<td>5 (1986-1990)</td>
<td>91</td>
<td>1475.6 ± 45.65&lt;sup&gt;°&lt;/sup&gt;</td>
</tr>
<tr>
<td>6 (1991-1995)</td>
<td>132</td>
<td>1548.5 ± 54.32&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>7 (1996-2000)</td>
<td>51</td>
<td>1748.9 ± 58.79&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td>8 (2001-2005)</td>
<td>40</td>
<td>1665.0 ± 73.46&lt;sup&gt;e&lt;/sup&gt;</td>
</tr>
<tr>
<td>9 (2006-2010)</td>
<td>79</td>
<td>1594.0 ± 78.42&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>10 (2011-2016)</td>
<td>51</td>
<td>1782.0 ± 117.42&lt;sup&gt;f&lt;/sup&gt;</td>
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<td>Season of birth</td>
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<tr>
<td>Rainy</td>
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<tr>
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<td>Summer</td>
<td>127</td>
<td>1605.4 ± 23.91</td>
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</table>

Mean of a trait bearing different superscript differ significantly (P<0.05)
Table - 4.5 Least squares analysis of variance for AFC in Gir cattle

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Source</th>
<th>D.F.</th>
<th>Means squares</th>
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</thead>
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<td>1</td>
<td>Sire</td>
<td>96</td>
<td>78303.13</td>
</tr>
<tr>
<td>2</td>
<td>Period</td>
<td>9</td>
<td>159063.71**</td>
</tr>
<tr>
<td>3</td>
<td>season</td>
<td>3</td>
<td>75794.45</td>
</tr>
<tr>
<td>4</td>
<td>Error</td>
<td>565</td>
<td>37801.69</td>
</tr>
</tbody>
</table>

**P < 0.01

The least–squares analysis of variance results indicated that age at first calving was highly significantly (P < 0.01) affected by period of calving while season of birth had no significant effect on AFC (Table 4.5). The highest value of age at first calving was observed in period 10 i.e. 2011-2016 (1782.0 ± 117.42 days) while, the lowest value of age at first calving was observed in period 2 i.e. in 1971-1975 (1356.8 ± 71.25 days), the difference being significant (P < 0.01) (Fig.- 4.8).

Figure - 4.8 Age at first calving (Days) in different period in Gir cattle
Results and discussion

Dangar and Vataliya (2014) noticed similar highly significant influence effect of period of calving on age at first calving in Gir cows while season of calving did not affect significantly. Savaliya et al. (2016) reported that influence of season of birth was non-significant on age at first calving, in Gir cattle.

Chawla and Mishra (1982) reported highly significant effect of period of birth on age at first calving in Sahiwal cows.

Season of birth and period of birth was found to significantly affect age at first calving in Gir Cattle at Junagadh as observed by Ramani (2016)

Period to period variation in AFC has been exhibited in Fig 4.8. AFC was found to increase during the period 10 (year 2011-2016) as compared to average AFC during 2006-10.

4.2.2 First calving interval (FCI):

The overall least squares mean for first calving interval was obtained as 456.2 ± 17.53 days (table-4.6). Averages reported in the literature for calving interval by various workers were all higher than that observed in the present study. (Odedra et al. 1978, Gajbhiye and Dhandal 1987, Ulmek 1991, Gadariya et al. 2016) in Gir cattle.

The first calving interval was not found to be affected by period of calving and season of calving in present study (Table - 4.7). Similarly Gajbhiye and Dhanda (1987) reported no significant effect of season of calving on calving interval in Gir Cattle at CBF, Junagadh.

The first calving interval was also not influenced by age at first calving. Although it ranged from 445.3 ± 26.41 days in cows was having less than 1201 days AFC to 482.1 ± 22.97 days in cows having 1601-1800 days AFC.

4.2.3 First dry period (FDP):

The overall least squares mean for first dry period was observed as 104.0 ± 6.59 days (Table -4.6). Averages reported in the literature for dry period by various workers were all higher than that observed in the present study (Gajbhiye and Dhanda 1987, Ulmek 1990, Gaur et al. 2003).
The first dry period did not found to be influenced by season of calving and period of calving in the present study (Table- 4.7). Similar results were obtained by Pandey et al. (2001) who reported no significant effect of period and season of calving on dry period in Red Sindhi.

Age at first calving also did not affect the first dry period significantly (table – 4.7). The first dry period in Gir cows was minimum (94.53 ± 11.33 days) in cows having AFC between 1801-200 days. While, it was maximum (110.7 ± 8.82 days) in cows having AFC between (1601-1800 days).
## Results and discussion

### Table - 4.6 Least square means for first lactation reproduction traits in Gir cattle

<table>
<thead>
<tr>
<th>Effect</th>
<th>Reproduction traits</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>N</td>
<td>FCI(days)</td>
</tr>
<tr>
<td>µ</td>
<td>700</td>
<td>456.2 ± 17.53</td>
<td>104.0 ± 6.59</td>
</tr>
<tr>
<td>Periods</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1(&gt;1971)</td>
<td>5</td>
<td>550.3 ± 123.72</td>
<td>115.1 ± 48.81</td>
</tr>
<tr>
<td>2 (1971-1975)</td>
<td>41</td>
<td>507.7 ± 79.87</td>
<td>73.0 ± 31.47</td>
</tr>
<tr>
<td>3 (1976-1980)</td>
<td>84</td>
<td>460.8 ± 59.42</td>
<td>79.6 ± 23.37</td>
</tr>
<tr>
<td>4 (1981-1985)</td>
<td>93</td>
<td>436.0 ± 42.13</td>
<td>83.2 ± 16.50</td>
</tr>
<tr>
<td>5 (1986-1990)</td>
<td>126</td>
<td>445.5 ± 44.68</td>
<td>110.5 ± 17.52</td>
</tr>
<tr>
<td>6 (1991-1995)</td>
<td>134</td>
<td>506.0 ± 58.46</td>
<td>144.29 ± 22.99</td>
</tr>
<tr>
<td>7 (1996-2000)</td>
<td>49</td>
<td>332.8 ± 61.87</td>
<td>108.9 ± 24.34</td>
</tr>
<tr>
<td>8 (2001-2005)</td>
<td>33</td>
<td>508.2 ± 75.70</td>
<td>138.1 ± 29.82</td>
</tr>
<tr>
<td>9 (2006-2010)</td>
<td>81</td>
<td>431.5 ± 77.50</td>
<td>83.17 ± 30.53</td>
</tr>
<tr>
<td>10 (2011-2016)</td>
<td>54</td>
<td>383.0 ± 111.17</td>
<td>103.9 ± 43.85</td>
</tr>
<tr>
<td>Season of calving</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rainy</td>
<td>134</td>
<td>430.2 ± 25.64</td>
<td>98.8 ± 9.90</td>
</tr>
<tr>
<td>Winter</td>
<td>188</td>
<td>455.2 ± 22.75</td>
<td>98.4 ± 8.73</td>
</tr>
<tr>
<td>Spring</td>
<td>260</td>
<td>470.7 ± 21.69</td>
<td>101.8 ± 8.30</td>
</tr>
<tr>
<td>Summer</td>
<td>118</td>
<td>468.7 ± 26.38</td>
<td>116.8 ± 10.20</td>
</tr>
<tr>
<td>AFC groups</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;1201</td>
<td>128</td>
<td>445.3 ± 26.41</td>
<td>108.0 ± 10.21</td>
</tr>
<tr>
<td>1201-1400</td>
<td>115</td>
<td>452.1 ± 27.54</td>
<td>107.8 ± 10.67</td>
</tr>
<tr>
<td>1401-1600</td>
<td>191</td>
<td>452.4 ± 23.37</td>
<td>98.9 ± 8.98</td>
</tr>
<tr>
<td>1601-1800</td>
<td>175</td>
<td>482.1 ± 22.97</td>
<td>110.7 ± 8.82</td>
</tr>
<tr>
<td>1801-2000</td>
<td>91</td>
<td>449.1 ± 29.18</td>
<td>94.53 ± 11.33</td>
</tr>
</tbody>
</table>
## Results and discussion

Table - 4.7 Analysis of variance for various first lactation reproduction traits of Gir cattle

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Source</th>
<th>D.F.</th>
<th>MS</th>
<th>FCI</th>
<th>FDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sire</td>
<td>56</td>
<td>69723.3466</td>
<td>10151.5561</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Period</td>
<td>9</td>
<td>76540.0231</td>
<td>8292.0850</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Season</td>
<td>3</td>
<td>44632.7214</td>
<td>8111.8194</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>AFC group</td>
<td>4</td>
<td>30192.0532</td>
<td>5340.4698</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Error</td>
<td>627</td>
<td>49235.5775</td>
<td>7679.8479</td>
<td></td>
</tr>
</tbody>
</table>

*P < 0.05; **P < 0.01
4.3 Genetic study of production and reproduction performance traits of first lactation

4.3.1 Heritability of First lactation production and reproduction traits

The degree of heritability may be defined as the fraction of the observed variance which was caused by difference in heredity (Lush J. L. 1940).

This fraction is as a statistics describing a particular population. It may vary from population to population for the same characteristic and may vary from one characteristic to another even in the same population (Lush J. L. 1940).

Heritability, genetic and phenotypic correlation estimates for first lactation traits have been presented in table 4.8

Table -4.8 Estimates of additive genetic variance and heritability

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Trait</th>
<th>$\sigma^2A$</th>
<th>$\sigma^2E$</th>
<th>$\sigma^2P$</th>
<th>t</th>
<th>$h^2 \cdot (t\times4)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LL</td>
<td>662.832</td>
<td>7390.00</td>
<td>8052.83</td>
<td>0.082</td>
<td>0.328 ± 0.116</td>
</tr>
<tr>
<td>2</td>
<td>LY</td>
<td>28442.30</td>
<td>573493.13</td>
<td>601935.43</td>
<td>0.047</td>
<td>0.188 ± 0.096</td>
</tr>
<tr>
<td>3</td>
<td>LY300</td>
<td>14625.2968</td>
<td>252208.48</td>
<td>266833.77</td>
<td>0.055</td>
<td>0.22 ± 0.100</td>
</tr>
<tr>
<td>4</td>
<td>MPY</td>
<td>294.6210</td>
<td>4204.70</td>
<td>4498.621</td>
<td>0.065</td>
<td>0.26 ± 0.108</td>
</tr>
<tr>
<td>5</td>
<td>LY/LL</td>
<td>0.10103</td>
<td>2.1493</td>
<td>2.25033</td>
<td>0.045</td>
<td>0.18 ± 0.096</td>
</tr>
<tr>
<td>6</td>
<td>LY/CI</td>
<td>0.15385</td>
<td>3.5048</td>
<td>3.73865</td>
<td>0.041</td>
<td>0.164 ± 0.096</td>
</tr>
<tr>
<td>7</td>
<td>CI</td>
<td>1983.73</td>
<td>49235.57</td>
<td>51219.3</td>
<td>0.039</td>
<td>0.156 ± 0.092</td>
</tr>
<tr>
<td>8</td>
<td>DP</td>
<td>239.32</td>
<td>7679.84</td>
<td>7919.6</td>
<td>0.030</td>
<td>0.12 ± 0.088</td>
</tr>
</tbody>
</table>

4.3.1.1 Heritability of First lactation length (FLL):

Heritability of first lactation length in Gir cattle herd was found as 0.328 ± 0.116 (table - 4.8). Kalavadia (1994) reported similar heritability estimates for first lactation length as 0.364 ± 0.214 in Gir cattle herd.

The results indicate that sufficient amount of additive genetic variance existed in the herd for first lactation length and there is ample scope of genetic improvement in the first lactation length (FLL) through selection. However in general average FLL in Gir cows is already very high (375.79 days) there is need to reduce FLL through selection in order to balance the reproduction and production traits for optimum yield.
Shukla and Prasad (1970), observed higher estimate of heritability in Gir cattle for lactation length as 0.54 ± 0.074, at Cattle Breeding Farm, Junagadh.

Ramani (2016) reported lower estimates heritability of lactation length (0.019 ± 0.032) in Gir cattle herd, at cattle breeding farm, Junagadh.

Ankuya et al. (2016) analyzed 475 first lactation records of Kankrej reported heritability of lactation length as 0.20 in Kankrej cattle.

4.3.1.2 Heritability of First lactation yield (FLY):

Heritability of first lactation yield in Gir cattle herd in the present study was found as 0.188 ± 0.096 (Table - 4.8).

Shukla and Prasad (1970) estimated the heritability for lactation yield as 0.172 ± 0.138 in Gir Cattle at Cattle Breeding Farm, Junagadh.

FLY was found to be moderately heritable and the estimate of heritability is indicative of the fact that improvement in FLY would be slow through selection.

Kalawadia (1994) reported heritability of first lactation yield - 0.048 ± 0.127 in Gir cattle herd. Sharma et al. (1987) and Singh et al. (2001) observed heritability by half sib correlation method as 0.30 ± 0.23 and 0.20 ± 0.03 in Sahiwal respectively while, Dhaka et al. (2002) and Pandey et al. (2001) observed heritability as 0.25 ±0.12 and 0.47 ± 0.22 in Hariana cattle respectively.

4.3.1.3 Heritability of first 300 day milk yield (FLY 300):

Heritability of first 300 day lactation yield in Gir cattle herd was observed as 0.22 ± 0.100 (table - 4.8). The heritability indicated that the first 300 day milk yield possesses moderate genetic variability, However first 300 day lactation yield should be the criterion for selection in the Gir cattle.

Ulmek (1990) estimated heritability of 300 days lactation yield was 0.17 ± 0.07 in Gir cattle. Ramani (2016) observed h² of 305 day first lactation milk yield in Gir Cattle as 0.069 ± 0.04.

Pandey et al. (2001) and Singh et al. (2001) reported heritability estimates for first lactation 300 day milk yield as 0.36 ± 0.20 and 0.20 ± 0.08 in Hariana and Sahiwal respectively.
4.3.1.4 Heritability of first lactation monthly peak yield (MPY):

Heritability of first lactation monthly peak yield was obtained as 0.26 ± 0.108 in Gir cattle herd (table - 4.8). This trait seems to be emerging out as a promising trait exhibiting sufficiently moderate genetic variability in the Gir herd. First lactation monthly peak yield (MPY) hence on ward could be used as important criteria for selection in Gir cows for future breeding and can be safely included in the breeding program.

4.3.1.5 Heritability of first lactation yield per day of lactation length (FLY/LL):

Heritability of first lactation yield per day of lactation length was found to be 0.18 ± 0.096 (table - 4.8). This estimate is indicates indicative of the fact that genetic variability was genetic variability was confounded with environmental variance of two traits. Klawadia (1994) reported heritability of first lactation yield per day of lactation length was 0.323 ± 0.207 which is higher than present study value.

Gandhi and Gurnani (1993) and Singh (1992) reported heritability of first lactation yield per day of lactation length was 0.64±0.03 and 0.14± 0.09 in Sahiwal cattle.

4.3.1.6 Heritability of first lactation yield per day of calving interval:

Heritability of first lactation yield per day of calving interval was found to be 0.164 ± 0.096 in Gir cattle herd (table - 4.8). Similar estimates were also reported by Ulmek (1991) in Gir cattle of same herd. He reported heritability of lactation yield per day of calving interval was 0.16 ± 0.15.

Kalawadia (1994) reported of lactation yield per day of calving interval was 0.216 ± 0.209 in Gir cattle herd, cattle breeding farm Junagadh. Singh (1992) reported heritability of lactation yield per day of calving interval was 0.33 ± 0.09 in Karnal, 0.33 ± 0.13 in Durg, and 0.03 ± 0.03 in Hissar in herds of Sahiwal cattle.

4.3.1.7 Heritability of first calving interval (FCI):

Heritability of first calving interval was obtained as 0.156 ± 0.092 in Gir cattle herd in the present study (Table - 4.8). Dangar (2012) reported heritability for calving interval as 0.068 ± 0.033 in Gir cattle at cattle breeding farm Junagadh. Kalawadia (1994) reported heritability of calving interval -0.030 ± 0.254 in Gir cattle at cattle breeding farm Junagadh. Sethi et al. (1997) reported heritability for calving interval as 0.034 ± 0.07 in Sahiwal cow at cattle breeding farm, Anjora, Madhya Pradesh.
4.3.1.8 Heritability of first dry period (FDP):

Heritability of first dry period was observed as 0.12 ± 0.088 in Gir cattle herd in the present study (Table - 4.8). Kalawadiya (1994) reported heritability of dry period was -0.077 ± 0.140 in Gir cattle at cattle breeding farm Junagadh. The very low estimates of heritability for dry Period were found (0.01 ± 0.04) in Gir by Ulmek (1990). While Javed et al. (2001) reported 0.029 ± 0.018 heritability for dry period in Sahiwal cattle.

In general it can be concluded that genetic variability among the reproduction traits is low and these traits can be improved through management. First lactation monthly peak yield emerged as a promising trait for effective and efficient selection for genetic improvement of milk yield in the Gir herd.

4.3.1.9 Heritability of age at first calving (AFC):

Heritability of age at first calving was obtained as 0.06 ± 0.144 in Gir cattle herd in the present study. This indicated existence of very low genetic variability among the Gir cows for AFC, as the trait is very much influenced by environment. Very high estimates of heritability of AFC in Gir cattle were reported by Shukla (1965) and Ulmek (1991) (0.56 ± 0.38 and 0.53 ± 0.10 in Gir cattle).

Surprisingly, Dangar (2012) recorded heritability of Age at first calving was 0.595 ±0.073 in Gir cattle at cattle breeding farm Junagadh.
Table 4.9 Phenotypic and genetic correlation coefficients among first lactation traits

<table>
<thead>
<tr>
<th>Traits</th>
<th>Genetic correlation</th>
<th>Phenotypic correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>LL</td>
<td>LY 0.166 ± 0.325</td>
<td>0.596</td>
</tr>
<tr>
<td></td>
<td>LY300 0.039 ± 0.323</td>
<td>0.362</td>
</tr>
<tr>
<td></td>
<td>MPY -0.519 ± 0.275</td>
<td>0.074</td>
</tr>
<tr>
<td></td>
<td>CI 0.544 ± 0.290</td>
<td>0.339</td>
</tr>
<tr>
<td></td>
<td>DP 0.088 ± 0.400</td>
<td>-0.045</td>
</tr>
<tr>
<td></td>
<td>LY/LL -0.324 ± 0.341</td>
<td>-0.041</td>
</tr>
<tr>
<td></td>
<td>LY/CI -0.312 ± 0.332</td>
<td>0.169</td>
</tr>
<tr>
<td>LY</td>
<td>LY300 1.010 ± 0.046</td>
<td>0.877</td>
</tr>
<tr>
<td></td>
<td>MPY 0.834 ± 0.159</td>
<td>0.636</td>
</tr>
<tr>
<td></td>
<td>CI 0.626 ± 0.354</td>
<td>0.263</td>
</tr>
<tr>
<td></td>
<td>DP 0.866 ± 0.507</td>
<td>-0.005</td>
</tr>
<tr>
<td></td>
<td>LY/LL 0.927 ± 0.197</td>
<td>0.554</td>
</tr>
<tr>
<td></td>
<td>LY/CI 0.896 ± 0.229</td>
<td>0.496</td>
</tr>
<tr>
<td>LY300</td>
<td>MPY 0.858 ± 0.166</td>
<td>0.743</td>
</tr>
<tr>
<td></td>
<td>CI 0.479 ± 0.369</td>
<td>0.185</td>
</tr>
<tr>
<td></td>
<td>DP 0.930 ± 0.494</td>
<td>-0.023</td>
</tr>
<tr>
<td></td>
<td>LY/LL 0.920 ± 0.134</td>
<td>0.691</td>
</tr>
<tr>
<td></td>
<td>LY/CI 1.012 ± 0.165</td>
<td>0.597</td>
</tr>
<tr>
<td>MPY</td>
<td>CI -0.241 ± 0.380</td>
<td>0.064</td>
</tr>
<tr>
<td></td>
<td>DP 0.596 ± 0.434</td>
<td>0.005</td>
</tr>
<tr>
<td></td>
<td>LY/LL 0.837 ± 0.158</td>
<td>0.654</td>
</tr>
<tr>
<td></td>
<td>LY/CI 0.840 ± 0.218</td>
<td>0.478</td>
</tr>
<tr>
<td>CI</td>
<td>DP 0.720 ± 0.333</td>
<td>0.471</td>
</tr>
<tr>
<td></td>
<td>LY/LL 0.550 ± 0.412</td>
<td>0.107</td>
</tr>
<tr>
<td></td>
<td>LY/CI 0.101 ± 0.454</td>
<td>0.462</td>
</tr>
<tr>
<td>DP</td>
<td>LY/LL 0.961 ± 0.521</td>
<td>0.007</td>
</tr>
<tr>
<td></td>
<td>LY/CI 0.635 ± 0.479</td>
<td>0.095</td>
</tr>
<tr>
<td>LY/LL</td>
<td>LY/CI 1.319 ± 0.248</td>
<td>0.537</td>
</tr>
</tbody>
</table>
4.3.2 Genetic and phenotypic correlation coefficients among first lactation traits

The estimates of phenotypic and genetic correlation among first lactation production and reproduction traits are given in the table 4.9.

Genetic correlation of lactation length with lactation yield, 300 day lactation yield, monthly peak yield, calving interval, dry period, lactation yield per day of lactation length and lactation yield per day of calving interval were $0.166 \pm 0.325$, $0.039 \pm 0.323$, $-0.519 \pm 0.275$, $0.544 \pm 0.290$, $0.088 \pm 0.400$, $-0.324 \pm 0.341$ and $-0.312 \pm 0.332$ respectively.

Phenotypic correlation of lactation length with lactation yield, 300 day lactation yield, monthly peak yield, calving interval, dry period, lactation yield per day of lactation length and lactation yield per day of calving interval were $0.596$, $0.362$, $0.074$, $0.339$, $-0.045$, $-0.041$ and $0.169$ respectively.

Genetic correlations of first lactation length were all positive and high with FCI, while low and positive with FLY, FLY-300 and DP. Genetic correlations of FLL with MPY, FLY/LL and FLY/CI were low and negative as expected. Phenotypic correlations of FLL with FLY, FLY-300, FCI, were positive and high while, with MPY, FLY/CI were low and positive. Phenotypic correlations of FLL with DP and FLY/LL were low and negative (Table-4.9).

Genetic correlation of lactation yield with 300 day lactation yield, monthly peak yield, calving interval, dry period, lactation yield per day of lactation length and lactation yield per day of calving interval were $1.010 \pm 0.046$, $0.834 \pm 0.159$, $0.626 \pm 0.354$, $0.866 \pm 0.507$, $0.927 \pm 0.197$ and $0.896 \pm 0.229$ respectively.

Phenotypic correlation of lactation yield with 300 day lactation yield, monthly peak yield, calving interval, dry period, lactation yield per day of lactation length and lactation yield per day of calving interval were $0.877$, $0.636$, $0.263$, $-0.005$, $0.554$ and $0.496$ respectively.

Genetic correlations of FLY with FLY-300, MPY, FCI, FDP, FLY/LL and FLY/CI were all positive and very high. While, phenotypic correlation of FLY with all other traits were moderate to high and positive except with FDP which was very low (-0.005) and close to zero (Table-4.9).
Results and discussion

Genetic correlation of 300 day first lactation yield with monthly peak yield (MPY), first calving interval (FCI), first dry period (FDP), lactation yield per day of lactation length (FLY/LL) and lactation yield per day of calving interval (FLY/CI) were 0.858 ± 0.166, 0.479 ± 0.369, 0.930 ± 0.494, 0.920 ± 0.134 and 1.012 ± 0.165 respectively.

Phenotypic correlation of 300 day first lactation yield with monthly peak yield (MPY), first calving interval (FCI), first dry period (FDP), lactation yield per day of lactation length (FLY/LL) and lactation yield per day of calving interval (FLY/CI) were 0.743, 0.185, -0.023, 0.691 and 0.597.

Genetic correlation coefficients of FLY-300 with MPY, FCI, FDP, FLY/LL and FLY/CI were all expectantly very high and positive. While, phenotypic correlations of FLY-300 with all above were all ranging from moderate to high except again with DP, which was negative and low.(-0.023) (Table-4.9).

Genetic correlation of monthly peak yield (MPY) with calving interval (FCI), dry period (FDP), lactation yield per day of lactation length (FLY/LL) and lactation yield per day of calving interval (FLY/CI) were -0.241 ± 0.380, 0.596 ± 0.434, 0.837 ± 0.158 and 0.840 ± 0.218 respectively.

Phenotypic correlation of monthly peak yield (MPY) with first calving interval (FCI), first dry period (FDP), lactation yield per day of lactation length (FLY/LL) and lactation yield per day of calving interval (FLY/CI) were 0.064, 0.005, 0.654 and 0.478 respectively.

MPY was found to be genetically highly positively correlated with FDP, FLY/LL and FLY/CI. However, with FCI, the MPY was negatively correlated. This indicates that higher MPY leads to shorter persistency and consequently shorter FCI. MPY was phenotypically positively and moderate to highly correlated with FLY/LL, FLY/CI, while with FCI and DP the correlation coefficient were very low.

Genetic correlation of first calving interval with first dry period, first lactation yield per day of lactation length and first lactation yield per day of calving interval were 0.720 ± 0.333, 0.550 ± 0.412 and 0.101 ± 0.454.
Results and discussion

Phenotypic correlation of first calving interval with first dry period, first lactation yield per day of lactation length and first lactation yield per day of calving interval were 0.471, 0.107 and 0.462.

First calving interval (FCI) was found to be genetically, positively and highly correlated with FDP. While with FLY/CI, the genetic correlation was low. Phenotypically, FCI was found to positively and moderately correlated with FLY/CI and FDP.

Genetic correlation of first dry period with first lactation yield per day of lactation length and first lactation yield per day of calving interval were 0.961 ± 0.521 and 0.635 ± 0.479.

Phenotypic correlation of first dry period with first lactation yield per day of lactation length and first lactation yield per day of calving interval were 0.007 and 0.095.

Genetic correlation among FDP and FLY/LL was astonishingly high but within range and with FLY/CI it was moderately high. Phenotypic correlation among FDP and FLY/LL and FLY/CI were all very low.

Genetic correlation of lactation yield per day of lactation length with lactation yield per day of calving interval was 1.319 ± 0.248 and phenotypic correlation was 0.537. Both the estimates were high and positive.
4.4 Pooled parity:

The analysis of 3236 lactation records of 700 Gir cows up to 10 parity for the period of 1965 to 2016 (51 Years) was carried out and the results pertaining to means and variances are presented and discussed as under General means and standard error for various production traits for pooled parity are presented in Table - 4.10.

Table - 4.10 General means, SE for various production and traits of pooled parity in Gir cattle

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>traits</th>
<th>N</th>
<th>Mean (Lit)</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LL</td>
<td>3236</td>
<td>332.15</td>
<td>1.99</td>
</tr>
<tr>
<td>2</td>
<td>LY</td>
<td>3236</td>
<td>2151.12</td>
<td>15.08</td>
</tr>
<tr>
<td>3</td>
<td>LY300</td>
<td>3236</td>
<td>1934.47</td>
<td>11.84</td>
</tr>
<tr>
<td>4</td>
<td>MPY</td>
<td>3236</td>
<td>283.24</td>
<td>1.49</td>
</tr>
</tbody>
</table>

General means for Lactation length, Lactation yield and 300 days lactation yields was observed as 332.15 ± 1.99 days, 2151.12 ± 15.08 Lit. and 1934.47 ± 11.84 Lit respectively. Average monthly peak yield which was recorded as total yield of milk for a particular month reaching to peak after calving was 283.24 ± 1.49 Lit. Thus Gir cows produce on an average 2151.12 Lit of milk in average 332.15 days of lactation period while it produce 1934.47 Lit of milk in 300 days of lactation (Table - 4.10). Average maximum milk yield in a month in Gir cows is 383 Lit. This could be treated as breed average and breed characteristics of Gir cattle.

4.4.1 Effect of non-genetic factors on pooled parity production traits:

Least squares analysis of variance carried on the 3236 lactation record of Gir cows using LSML, mixed model (Harvey, W R. 1990) to study the effects of non-genetic factors such as parity, period of calving, Season of Calving production traits in Gir cattle.

The least squares mean and least squares analysis of variance for production traits of Gir cattle for pooled parity are presented in table -4.11 and table -4.12.
Table - 4.11 least squares means for various production traits of pooled parity in Gir cattle

<table>
<thead>
<tr>
<th>Effect</th>
<th>N</th>
<th>Economic traits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>LY(Lit.)</td>
</tr>
<tr>
<td>μ</td>
<td>3236</td>
<td>1933.32 ± 63.01</td>
</tr>
<tr>
<td>Parity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>781</td>
<td>1942.90 ± 61.97&lt;sup&gt;cd&lt;/sup&gt;</td>
</tr>
<tr>
<td>2</td>
<td>737</td>
<td>2088.69 ± 62.63&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>3</td>
<td>553</td>
<td>2122.03 ± 65.25&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>4</td>
<td>406</td>
<td>2116.71 ± 69.18&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>5</td>
<td>290</td>
<td>2125.59 ± 74.33&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>6</td>
<td>201</td>
<td>1998.87 ± 81.83&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>7</td>
<td>121</td>
<td>1996.87 ± 95.36&lt;sup&gt;c&lt;/sup&gt;</td>
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<tr>
<td>8</td>
<td>77</td>
<td>1836.08 ±111.71&lt;sup&gt;d&lt;/sup&gt;</td>
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<tr>
<td>9</td>
<td>38</td>
<td>1580.28 ±146.51&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>10</td>
<td>32</td>
<td>1525.53 ±160.62&lt;sup&gt;a&lt;/sup&gt;</td>
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</table>
### Results and discussion

**Effect**

<table>
<thead>
<tr>
<th>Period</th>
<th>N</th>
<th>LY (Lit.)</th>
<th>LL (days)</th>
<th>LY300 (Lit.)</th>
<th>MPY (Lit.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (&gt;1971)</td>
<td>85</td>
<td>1844.76 ± 147.69&lt;sup&gt;a&lt;/sup&gt;</td>
<td>324.73 ± 19.77&lt;sup&gt;cd&lt;/sup&gt;</td>
<td>1803.07 ± 144.32&lt;sup&gt;c&lt;/sup&gt;</td>
<td>238.63 ± 13.49&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>2 (1971-1975)</td>
<td>208</td>
<td>1952.84 ± 107.73&lt;sup&gt;ad&lt;/sup&gt;</td>
<td>296.11 ± 14.42&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1955.99 ± 83.38&lt;sup&gt;d&lt;/sup&gt;</td>
<td>274.68 ± 9.84&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>3 (1976-1980)</td>
<td>331</td>
<td>1766.37 ± 96.38&lt;sup&gt;a&lt;/sup&gt;</td>
<td>285.39 ± 12.09&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>1737.35 ± 74.60&lt;sup&gt;b&lt;/sup&gt;</td>
<td>263.31 ± 8.80&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>4 (1981-1985)</td>
<td>367</td>
<td>1748.10 ± 89.25&lt;sup&gt;a&lt;/sup&gt;</td>
<td>278.61 ± 11.94&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1684.65 ± 69.08&lt;sup&gt;a&lt;/sup&gt;</td>
<td>278.88 ± 8.15&lt;sup&gt;cd&lt;/sup&gt;</td>
</tr>
<tr>
<td>5 (1986-1990)</td>
<td>438</td>
<td>1754.99 ± 87.25&lt;sup&gt;a&lt;/sup&gt;</td>
<td>295.55 ± 11.68&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1673.99 ± 67.53&lt;sup&gt;a&lt;/sup&gt;</td>
<td>266.55 ± 7.97&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>6 (1991-1995)</td>
<td>505</td>
<td>1756.64 ± 82.72&lt;sup&gt;a&lt;/sup&gt;</td>
<td>318.48 ± 11.07&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1854.47 ± 64.02&lt;sup&gt;c&lt;/sup&gt;</td>
<td>289.58 ± 7.55&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>7 (1996-2000)</td>
<td>354</td>
<td>1792.62 ± 80.09&lt;sup&gt;a&lt;/sup&gt;</td>
<td>281.16 ± 10.72&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1727.60 ± 61.99&lt;sup&gt;ac&lt;/sup&gt;</td>
<td>271.52 ± 7.31&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>8 (2001-2005)</td>
<td>284</td>
<td>2190.53 ± 81.93&lt;sup&gt;c&lt;/sup&gt;</td>
<td>320.11 ± 10.96&lt;sup&gt;c&lt;/sup&gt;</td>
<td>2007.87 ± 63.41&lt;sup&gt;d&lt;/sup&gt;</td>
<td>304.12 ± 7.48&lt;sup&gt;e&lt;/sup&gt;</td>
</tr>
<tr>
<td>9 (2006-2010)</td>
<td>338</td>
<td>2292.83 ± 82.81&lt;sup&gt;b&lt;/sup&gt;</td>
<td>350.45 ± 11.08&lt;sup&gt;e&lt;/sup&gt;</td>
<td>1990.63 ± 64.10&lt;sup&gt;d&lt;/sup&gt;</td>
<td>293.57 ± 7.56&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>10 (2011-2016)</td>
<td>326</td>
<td>2033.56 ± 90.84&lt;sup&gt;d&lt;/sup&gt;</td>
<td>338.90 ± 12.16&lt;sup&gt;d&lt;/sup&gt;</td>
<td>1774.31 ± 70.31&lt;sup&gt;c&lt;/sup&gt;</td>
<td>586.00 ± 8.29&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

### Season

<table>
<thead>
<tr>
<th>Effect</th>
<th>N</th>
<th>LY (Lit.)</th>
<th>LL (days)</th>
<th>LY300 (Lit.)</th>
<th>MPY (Lit.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainy</td>
<td>613</td>
<td>1920.88 ± 69.56&lt;sup&gt;b&lt;/sup&gt;</td>
<td>313.90 ± 9.31&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1817.49 ± 53.84&lt;sup&gt;b&lt;/sup&gt;</td>
<td>268.73 ± 6.35&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Winter</td>
<td>960</td>
<td>1971.69 ± 66.76&lt;sup&gt;c&lt;/sup&gt;</td>
<td>307.45 ± 8.93&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1857.03 ± 51.67&lt;sup&gt;c&lt;/sup&gt;</td>
<td>280.74 ± 6.10&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Spring</td>
<td>977</td>
<td>1999.74 ± 66.94&lt;sup&gt;c&lt;/sup&gt;</td>
<td>314.13 ± 8.96&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1882.39 ± 51.81&lt;sup&gt;c&lt;/sup&gt;</td>
<td>284.71 ± 6.11&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Summer</td>
<td>686</td>
<td>1840.98 ± 68.78&lt;sup&gt;a&lt;/sup&gt;</td>
<td>300.76 ± 9.20&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1727.06 ± 53.23&lt;sup&gt;a&lt;/sup&gt;</td>
<td>272.54 ± 6.28&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Mean values bearing different superscript differ significantly (P<0.05)
Table - 4.12 Analysis of variance for various production traits of pooled parity in Gir cattle

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Source</th>
<th>d.f.</th>
<th>Mean square</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>LY</td>
</tr>
<tr>
<td>1</td>
<td>Parity</td>
<td>9</td>
<td>369851.1499**</td>
</tr>
<tr>
<td>2</td>
<td>Period</td>
<td>9</td>
<td>5154160.1368**</td>
</tr>
<tr>
<td>3</td>
<td>Season</td>
<td>3</td>
<td>3551590.9055**</td>
</tr>
<tr>
<td>4</td>
<td>Error</td>
<td>3214</td>
<td>644106.1327</td>
</tr>
</tbody>
</table>

*P < 0.05; **P < 0.01
4.4.1.1 Lactation length (LL):

The general least square means for Lactation length (LL) was observed 308.95 ± 8.43 (Table – 4.11). Averages reported in the literature for lactation length by various workers were all higher than that observed in the present study (Shukla and Prasad 1970, Gajbhiye and Dhanda 1987, Tajane et al. 1998, Gaur et al. 2003, Vataliya et al. 2013, Ghodasara et al. 2015, Gajbhiye et al. 2016) in Gir cattle.

The least–squares analysis of variance results indicated that lactation length (LL) was highly significantly (P < 0.01) influenced by parity of lactation, period calving, while significantly (P < 0.05) influenced by season of calving (Table - 4.12). The lactation length ranged from 360.7 ± 8.29 days, the highest lactation length in 1st parity to 275.92 ± 19.61 days and the lowest in 9th parity (Figure - 4.9). The highest lactation length recorded in cows those calved in spring (Jan-March) (314.13 ± 8.96 days) while the lowest lactation length recorded in cows those calved in summer (April- June) (300.76 ± 9.20 days) (Figure - 4.10).

Figure 4.9 Lactation length (LL) in different Parity in Gir cattle
The Gir cows in first lactation produced for longer lactation period. While as the parity advances the lactation length decreases gradually up to 9th parity. With the advancement of parity (age) the physiological sustainability of lactation decrease is once again evident.

Period to period variation in average lactation length was significant (P<0.01). The cows calved during the period of 2006 to 2010 had highest average lactation length. Thus in this particular period the cows produced for long duration of lactation, the average LL being 350.45 ± 11.08 days while, those calved in the period from 1981 to 1985 had lowest average lactation length (273.61 ± 11.94) (fig – 4.11).
Shukla and Prasad (1970), Tomar and Sharma (1986) and Gajbhiye and Dhanda (1987) observed significant effect of season of calving on lactation length in Gir cattle.

Kalavadia (1994) studied the data on Gir cattle for first three consecutive lactations of 475 cows (daughter) of 54 sires in the period of 1965-1991. He observed that lactation length is significantly affected by period and season of calving.

Contrary to this Ulmek (1990) and Dangar, (2012), Ramani (2016) obtained non significant differences among Lactation length due to season of calving in Gir cattle.

**4.4.1.2 Lactation yield (LY):**

The least square means of lactation yield with standard errors for different parity, period of calving and season of calving are presented in table -4.11.

The overall least square means for lactation yield (LY) 1933.32 ± 63.01 Lit (Table- 4.11). It was lower than that reported by Shukla and Prasad 1970 and Dangar and Vataliya 2015 respectively. The overall least square means for lactation yield obtained in Gir cattle in the present study was higher than that reported by Gajbhiye and Dhanda 1987 and Ulmek 1990 respectively in Gir cattle.

Gaur and Raheja in 1996 reported lactation yield 2177.8 ± 40.8 kg in Sahiwal which was higher than that reported in present study while Sharma et al. (1987) and
Gulam et al. (2001) reported lactation yield 1880.3 ± 44.56 kg and 1579.04 ± 18.17 kg respectively in Sahiwal cattle which is lower than reported in present study.

The least–squares analysis of variance results indicated that Lactation yield (LY) was highly significantly (P < 0.01) affected by parity, period and season of calving (Table – 4.12). The highest lactation yield was recorded in fifth parity (2125.59 ± 74.33 Lit). While the lowest lactation yield was recorded in tenth parity (1525.53 ± 160.62 Lit) (Figure – 4.12).

The maximum average lactation yield was observed as 2292.83 ± 82.81 Lit. in 9th period i.e. years 2006-2010 and the lowest lactation length was observed as 1748.10 ± 89.25 Lit. in 4th period i.e. years 1981-1985 (Figure – 4.13). Period to period variation in lactation yield indicates change in the structure of herd main genetic in origin. Animals calved in spring (Jan-March) produce average LY 1999.74 ± 66.94 Lit. While those calved in summer (April- June) produced average LY as 1840.98 ± 68.78 Lit. (Table - 4.14). The variation in lactation yield could be due to variation in climate and variation in feed and fodder available during year.

**Figure 4.12 Lactation yield (LY) in different Parity in Gir cattle**
Figure 4.13 Lactation yield (LY) in different period in Gir cattle

Figure 4.14 Lactation yield (LY) in different season in Gir cattle
Gajbhiye and Dhanda (1987) analyzed data on 343 lactation records of Gir cattle stationed at the livestock research station, Gujarat Agricultural University, Junagadh for the period of 10 years (from 1974 to 1983). They reported significant effect of season of calving on standard lactation milk yield.

Nagare and Patel (1997) observed that genetic group and period of birth were potential source of variation while season birth had no significant effect on lactation yield.

Gajbhiye et al. (2016) analyzed 25 years data on Gir cow at CBF, Junagadh, and noticed that lactation order significantly influenced total lactation milk yield in Gir cows in CBF, Junagadh.

Significant effect of season of calving on average lactation milk yield were reported by Kumar (2007), Rehman et al. (2008), Zafar et al. (2008) and Shafiq et al. (1995) in Sahiwal cattle.

Contrary to this Mohanty (2001), Singh et al. (2001), Banik (2004), Banik and Gandhi (2007) and Singh et al. (2005) observed non-significant effect of season of calving on lactation milk yield in Sahiwal cattle.

4.4.1.3 300 day lactation yield (LY300):

The least square means of 300 day lactation yield with standard errors for different parity, period of calving and season of calving are presented in table – 4.11.

The overall least square mean for 300 day lactation yield (LY300) was observed as 1820.99 ± 48.77 Lit (Table - 4.11). It was lower than that reported by Gajbhiye and Dhanda (1987) and Gajbhiye et al. (2016) respectively. While it was higher than that reported by Ulmek (1990) and Ramani (2016) respectively in Gir cattle.

Pandey et al. (2001) reported 300 day lactation yield as 1103.02 ± 39.83 kg in Hariyana cattle. While Maurya and Saraswat (2004) reported 300 day lactation yield as 1667.94 ± 44.77 kg in Sahiwal cattle.

The least–squares analysis of variance results indicated that 300 day lactation yield (LY300) was highly significantly (P<0.01) influenced by parity, period and season of calving (Table – 4.12). The highest 300 day lactation yield was observed in 5th parity (2027.61 ± 57.53 Lit.), While the lowest 300 day lactation yield was observed in 10th
Results and discussion

parity, in present study (1562.32 ± 124.32 Lit.) (Figure - 4.15). Thus it can be inferred that fully physical maturity in Gir cows was achieved in 5th lactation.

Period to period variation in LY300 was significant (P<0.001). This again indicates, change in genetic structure of herd from one period to another. The period from 1986-1990 was seen as period of most depression in all the production traits. The genetic structure of the population during 1986-90 was of poor make up, while from 1990 onward up to 2001 to 2005 and 2010 it improved steadily. The highest 300 day lactation yield was observed in period 8 i.e. 2001-2005 (2007.87 ± 63.41 Lit.) While the lowest 300 day lactation yield (LY300) was recorded in 5th period i.e. 1986-1990 (1673.99 ± 67.53 Lit) (Figure – 4.16).

Season of calving was found to exert significant effect (P<0.01) on LY 300. The highest 300 day lactation yield recorded in season spring i.e. Jan-March was 1882.39 ± 51.81 Lit. While lowest 300 day lactation yield (LY300) was recorded in season summer i.e. April- June was 1727.06 ± 53.23 Lit (Figure – 4.17).

Figure - 4.15 300 day Lactation yield (LY300) in different Parity in Gir cattle
Gajbhiye and Dhanda (1987) also reported highly significant effect of parity and period of caving on 300 day lactation milk yield while significant effect of season on 300 day milk yield in Gir cattle.
Results and discussion

Ulmek (1990) reported highly significant (P<0.01) effect of parity and period of calving while non significant effect of season of calving on 300 day lactation milk yield in Gir cattle.

Dangar (2012) also reported highly significant effect of parity and period of calving while season of calving had no significant effect on 300 day lactation milk yield in Gir cattle.

Ramani (2016) observed a non significant influence of season of calving and period of calving on first lactation 305 days milk yield in Gir cattle at CBF Junagadh.

4.4.1.4 Monthly peak yield (MPY):

The least square means for monthly peak yield with standard errors for different parity, period of calving and season of calving are presented in table- 4.11

The overall least square means for monthly peak yield i.e. peak production of the month during lactation as observed averaged 276.68 ± 5.75 Lit. (Table – 4.11) This trait indicates the production potential of the animal during progression of lactation. As is well known the Gir cows reaches their peak in the third or fourth month of the commencement of lactation. Thus it exhibits the production potential of animal in the form of monthly peak production in Gir cattle.

The least–squares analysis of variance reveals that monthly peak yield was varying highly significantly (P<0.01) due to parity, period and season of calving (Table - 4.12). The highest monthly peak yield reached in 5th parity (303.55 ± 6.79 Lit.) while the lowest monthly peak yield was recorded in 1st parity (220.78 ± 5.66 Lit.) (Figure - 4.18).

Monthly peak yield (MPY) was found to varying significantly (P<0.01) due to period of calving the cows those calved during the period 2011-2016 had significantly highest MPY (586.0 ± 8.29 Lit.) (Table - 4.11) while those calved during the period before 2071 produce significantly lowest MPY (238.63 ± 13.49 Lit.) (Figure - 4.19). Similarly, season of calving exerted highly significant (P<0.01) influence on MPY in the present study (Table – 4.12). Seasonal variation can be justified as due to availability of feed and fodder in different season.

Spring season (January-March) was observed to be more favorable season for calving where the animal produced maximum MPY (284.71 ± 6.11 Lit.). While rainy season (July – September) was found to be most inconvenient and uncomfortable season.
of calving where the animals produced least average MPY (268.73 ± 6.35 Lit.) (Figure – 4.20)

**Figure - 4.18 Monthly peak yield (MPY) in different Parity in Gir cattle**

![Graph showing MPY in different Parity in Gir cattle](image)

**Figure - 4.19 Monthly peak yield (MPY) in different period in Gir cattle**

![Graph showing MPY in different period in Gir cattle](image)
Figure - 4.20 Monthly peak yield (MPY) in different Season in Gir cattle
4.4.2  Effect of calving interval on pooled parity production traits:

Table – 4.13 lest squares means of production traits in different calving interval

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>N</th>
<th>LL (days)</th>
<th>LY (Lit.)</th>
<th>LY300 (Lit.)</th>
<th>MPY (Lit.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>µ</td>
<td>2375</td>
<td>333.70 ± 2.55</td>
<td>2275.14 ± 20.22</td>
<td>2050.05 ± 16.38</td>
<td>301.35 ± 1.97</td>
</tr>
<tr>
<td>CI code (days)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (&lt;401)</td>
<td>753</td>
<td>300.03 ± 3.90</td>
<td>2042.86 ± 30.94</td>
<td>1925.73 ± 25.06</td>
<td>297.25 ± 3.02</td>
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<td>308.10 ± 4.80</td>
<td>2063.64 ± 38.01</td>
<td>1964.98 ± 30.79</td>
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<td>2205.94 ± 45.32</td>
<td>2000.69 ± 36.71</td>
<td>300.87 ± 4.43</td>
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<td>2330.5 ± 52.56</td>
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<td>2362.73 ± 64.00</td>
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<td>6 (641-700)</td>
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<td>2415.11 ± 69.80</td>
<td>2142.85 ± 56.54</td>
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<td>7 (&gt;700)</td>
<td>187</td>
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<td>2505.21 ± 62.09</td>
<td>2151.56 ± 50.30</td>
<td>306.02 ± 6.07</td>
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Mean of a trait bearing different superscript differ significantly (P<0.05)

Table – 4.14 analysis of variance table

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*P < 0.05; **P < 0.01

The overall mean of lactation length in Gir cattle was found as 333.70 ± 2.55 days (Table - 4.13). The Least squares model used was not perfect and hence many of the environmental variances remained confounded and could not be eliminated hence overall means varied from earlier analysis. Lactation length was significantly affected by different calving interval range (Table- 4.14). The highest lactation length (353.66 ± 7.84 days) recorded in Gir cattle having calving interval more than 700 days while lowest lactation length (300.03 ± 3.90 days) recorded in calving interval less than 401 days (Table – 4.13) (Figure - 4.21). From reproduction point of view, Calving interval with the
range from 14 to 15 Months seems to be ideal to achieve economic reproductive cycle and also milk production.

**Figure - 4.21 Lactation length in different calving interval in Gir cattle**

![Graph showing lactation length in different calving intervals](image)

The overall least squares means for lactation yield in Gir cattle was found as 2275.14 ± 20.22 Lit. (Table - 4.13). The lactation yield was significantly affected by calving interval range (Table – 4.14). The highest lactation milk yield (2505.21 ± 62.09 Lit.) recorded in Gir cattle had more than 700 days calving interval. While the lowest lactation yield (2042.86 ± 30.94 Lit.) recorded in Gir cattle had less than 401 days calving interval (Table – 4.13) (Figure – 4.22).
Results and discussion

Figure - 4.22 Lactation yield in different calving interval in Gir cattle

The overall least square means for 300 day lactation yield in Gir cattle was found as 2050.05 ± 16.38 Lit. (Table - 4.13). The 300 day lactation yield in Gir was cattle significantly affected by calving intervals (Table- 4.14). The highest 300 day milk yield (2151.56 ± 50.30 Lit.) recorded in Gir cattle had calving interval more than 700 days. While the lowest 300 day lactation yield (1925.73 ± 25.06 Lit.) recorded in Gir cattle had calving interval less than 401 days (Figure – 4.23).

Figure – 4.23 300 day Lactation yield in different calving interval in Gir cattle

The overall least square means for monthly peak yield in Gir cattle was found as 301.35 ± 1.97 Lit. (Table - 4.13). The monthly peak yield was not significantly affected by calving intervals in Gir cattle (Table - 4.14).
4.5 Repeatability Estimates for production traits in pooled parity:

Repeatable traits like lactation milk yield, litter size and number of eggs laid in different periods consist of variance due to permanent environment and temporary environment.

Since the temporary effects vary in a random way from period to period, they are likely to be positive or negative and should tend to average to zero over several periods. Permanent environmental effects together with the genotype determine an animal performance potential during its whole life and are termed as “real producing ability”.

The repeatability or the intraclass correlation “r” is an estimate of the proportion of the variation among observations caused by permanent differences among animals.

Table - 4.15 Estimates of variance components and repeatability in pooled parity

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4.5.1 Repeatability of lactation length:

Repeatability estimates for lactation length was found as 0.0195 in Gir cattle herd. This is a very low estimate indicating, poor reliability on single or repeated recodes. Ulmek (1990) reported repeatability estimate of 0.28 ± 0.10 in Gir cattle. Dangar (2012) reported Repeatability estimates for lactation length as 0.378 ± 0.042 in Gir cattle in cattle breeding farm Junagadh.

Gandhi and Gurnani (1992) in Sahiwal cattle, Sarwar (1991) in Red Sindhi cattle reported moderate estimates of repeatability of lactation length as 0.25 ± 0.01 and 0.25, respectively.
4.5.2 **Repeatability of lactation yield:**

Repeatability estimates for lactation milk yield was observed as 0.1301 in present study. Repeatability of a trait is not a constant. If measurement errors or quite frequently varying environmental conditions tend to increase temporary environmental variance and repeatability tends to decrease. Repeatability for LY in the present study was lower than those reported by Ulmek (1990), Dangar (2012) in Gir cattle.

The Repeatability for lactation milk yield in Gir cattle as reported by Ulmek (1990) was 0.35 ± 0.10. Dangar (2012) reported Repeatability estimate of 0.45 ± 0.04 for lactation yield in Gir cattle, in cattle breeding farm Junagadh.

4.5.3 **Repeatability of 300 day milk yield:**

Repeatability estimates for 300 day milk yield in Gir cattle in present study was observed as 0.1342. The repeatability of LY300 was towards lower side and this is again indicative of fact that no single record is useful for prediction of future records. Hence information on repeated records is necessary for selecting or culling the animals.

Consideration of additional records although implies a delay in decision making and therefore a loss of time when repeatability is low additional information is worth additional time required to reach the culling decision.

4.5.4 **Repeatability of monthly peak yield:**

Repeatability estimate of monthly peak yield found to be 0.1216 in Gir cattle herd in present study. This estimate again reflects the same fact as was in LY or 300 day LY.
4.6 **Trends in the breeding value of sires:**

Genetic trend evolution is the most powerful tool to analyze and evaluate the result of selection work in the population.

For good result we need a long term strategy in a population selection the trends indicates the result of selection programme executed in the herd. For examination of efficiency of selection and breeders work the best parameter is genetic trend.

BLUP estimate thus estimated for breeding value of 57 sires has been presented in table - 4.18

Thus ranking of sires on the basis of the breeding value revealed that the sire Lilam was having highest breeding value for trait FLY i.e. 2318.2 Lit and also for trait FLY 300 is 1938.7 Lit.

All the estimates of BV of 57 sire used during 51 years were subjected to regression analysis for estimation trends. Using ms excel, the trend estimated represents regression of BV on period 1 to period 10 and thus BV were regressed on period. The regression coefficient obtained was 7.22 Lit. per generation (5 year period). Thus from 1965-2016 there is an overall steady improvement in BV of sires at the rate of 7.22 Lit. Which indicates genetic trend of the BV of Sires towards positive side overall improvement in the herd structure.
Table – 4.16 period wise average breeding value of sires.

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### Results and discussion

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Table 4.17 Projected B.V. of sires for period from 11th to 15th period

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\[ b = 7.218182 \]

**Figure – 4.24 Improvement in BV of the sires over period**

Figure - 4.24 indicates trends of BV of sires used from 1965 to 2016 and also future projected BV of sires up to 2040 with the existing rate of improvement. Sire used during 1986-90 were having higher breeding value while sire used during 1991-95 use of drastically low breeding value. This has hampered the genetic progression in future coming generation and it needed 15-20 years to recover the rates of genetic improvement.
The sires used further in 2011-2016 were of highest merit. The average breeding value being 2157 Lit. The rate of genetic improvement as the genetic trends suggested was 7.22 Lit. per generation. Figure- 4.25 and 4.26 explains genetic improvement in LY through Sires BV graphically.

**Figure – 4.25 Improvement in BV of the sires over period**

**Figure – 4.26 Improvement in BV of the sires over period**
Table – 4.18 BLUP estimates of lactation yield for different sires:

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<tr>
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<td>57</td>
<td>2280.97 ± 147.38</td>
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<td>Jaidev</td>
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<td>Prem</td>
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<td>2199.05 ± 148.85</td>
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<tr>
<td>Sagar</td>
<td>35</td>
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<tr>
<td>Umesh</td>
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<td>2182.56 ± 121.51</td>
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<td>Sunil</td>
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<td>Vijay</td>
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<td>Arjun</td>
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<tr>
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<td>Lax-2</td>
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<td>Anand</td>
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<td>2159.26 ± 141.34</td>
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<td>Daxana/Daxano</td>
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<td>Bhavik</td>
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<td>2141.37 ± 149.13</td>
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<tr>
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## Results and discussion

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