EFFECT OF CALVING SEASON, PARITY AND AGE AT FIRST CALVING ON PERFORMANCE TRAITS AND PHENOTYPIC CORRELATIONS BETWEEN THESE TRAITS IN HOLSTEIN FRIESIAN COWS

Abbas, S.F.
Animal Production Dept., Faculty of Agriculture, Assiut University, Assiut 71526, Egypt, address E-mail: abbas@aun.edu.eg

ABSTRACT

The effects of calving season, parity and age at first calving on performance traits and phenotypic correlations between these traits were studied in 587 Holstein Friesian cows. Mean 305-day milk yields and calving interval were significantly affected by calving season while this effect was non-significant on daily milk yield, lactation length and dry period. Milk traits, calving interval and dry period were significantly different. The calving interval was highest in third parity (452 days) and lowest in the first parity (404 days). The dry period was highest during 3rd lactation (161 days) and lowest in the 1st lactation (81 days). The decreasing milk yield with increasing parity suggesting that factors other than parity was contributing to the observed results. Age at first calving indicated that daily milk yield and mean 305-day milk yield were highest (P <0.01) for calving at 28 to 30 months compared with cows calving at 24 to 27 months. Whereas calving interval was highest for calving at 24 to 27 months compared with 28 to 30 month of age at first calving. Highly significant, positive phenotypic correlations of lactation length with milk yields, calving interval, 305-day yields and daily milk yield were 0.73, 0.60 0.87 and 0.23, respectively. The phenotypic correlations were found to be negative between dry period and milk yield (-0.30) daily yield (-0.36) and 305-day yields (-0.18). Results may imply that Holstein-Friesian cows in sub tropic are not producing up to their potential probably because of shortcomings in management and relatively harsh climatic conditions.

Keywords: Holstein Friesian, phenotypic correlations, Productive and reproductive performance

INTRODUCTION

Holstein Friesian is one of the best dairy cattle breed raised in the tropical and sub-tropical regions. Milk yield is the major trait of economic importance in dairy breeds. The yields of farm animals are the result of the combined effects of genotype and environmental conditions. In order to increase the yield level, it is necessary to optimize the environmental conditions and to improve the genetic structure of the animals. Environmental factors can be classified as factors with measurable effects (age, season, age at first calving, calving interval, milking frequency, etc.) and factors with unmeasurable effects (infectious diseases, parasitic infestations, etc.). A number of factors have been reported to affect milk production in the tropics. These include genetic, climatic, disease, feeding, year of calving and managerial factors (Payne and Wilson 1999; Msanga et al. 2000 Epaphras et al., 2004). Animal factors such as breed, age, stage of lactation, parity and even milking frequency, have also been reported in other studies to affect
Abbas, S.F.

milk production (Tekerli et al 2000; Johnson et al 2002). This study was conducted to investigate the environmental factors affecting productive and reproductive traits for Holstein Friesian cows and the phenotypic correlation between these traits.

MATERIALS AND METHODS

Data: The data were collected from records of 309 Holstein Friesian cows from Ghot-Al-Sultan farm 180 kilometer Southwest El-Beda, Libya, latitude 31°32' N, and longitude 20°21' E.

Table (1): Minimum and maximum seasonal temperature (°C) and relative humidity (%).

<table>
<thead>
<tr>
<th>Season</th>
<th>Temperature (°C)</th>
<th>Relative Humidity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Max</td>
<td>Min</td>
</tr>
<tr>
<td>Winter</td>
<td>17.03</td>
<td>8.08</td>
</tr>
<tr>
<td>Summer</td>
<td>33.03</td>
<td>19.72</td>
</tr>
</tbody>
</table>

Feeding and managing cows: The production system in the farm was semi-open system. Cows were milked two times/day and fed concentrate according to their milk production. Hay, ray grass and barley were fed as maintenance rations. The hay was fed four time/day (2 kg/cow). Green pastures were only available during winter season. Mineral salt blocks and water were freely available for all times.

Statistical Analysis: Age at first calving was divided into three classes, being the first class was 24 to 27, second 28 to 30 and the third from 31 to 36 month. Three parities of dam were defined; 1, 2 and 3. The calving lactation, two seasons were defined; Winter season from October to March and Summer season from April to September.

Data were statistically analyzed using the general linear model according to SAS (1996) for the effect of age at first calving, calving season, and parity of dam as main factors. Fixed effect model:

\[ Y = \mu + G_i + S_j + P_k + \text{SIRE}_m + E_{ijklm} \]

\[ \mu = \text{Overall means} \]
\[ G_i = \text{Effect of the } i^{th} \text{ age at first calving,} \]
\[ S_j = \text{Effect of the } j^{th} \text{ calving season.} \]
\[ P_k = \text{Effect of the } k^{th} \text{ parity of dam} \]
\[ E_{ijkl} = \text{Experimental error.} \]

Correlation coefficients between milk yield traits were calculated.

8182
RESULTS AND DISCUSSION

Season of calving: Season effects on economically important traits are of interest because of their association, especially in the tropics, to direct effects of forage availability and quality, temperature and humidity on the animals. The analysis of variance (Table 2) showed that mean 305-day yields and calving interval were significantly affected by calving season while this effect was non-significant on milk yield, daily yield, lactation length and dry period. Cows calving in the summer season (dry season) produced more 305-day yields, however, cows calving in this period had longest calving interval (Table 2). Feed supplementation may help to solve this problem. The benefits of a better feeding and management on production and reproduction of cattle have been documented (Román-Ponce, 1992; Vaccaro et al., 1997; Combellas, 1998, Parra-Bracamonte et al. 2005. This agree with and Parra-Bracamonte et al. (2005) in Mexico and Vaccaro (1992) who found more milk per cow in Venezuela when calving occurred in the dry season compared to the other seasons. However, Hernández-Reyes et al. (2000) and Román et al. (1978) did not find significant differences between seasons in Yucatan and Veracruz, Mexico, respectively. Villegas and Román (1986) observed that cows calving in the rainy season in Veracruz had the best milk performance. Seasonal differences in milk traits are expected to be influenced by feeding management practices in the regions or herds, as well by the type of tropical climate (sub humid or humid). Under Tunisian conditions. Nagarcenkar and Rao (1982); Rao et al. (1984) and Gandhi and Gurnani (1987) also observed non-significant effect of season of calving on milk yield. Ajili et al. (2007) found that Mean milk production in the summer season was low (5807 kg). Poor management may hamper the restitution of cows body reserves and consequently affect cow performances in subsequent lactations. That is, the length of the cow’s productive life is reduced.

Table 2: Least-Square means and standard errors lactation milk yield, daily milk yield, lactation length, 305-day yields, calving interval and dry period as influenced by calving season.

<table>
<thead>
<tr>
<th>Traits</th>
<th>N</th>
<th>Summer</th>
<th>Winter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk yield (kg)</td>
<td>306</td>
<td>5068.08 ± 106.24</td>
<td>4921.51 ± 100.97</td>
</tr>
<tr>
<td>Daily lactation (kg)</td>
<td>302</td>
<td>16.30 ± 0.26</td>
<td>15.85 ± 0.25</td>
</tr>
<tr>
<td>Lactation length</td>
<td>309</td>
<td>309.04 ± 4.33</td>
<td>302.70 ± 4.02</td>
</tr>
<tr>
<td>305-day yields (kg)</td>
<td>309</td>
<td>4970.13 ± 78.39a</td>
<td>4724.92 ± 84.13 b</td>
</tr>
<tr>
<td>Calving Interval (days)</td>
<td>218</td>
<td>403.63 ± 4.97a</td>
<td>418.33 ± 4.74b</td>
</tr>
<tr>
<td>Dry period (days)</td>
<td>218</td>
<td>91.43 ± 3.58</td>
<td>98.93 ± 3.35</td>
</tr>
</tbody>
</table>

a, b Values with different superscript in the same row within item are differ significantly (P<0.01).
Effect of parity: According to parity effect milk traits, calving interval and dry period were significantly different (P > 0.01) (Table 3). In the present investigation the lactation length was longer in first parity as compared to the second and third parity. The differences in milk-yield traits in our study were partly due to a shorter lactation length for the third parity cows. The overall lactation length in the first, second and third parity is in agreement with reported those by Yadav et al. (1994) and Sreemannarayana and Rao (1995). Dhara et al. (2006) reported that in fact, the highest productions under sub tropic conditions were obtained early in the cow’s career, during the first lactation (5922 kg) and total milk yield, daily milk yield and 305-day yield were declined rapidly in second and third lactation. In the present study differences between the highest and lowest in first and third parity for daily milk yield and 305-day yield were 8.45 kg and 2575.44 kg, respectively (Table 3). Such a performance is still lower than recorded in more favourable conditions for all lactations (World Holstein-Friesian Federation, 2006). Holsteins produce the maximum of milk in the fourth and fifth lactations in their countries of origin (World Holstein-Friesian Federation, 2006). Harsh conditions and food shortages in some cases may compromise performances of cows with high potentials for milk production. These decreasing, suggesting that factors other than parity cows was contributing to the observed results. However, the longest calving interval obtained for the first parity cows is similar to those found in previous studies in the tropics (Villegas and Román, 1986; Vaccaro, 1992; Parra-Bracamonte et al. (2005). The longer calving interval could be due to a delay in the re-start of postpartum estrus in lactating young cows and to the greater effect of the stress of lactation in younger than in older cows (Galina and Arthur (1989). Also, due to longest dry period. The longest calving interval had the lowest milk yield or milk yield per day (Table 3). Vaccaro et al. 1997 suggested correction for this case when evaluating cows for selection. Dry period was significantly longer in first party (161 days) compared with second (119 days) and first parity (81 days). Part of parity effect on dry period was related to body condition of the cow at calving. Cows in good body condition at calving produce higher milk yield during the following lactation than in cows in thin body condition at calving.

Effect of age at first calving: Table (4) summarize Least- Square means and standard errors of total milk yield, daily milk yield, lactation length, 305-day yield, calving interval and dry period as influenced by age at first calving. Total milk yield, lactation length, and dry period were not affected by age at first calving. Similar observations were found by Venkayya and Anantkrishnan (1957) and Agarwal (1962) and Rakhe (2003) who reported no effect of age at first calving either on milk days or dry days in buffalo.

Age at first calving is an important economic criterion. It does allow not only for time winning and then an increased production but also affects the lifespan of cow in the herd. In the present study the estimates for age at first calving indicated that cows calving at 28 to 30 months produced more (P <0.01) milk for daily milk yield and mean 305 day lactation than cows calving at 24 to 27 months.
Whereas calving interval was highest for calving at 24 to 27 months (Table 4). The influence of age at first calving on total milk yield was consistent with published results (Boujenane et al. (2000); Boujenane (2002). These results suggested that optimal age at first calving is 28 to 30 months. 28 and 30 months of age at first calving, Heifers that calve early spend more of their life producing milk than heifers that calve later.

Advanced age at first calving dramatically increases herd costs. An extra day to first calving is estimated to cost 13 times as much as an extra open day (Cady and Smith 1996). In other hand, may be animals Calving before 24 months may be had a risky option due to problems associated with rapid growth. Since calving weight, not calving age, is the major factor affecting lactation milk yield. Perez et al. (1999) estimated mean of age at first calving 28.6 months in Spain. The primary advantages of reducing age at first calving include reducing rearing costs as well as reducing the amount of time in which the heifer is only a capital drain on farm resources. The primary disadvantage of reducing age at first calving is that it is frequently associated with a reduction in first lactation milk yield (Meyer et al. 2005).

**Phenotypic correlations:** Phenotypic correlations among different productive and reproductive traits are presented in Table (5). Highly significant, positive phenotypic correlations of lactation length with milk yield, 305 day lactation and daily yield were obtained (0.73, 0.60 0.87 and 0.23 respectively. Similarly phenotypic correlations of total milk yield with calving interval, 305 day lactation and daily yield were 0.22, 0.94 and 0.81, respectively, the latter were high and positive. These correlations are comparable to most of those reported in the literature (Ben Gara, (1998) and Ajili et al., (2007).The phenotypic correlations were found to be negative between dry period and total milk yield (-0.30) daily yield (-0.35) and 305-day yield (-0.18). Similarly negative phenotypic correlations were observed for calving interval and daily lactation (-0.27). A negative effect of early calving on milk yield was obtained in our study and may be due to insufficiently developed heifers. Nilforooshan and Edriss (2004) considered the effect of age at first calving had negative correlation between milk yield and age at first calving. Positive correlations show that yield is the most important trait for culling and cows with satisfactory yields tend to stay longer in the herd (Ben Gara, (1998); Tsuruta et al. (2004) Ajili et al. ( 2007).

The results of the present study are partially in agreement with the results of Khan (1985) and Nilforooshan and Edriss ( 2004)

Phenotypic performances of Friesian-Holstein cows for productive and reproductive traits were estimated under sub tropic conditions. Results may imply that Holstein-Friesian cows in sub tropic are not producing up to their potential probably because of shortcomings in management and relatively harsh climatic conditions.
Table 5: Phenotypic correlations among various productive and reproductive traits

<table>
<thead>
<tr>
<th>Traits</th>
<th>Lactation length</th>
<th>Total milk yield</th>
<th>Age at first calving</th>
<th>Calving interval</th>
<th>Dry period</th>
<th>305- day yield</th>
<th>Daily yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lactation length</td>
<td>1</td>
<td>-0.031</td>
<td>0.600**</td>
<td>-0.021</td>
<td>0.867**</td>
<td>0.225**</td>
<td></td>
</tr>
<tr>
<td>Total milk yield</td>
<td>1</td>
<td>0.029</td>
<td>0.220**</td>
<td>-0.300**</td>
<td>0.942**</td>
<td>0.812**</td>
<td></td>
</tr>
<tr>
<td>Age at first calving</td>
<td>1</td>
<td>-0.083</td>
<td>0.017</td>
<td>0.149**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calving interval</td>
<td>1</td>
<td>0.597**</td>
<td>0.459**</td>
<td>-0.269**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry period</td>
<td>1</td>
<td>-0.180**</td>
<td>-0.355**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>305- day yield</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>0.584**</td>
</tr>
</tbody>
</table>

Conclusions

This study has investigated effects of calving season, parity and age at first calving on productive and reproductive traits for Holstein Friesian cows and the phenotypic correlation between these traits. The highest productions under sub tropic conditions were obtained early in the cow’s career, during the first lactation and declined rapidly in second and third lactation. Such performance is still lower than recorded in more favourable conditions for all lactations. Harsh conditions and food shortages in some cases may compromise performances of cows with high potentials for milk production. The optimal age at first calving is 28 to 30 months. Phenotypic performances of Friesian-Holstein cows were estimated under sub tropic conditions. Results may imply that Holstein-Friesian cows in sub tropic are not producing up to their potential probably because of shortcomings in management and relatively harsh climatic conditions.

REFERENCES

Abbas, S.F.


Abbas, S.F.


تأثير موسم الولادة و ترتيب موسم الحليب والعمر عند أول ولادة على خصائص الأداء والارتباط المظاهر بين هذه الصفات في أبقار هولشتين الفريزيان.

سالف النزل فتحي عباس

قسم الانتاج الحيواني- كلية الزراعة- جامعة أسيوط

تأثر موسم الولادة و ترتيب موسم الحليب والعمر عند أول ولادة على خصائص الأداء والارتباط المظاهر بين هذه الصفات درست في 587 أبقار الفريزيان الهولشتين. وجد إن إنتاج الولادة في (305 يوم) والفترة بين ولايات تتأثر عشوائيا بموسم الولادة بينما هذا التأثير غير معنوي على إنتاج الولادة الكلي واليومي وطول موسم الحليب و فتره الجفاف. هناك اختلافات معنوية ظهرت بين ترتيب مواسم الولادة في كل من صفات الولادة والفترة بين ولايات فتره الجفاف. وجد أن الفترة بين ولايات كانت أطول في الموسم الثالث (457 يوم) وأقصر في الموسم الأول (81 يوم) بينما فترة الجفاف كانت أطول في الموسم الثالث (161 يوم) وأقصر في الموسم الأول (35 يوم).

بدل النتائج في إنتاج الولادة في مواسم الحليب على أن هناك بعض العوامل الأخرى غير موسم الحليب تساهم في إحداث هذا التأثير. علاج الارتدار اليومي وإنتاج اللبن في (305 يوم) كان مرتفعا في الأقبار التي تلد أول مرة عند عمر 28-30 شهرًا، مقابلة بالأقبار التي تلد أول مرة بمجرد عند عمر 28-29 شهرا، وتدل النتائج على أن العمر الأمثل للولادة أول مرة هو 28 إلى 30 شهر. وكذلك كانت الفترات بين ولايات أقصر عند هذا العمر (26-27 شهرا).

هناك فروق عالية معنوية إيجابية في الصفات المظاهرية لصفة طول موسم الحليب مع تأثير الولادة الكلي والفترة بين ولايات وإنتاج الولادة في (305 يوم) ونسبة كم الولادة اليومي في (0.73-0.77) على التوالي. كما وجد ارتباط معنوي سلبي لفترة الجفاف مع إنتاج الولادة الكلي (0.30-0.36) مع إنتاج الولادة اليومي (0.30-0.36) وإنتاج اللبن في (0.30-0.36). ومع نسبة كم الولادة اليومي (0.81-0.82)

من نتائج هذه الدراسة يتبين أن تربية أبقار الفريزيان تحت الظروف المصرية من رعاية ومناخ يثير سلباً إنتاجية هذه الأبقار من الحليب وكذلك على بعض الصفات التناسلية محل هذه الدراسة.
Table 3: Least-Square means and standard errors of total milk yield, daily milk yield, lactation length, 305-day yield, calving interval and dry period as influenced by parity of dam.

<table>
<thead>
<tr>
<th>Traits</th>
<th>N</th>
<th>Parity 1</th>
<th>Parity 2</th>
<th>Parity 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total milk yield (kg)</td>
<td>292</td>
<td>5921.52 ± 81.05a</td>
<td>4273.48 ± 84.77b</td>
<td>2151.56 ± 113.43c</td>
</tr>
<tr>
<td>Daily yield (kg)</td>
<td>292</td>
<td>18.19 ± 0.19 a</td>
<td>14.26 ± 0.24 b</td>
<td>9.74 ± 0.30 c</td>
</tr>
<tr>
<td>Length of lactation</td>
<td>296</td>
<td>323.47 ± 4.02a</td>
<td>296.75 ± 3.74b</td>
<td>220.69 ± 10.03c</td>
</tr>
<tr>
<td>305-day yield (kg)</td>
<td>296</td>
<td>5474.39 ± 68.30a</td>
<td>4327.27 ± 5.15b</td>
<td>2898.95c ± 113.25</td>
</tr>
<tr>
<td>Calving interval (days)</td>
<td>258</td>
<td>403.78 ± 4.32b</td>
<td>421.91 ± 6.05ab</td>
<td>452.00 ± 7.44b</td>
</tr>
<tr>
<td>Dry period (day)</td>
<td>254</td>
<td>80.96 ± 2.47c</td>
<td>119.02 ± 4.22b</td>
<td>160.77 ± 22.21a</td>
</tr>
</tbody>
</table>

a, b, c Values with different superscript in the same row within item are differ significantly (P<0.01).

Table 4: Least-Square means and standard errors of total milk yield, daily milk yield, lactation length, 305-day yields, calving interval and dry period as influenced by age at first calving

<table>
<thead>
<tr>
<th>Traits</th>
<th>N</th>
<th>Age at first calving from 24 to 27 month</th>
<th>Age at first calving from 28 to 30 month</th>
<th>Age at first calving from 31 to 36 month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total milk yield (kg)</td>
<td>256</td>
<td>4888.66 ± 161.48</td>
<td>4990.70 ± 103.11</td>
<td>5120.50 ± 140.20</td>
</tr>
<tr>
<td>Daily yield (kg)</td>
<td>254</td>
<td>15.39 ± 0.34 b</td>
<td>16.21 ± 0.26 a</td>
<td>16.49 ± 0.35 a</td>
</tr>
<tr>
<td>305-day yield (kg)</td>
<td>257</td>
<td>4547.03 ± 124.75 b</td>
<td>4886.34 ± 85.86 a</td>
<td>5028.40 ± 105.33 a</td>
</tr>
<tr>
<td>Lactation length (day)</td>
<td>257</td>
<td>306.91 ± 7.50</td>
<td>303.78 ± 3.81</td>
<td>307.72 ± 5.52</td>
</tr>
<tr>
<td>Calving interval (day)</td>
<td>196</td>
<td>430.18 ± 7.53 a</td>
<td>405.64 ± 4.89 b</td>
<td>408.13 ± 6.40 b</td>
</tr>
<tr>
<td>Dry period (day)</td>
<td>191</td>
<td>99.03 ± 5.29</td>
<td>91.65 ± 3.51</td>
<td>97.21 ± 4.35</td>
</tr>
</tbody>
</table>

a, b, Values with different superscript in the same row within item are differ significantly (P<0.01).