FACTORS AFFECTING MILK PRODUCTION AND SOME REPRODUCTIVE TRAITS OF FRIESIAN COWS IN EGYPT

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ABSTRACT

Data obtained from 2152 records relevant to 849 Friesian cows raised at Dalla farm, 75 km south Alexandria, between 1987-1991 were utilized to study the effects of sire, age at first calving, season and year of calving and parity on milk yields and some reproductive traits of these cows. The least squares analysis with unequal subclass numbers indicated that the overall least square means of total and 305-days milk yield were 5076.4 and 4795.3 kg, in respective order, corresponding means for age at first calving, days open, calving interval and breeding efficiency were 28.1 month, 119.4 day, 397.3 day and 92.4%, respectively.

Sire had highly significant effect on all studied traits except the days open and calving interval where the effect was not significant. However, age at first calving had no significant effect on days open and calving interval but had highly significant effect on total and 305-days milk yield and had significant effect only on breeding efficiency. Season of calving had highly significant effect on age at first calving, days open and calving interval and had significant effect only on 305-days milk yield, but had no significant effect on total milk yield and breeding efficiency. Year of calving had highly significant influence on all traits except age at first calving which was not significantly affected. Parity had highly significant effect on all traits except age at first calving, days open and calving interval where the effect was not significant. The results of this investigation in general show that sire, managerial systems and appropriate environmental conditions have positive effects on milk yields and reproductive traits of Friesian cows of this herd.

INTRODUCTION

In Egypt, cattle population is continuously increasing and is estimated to be about 4.5 million heads (FAO, 2006). This cattle population produces about 2.30 million metric tons of milk and about 0.32 million metric tons of meat, representing about 49 % of the total milk production (4.71 million metric tons) and 49 % of the total meat production (0.65 million metric tons), respectively (FAO, 2006). The exotic dairy breeds and their crosses with Baladi cattle produce about 30 % of the national milk (MALR, 2000). However, Baladi cattle have suffered greatly from the introductions of exotic breeds due the indiscriminate crossing that usually follows these introductions (Galal, 2007).

Although milk yield is the major trait of economic importance in dairy farms, other traits such as age at first calving, lactation period, days open, and calving interval are affecting the profitability of dairy farms (Hammoud, 1997 and Tozer and Heinrichs, 2001). Therefore, the optimal productive and reproductive traits of dairy cows depend upon the interactions of genetic, nutritional, physiological and environmental factors.

The objective of this investigation was to study the effect of sire, age at first calving, season and year of calving and parity on total and 305-days milk yields, age at first calving, days open, calving interval and breeding efficiency of Friesian cows in a commercial herd in Egypt.

MATERIALS AND METHODS

Source of data:

Data used in this study were collected from 2152 lactation records relevant to 849 pure Friesian cows which belong to the dairy commercial herd of the Dalla Farm, Alexanria-Cairo desert road, 75 km south Alexandria, Egypt. The records used covered the period from 1987 to 1991. The relevant details of the herd management were described by El-Nady (1996) and El-Awady and Tawfik (2000). The cows were daughters of 84 sires and each sire had at least four daughters. The studied traits were total milk yield in kilograms (TMY), 305-days milk yield in kilograms (305-DMY), age at first calving in months (AFC), days open in days (DO), calving interval in days (CI) and breeding efficiency in percent (BE). Breeding efficiency was calculated using the formula described by Wilcox *et al.* (1957).

Statistical procedures:

The data were analyzed using least squares analysis with unequal subclass numbers using Generalized Linear Model procedures (SAS, 1999) to estimate the effects of sire, age at first calving, season and year of calving and parity on the traits under investigation.

The statistical model used was as follows:

$$Y_{ijklmn} = u + s_i + a_k + b_l + c_m + p_j + e_{ijklmn}$$

Where,

Y_{ijklmn} : An observation of each trait.
U : The overall mean.
s_i : The random effect of the i^{th} sire.
a_k : The fixed effect of the k^{th} age at first calving.
b_l : The fixed effect of the l^{th} season of calving.
c_m : The fixed effect of the m^{th} year of calving.
p_j : The fixed effect of the j^{th} parity.
e_{ijklm} : The random effect assumed to be distributed with mean zero and variance s^2_e.

The same model was used for age at first calving after excluding a_k.

RESULTS AND DISCUSSION

Least square means and standard errors of the factors affecting the traits studied are presented in Tables (1), (2) and (3). The overall means of TMY and 305-DMY were 5076.4 and 4795.3 kg, respectively. These values were higher than the estimates reported by Hammoud (2006) on a similar herd in Egypt. The overall means of AFC, DO, CI and BE were 28.1 month, 119.4 day and 397.3 day and 92.4 %, respectively. These values were better than the estimates depicted by Hammoud (2007) on a similar herd in Egypt.

1- Effect of sire:

Sire had highly significant effects on TMY and 305-DMY, indicating the possibility of the genetic improvement of these traits through sire selection. Similar results were reported by Hammoud (2006) and Nowier (2006). However, El-Barbary *et al.* (1999) found that sire had no significant effect on traits of milk yields of Friesian cows.

The effect of sire on AFC was highly significant. This indicates that sire selection is useful for the genetic improvement of this trait. Similar results were documented by Soliman and Khalil

(1991), Amin (1992), Soliman and Hamed (1994) and Hammoud (2007). However, nonsignificant effect of sire on AFC was indicated by Khattab and Sultan (1990) and Hammoud (1997). However, sire had nonsignificant effects on DO and CI. Similar effects of sire on DO and CI were found by Aly (1995) and Nowier (2006). Contradictory, highly significant effects of sire on DO and CI were documented by Alemam (2002) and Hammoud (2007). Sire had highly significant effect on BE which indicates the usefulness of sire selection when applying improvement programmes on this trait. Significant effect of sire on BE was obtained by El-Barbary *et al.* (1987) and Hammoud (2007). However, nonsignificant effect of sire on BE was indicated by Aly (1995).

2- Effect of age at first calving:

The effect of age at first calving on TMY and 305-DMY were highly significant. Milk yields were increased with the increase of age at first calving. Lower age at first calving heifers should be offered higher levels of feeding and better management during their early stages of rearing and ought to be bred at the proper time of the estrus cycle to ensure conception. A reduction in the age at first calving will minimize the raising costs and shorten the generation interval and subsequently maximize the number of lactations per head. These results are in line with those found by Aly (1995) and Nowier (2006). Contradictory results were obtained by El-Barbary *et al.* (1999) and Hammoud (2006).

The effect of age at first calving on DO and CI was not significant. The results obtained are in agreement with those indicated by Aly (1995), El-Nady (1996), Alemam (2002), Nowier (2006) and Hammoud (2007). BE was increased significantly with increasing age at first calving. The same effect was obtained by El-Barbary *et al.* (1987) and Hammoud (2007). On the other hand, Sadek *et al.* (1994) and Aly (1995) reported that the effect of age at first calving on BE was not significant.

3- Effect of season of calving:

Season of calving had significant influence on 305-DMY, but had nonsignificant influence on TMY. Winter calvers had the highest milk yields. The high yields in winter could be attributed to better climatic conditions, feeding on berseem and the increase in the amount of feed intake. However, the decreased milk yields in summer may be attributed to the increased temperature and the low quality vegetative feed. Significant effect of season of calving on milk yields

were reported by Hammoud (2006) and Nowier (2006). However, nonsignificant effects of season of calving on milk yields were depicted by El-Awady (1991), Amin (1992), Aly (1995), El-Barbary *et al.* (1999) and Amino *et al.* (2007).

The effects of season of calving on AFC, DO and CI were highly significant. Similarly, highly significant effect of season of calving on DO and CI was depicted by Abou-Bakr *et al.* (2006). However, El-Barbary *et al.* (1992), Alemam (2002) and Hammoud (2007) indicated that season of calving had nonsignificant influences on Do and CI. Cows calved in spring had higher BE than those calved in autumn, winter and summer. The effect of season of calving on BE was not significant. Similar effect of season of calving on BE was documented by El-Barbary *et al.* (1987), Sodakar *et al.* (1988) and Kassab and Salem (1993). However, Sadek *et al.* (1994) and Hammoud (2007) found significant effect for season of calving on BE.

4- Effect of year of calving:

The effects of year of calving on TMY and 305-DMY were highly significant, but no specific trends for these effects were indicated. The trends depended mainly on the conditions of individual animals, feeding and management practices and year to year climatic changes. The highest yields were attained during the years 1988 and 1989. Highly significant effects of year of calving on TMY and 305-DMY were depicted by Abou-Bakr *et al.* (2006) and Amino *et al.* (2007). The lack of trends was in agreement with those obtained by El-Awady (1991), El-Naday (1996), Nowier (2006) and Hammoud (2007).

Year of calving had nonsignificant effect on AFC, but had highly significant effect on DO and CI. Similar effect of year of calving on AFC was reported by Khattab and Sultan (1990) and El-Barbary *et al.* (1991). However, Soliman and Khalil (1991), Soliman and Hamed (1994) and Hammoud (1997) indicated that AFC was highly significantly influenced by year of calving. In addition, El-Nady, (1996), Alemam (2002), Abou-Bakr *et al.* (2006) and Nowier (2006) and Hammoud (2007) reported highly significant effect of year of calving on DO and CI. However, nonsignificant effect of year of calving on DO and CI was reported by El-Barbary *et al.* (1991). The highest BE was recorded on cows calved during the years 1989 and 1991, year of calving had highly significant effect on BE. This is mainly due to the changes in managerial systems and environmental conditions which occurred during different years. Similar results were reported by Sodakar *et al.* (1988) and Hammoud (2007).

5- Effect of parity:

Parity had highly significant effects on TMY and 305-DMY. Milk yields increased with increase of lactation order up to the fourth lactation and declined thereafter. This is logically due to the increase in age accompanied with the increase in body weight and to the full development of the udder secretary tissues and due to the changes in managerial systems and environmental conditions among parties. These findings are similar to those reported by El-Awady (1991), Amin (1992), Sadek *et al.* (1994), Aly (1995), Abou-Bakr *et al.* (2006), Hammoud (2006), Nowier (2006) and Amino *et al.* (2007). On the other hand, nonsignificant effects of parity on milk yields were depicted by El-Barbary *et al.* (1999).

There was nonsignificant association between parity and AFC. A similar result was found by El-Barbary *et al.* (1991). However, El-Nady (1996), Alemam (2002), Nowier (2006) and Hammoud (2007) reported highly significant effect of parity on AFC. The effects of parity on DO and CI were not significant. No specific trends for parity effects on DO and CI were indicated. These trends depended mainly on the conditions of individual animals, feeding and management practices. El-Barbary *et al.* (1992) depicted that DO and CI were not significantly affected by parity. However, El-Nady (1996), Alemam (2002), Abou-Bakr *et al.* (2006), Nowier (2006) and Hammoud (2007) reported highly significant effect of parity on DO and CI. The influence of parity on BE was highly significant. This is mainly due to the increase in the body weight combined with advancing age when body is fully developed followed by increase in function of the body systems including reproductive system and due to the changes in managerial systems and environmental conditions among parties. Similar influence was reported by hammoud (2007).

In conclusion, highly significant effect of sire on TMY, 305-DMY, AFC and BE indicates that sire selection is useful for the genetic improvement of these traits. Therefore, the adjustments for age at first calving, season and year of calving and parity seem to be necessary if bulls are to be evaluated for the performance of their daughters. Consequently, the results of this investigation show that sire, managerial systems and appropriate environmental conditions have positive effects on milk production and reproductive traits of Friesian cows of this herd.

Table (1): Least-square means (LSM) and standard errors (SE) of factors affecting total milk yield (TMY) and 305-days milk yield (305-MY).

Factor		TMY(day)	305-DMY (kg)
	No	LSM±SE	LSM±SE
Overall mean	2152	5076.4±26.3	4795.2±22.5
Sire (1- 84)		**	**
Minimum		4036.0±335.3 (14)	3872.0±230.7 (21)
Maximum		5617.5±346.3 (12)	5306.3±181.2 (35)
Age at first calving		**	**
< 25	187	4836.5±107.6	4572.3±91.9
25 – 28	1167	5047.3±65.1	4760.3±55.6
29 – 32	665	5020.5±69.2	4764.1±59.0
> 32	133	5401.5±123.4	5084.5±105.4
Season of calving		NS	*
Winter	444	5124.2±87.7	4901.9±74.9
Spring	319	5071.2±91.2	4666.4±77.9
Summer	758	5071.3±72.3	4763.1±61.7
Autumn	631	5039.2±76.4	4849.6±65.2
Year of calving		**	**
1987	260	4489.5±117.5	4194.9±100.4
1988	270	5306.6±109.8	4854.5±93.8
1989	489	5745.4±86.1	5533.8±73.6
1990	743	4906.3±70.4	4591.4±60.1
1991	390	4934.5±74.5	4801.7±63.7
Parity		**	**
1st	849	4777.9±61.5	4372.3±52.5
2nd	627	5312.3±70.7	4066.2±60.4
3rd	369	5204.7±86.2	4966.0±73.6
4th	239	5307.4±104.3	5013.1±89.1
5th and over	68	47801.0±25.8	4558.5±148.6

NS: Not significant (P>0.05), *: Significant (P< 0.05), **: Highly significant (P< 0.01).
Figures in parentheses indicate the number of observations.

Table (2): Least-square means (LSM) and standard errors (SE) of factors affecting age at first calving (AFC) and days open (DO).

Factor	AFC(month)		DO (day)	
	No	LSM±SE	No	LSM±SE
Overall mean	2152	28.1±0.1	2140	119.4±1.6
Sire (1- 65)		**		NS
Minimum		24.8±0.8 (29)		78.3 ±16.3 (21)
Maximum		35.5±0.6 (14)		166.6±21.5 (13)
Age at first calving				NS
< 25		-------	186	114.1±6.5
25 – 28		-------	1162	121.8±4.0
29 – 32		-------	661	118.8±4.2
> 32		-------	131	122.7±7.5
Season of calving		**		**
Winter	444	29.0±0.2	440	119.1±5.3
Spring	319	27.9±0.2	318	128.0±5.5
Summer	758	27.4±0.3	758	120.3±4.4
Autumn	631	28.2±0.2	624	109.8±4.6
Year of calving		NS		**
1987	260	28.2±0.3	260	134.4±7.1
1988	270	28.3±0.3	270	137.0±6.6
1989	489	27.6±0.2	489	102.2±5.2
1990	743	28.0±0.2	742	115.4±4.3
1991	390	28.3±0.2	379	107.6±4.6
Parity		NS		NS
1st	849	28.4±0.1	843	126.5±3.7
2nd	627	28.2±0.2	624	117.3±4.3
3rd	369	28.2±0.2	368	116.3±5.2
4th	239	27.9±0.2	238	122.4±6.3
5th and over	68	28.4±0.1	67	114.1±10.6

NS: Not significant (P>0.05), **: Highly significant (P< 0.01).
Figures in parentheses indicate the number of observations.

Table (3): Least-square means (LSM) and standard errors (SE) of factors affecting calving interval (CI) and breeding efficiency (BE %).

Factor	CI (day)		BE (%)	
	No	LSM±SE	No	LSM±SE
Overall mean	2136	397.3±1.6	1840	92.4±0.3
Sire (1- 65)		NS		**
Minimum		377.3±14.8 (26)		84.0±3.0 (23)
Maximum		445.1±21.6 (13)		102.8±3.4 (19)
Age at first calving		NS		*
< 25	186	391.6±1.6	156	91.2±1.2
25 - 28	1159	399.2±4.0	988	92.6±0.7
29 - 32	660	397.5±4.2	581	94.4±0.7
> 32	131	401.1±7.5	115	91.6±1.4
Season of calving		**		NS
Winter	438	396.2±5.4	398	92.0±0.9
Spring	318	406.8±5.6	544	91.8±1.0
Summer	757	398.5±4.4	640	93.4±0.8
Autumn	623	387.8±4.7	258	92.6±0.9
Year of calving		**		**
1987	260	412.6±7.2	259	87.7±1.3
1988	270	416.2±6.7	269	89.3±1.2
1989	488	380.3±5.6	488	95.3±0.9
1990	740	392.6±4.3	728	93.6±0.7
1991	378	384.7±4.6	96	96.3±1.5
Parity		NS		**
1st	840	402.7±3.8	803	94.0±0.7
2nd	624	395.5±4.3	544	93.6±0.8
3rd	368	394.5±5.3	286	89.2±1.1
4th	237	401.3±6.4	207	93.0±1.3
5th and over	67	392.5±10.7	-	-

NS: Not significant (P>0.05), *: Significant (P< 0.05), **: Highly significant (P< 0.01).
Figures in parentheses indicate the number of observations.

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العوامل المؤثرة علي إنتاج اللبن وبعض الصفات التناسلية لأبقار الفريزيان في مصر

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أجرى هذا البحث على بيانات قطيع أبقار الفريزيان بمزرعة دلة - محافظة البحيرة - والتي تبعد ١٣٠كم عن مدينة القاهرة - مصر. وقد شملت الدراسة ٨٤٩ بقرة فريزيان لها ٢١٥٢ سجل خلال الفترة من ١٩٨٧ وحتى ١٩٩١. واستهدف البحث دراسة تأثير كل من الأب، العمر عند أول ولادة، فصل الولادة، سنة الولادة وترتيب موسم الحليب علي إنتاج اللبن وبعض الصفات التناسلية لهذا القطيع التجاري.

تم تحليل البيانات إحصائياً بطريقة الحد الأدنى للمربعات, وتتلخص أهم النتائج المتحصل عليها فيما يلي :

١- المتوسط العام: بلغ المتوسط العام لإنتاج اللبن الكلي ٥٠٧٦,٤ كجم, لإنتاج اللبن في ٣٠٥ يوم ٤٧٩٥,٣ كجم، لفترة التلقيح ١١٩,٤ يوم، وللفترة بين الولادتين ٣٩٩,٣ يوم، للعمر عند أول ولادة ٢٨,١ شهر. وللكفاءة التناسلية ٩٢,٤ %.
٢- الأب: له تأثير معنوي جداً علي الصفات موضع البحث ما عدا طول فترة التلقيح والفترة بين الولادتين حيث كان التأثير غير معنوي.
٣- العمر عند أول ولادة: له تأثير غير معنوي علي فترة التلقيح وفترة بين الولادتين، له تأثير معنوي جداً علي إنتاج اللبن الكلي وإنتاج اللبن في ٣٠٥ يوم وله تأثير معنوي فقط علي الكفاءة التناسلية.
٤- موسم الولادة: له تأثير معنوي جداً علي العمر عند أول ولادة، فترة التلقيح والفترة بين الولادتين، له تأثير معنوي فقط علي إنتاج اللبن في ٣٠٥ يوم وليس له تأثير معنوي علي إنتاج اللبن الكلي والكفاءة التناسلية.
٥- سنة الولادة: لها تأثير معنوي جداً علي الصفات موضع البحث ما عدا العمر عند أول ولادة حيث كان التأثير غير معنوي.
٦- ترتيب موسم الحليب: له تأثير معنوي جداً علي إنتاج اللبن الكلي, إنتاج اللبن في ٣٠٥ يوم والكفاءة التناسلية وليس له تأثير معنوي علي العمر عند أول ولادة، فترة التلقيح والفترة بين الولادتين.

توضح نتائج هذا البحث بصفة عامة أن للأب، نظم الرعاية المناسبة والظروف البيئية الملائمة أثر كبير علي الأداء الإنتاجي والتناسلي لأبقار الفريزيان في هذا القطيع.