

Effect of sire, age at first calving, season and year of calving and parity on reproductive performance of Friesian cows under semiarid conditions in Egypt

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SUMMARY

The objective of this paper was to study some factors affecting reproductive performance of a locally-born Friesian herd in Egypt. Data of 2096 reproductive records representing 482 Friesian cows daughters of 38 sires raised at the Dairy Unit of Milk and Meat Project of Faculty of Agriculture, Alexandria University, Egypt (located at the northern western part of the Nile Delta) between 1985-2002 were utilized to study the effects of sire of the cow, age at first calving (AFC), season and year of calving/birth and parity on period from parturition to first service (FSP), days open (DO), calving interval (CI), number of services per conception (NSC), AFC and breeding efficiency (BE). The least squares mixed model analysis by SAS (1999) indicated that the overall least squares means (\pm standard error) of FSP, DO, CI, NSC, AFC and BE were 88.4 ± 1.1 , 130.7 ± 1.9 , 403.1 ± 1.9 days, 2.1 ± 0.1 services, 30.7 ± 0.1 months and 90.1 ± 0.6 %, respectively. Sire had highly significant ($P < 0.01$) effect on DO, CI, NSC and AFC, but had insignificant effect on FSP and BE. The influence of AFC on FSP was highly significant ($P < 0.01$) and not significant on DO, CI, NSC and BE. Cows had AFC more than 36 months had the longest FSP (92.6 ± 4.5) and cows had AFC less than 29 months of age had 87.8 ± 2.7 days FSP. Season of calving had significant effect on FSP ($P < 0.01$), DO and CI ($P < 0.05$), but had insignificant effect on NSC. Season of birth had no significant effect on both AFC and BE. Cows calving in autumn had the shortest CI (394.3 ± 4.7 days) comparing with those calved in other seasons (ranged between 404.8 ± 6.5 and 409.4 ± 5.2 days). Cows calving in autumn also had the shortest DO (122.6 ± 4.8 days). Year of calving/birth had significant ($P < 0.05$ or $P < 0.01$) effect on all traits studied. A decreasing efficiency in reproductive performance of cows was observed over time. The shortest FSP and DO were in the period 1988 to 1990 (64.3 ± 5.3 and 98.1 ± 8.9 days, respectively) and the longest were in the period 2000 to 2002 (107.5 ± 5.2 and 188.1 ± 8.8 days, respectively). Calving interval increased from 371 days in 1988-1990 to 450 days

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in 2000-2002. NSC increased during 1985-1990 from 1.7 services to 2.3 during the period 1991 to 1999. Breeding efficiency deteriorated from 96.7% in 1982-1984 to 84.8% in 1994-1996 and AFC increased from 30.8 to 33.8 months during the same periods. Parity had highly significant effect ($P < 0.01$) on FSP, DO and CI and had insignificant effect on NSC. Generally, FSP, DO and CI decreased with increasing parity. The results of the present study showed that sire of the cow, managerial systems and appropriate environmental conditions have significantly effects on reproductive efficiency of Friesian cows of the herd under investigation. The highly significant ($P < 0.01$) effect of sire on DO, CI, NSC and AFC indicating that sire selection may be used as a useful tool for the genetic improvement of these reproductive traits.

Keywords: Friesian, reproductive traits, environmental effects

INTRODUCTION

The success of selection for milk production has contributed to the domination of the Friesian breed around the world. In Egypt, dairy industry represents 35% of the total animal production sector. During the last two decades, considerable emphasis had been placed upon the importance of Friesian cattle in Egypt for milk production, accordingly the number of large Friesian herds had increased either in the governmental or commercial farms through importation from Europe and USA (Shalaby et al., 2001). The commercial production systems, where high technology in milk production and animal husbandry are used, represent 10% of the total production in Egypt where the exotic dairy cattle breeds are raised. There are several measures of reproductive performance such as age at first calving, days from parturition to first service, days open, calving interval, number of services per conception and breeding efficiency. Basic information on reproductive performance and the factors affecting it in exotic breeds in Egypt is periodically needed for the planning and management for maximum herd production and high fertility.

Since genetic improvement of any trait depends, in part, on the heritability of that trait and since the precision of estimating heritability is increased by reducing the environmental variation, so that adjusting the performance records for known environmental effects should make selection more effective. Maximum rates of breeding efficiency in dairy cattle are attained through regular calving of one viable offspring per breeding cow in the herd in a year. Lowered breeding efficiency rates can be due to long calving interval of dairy cow which is mainly due either to low conception rate and/or high early embryonic mortality (Butler and Smith, 1989). Therefore, the optimal reproductive traits depend upon the interactions of genetic, nutritional, physiological and environmental factors.

Low reproductive efficiency due either to delayed first service, missed estrus, or multiple services per conception continues to be a major problem in dairy herds. Insufficient reproductive performance results in excessively late

age at first calving and long lactations. Both are costly to the dairy producers because of the veterinarian breeding expense, high reproductive replacement costs and fewer calves being born (Oudah et al., 2001). Several reports have indicated that poor reproductive performance, manifested as prolonged calving intervals, can result in reduced milk yield and increased culling rates and replacement cost (Pryce et al., 2000; Kadarmideen et al., 2003 and Sewalem et al., 2008).

Reproductive efficiency in dairy cows is decreasing worldwide. The shift toward more productive cows and larger herds is associated with a decrease in reproductive efficiency. Cows with the greatest milk production have the highest incidence of infertility (Lucy, 2001). Beever (2006) reported that average dairy herd fertility is declining, with more services per successful conception, extended calving intervals and increased culling due to failure to rebreed, all adding significant costs to milk production. Genetics, management and nutrition have all contributed to this decline in fertility.

The objectives of this investigation were to evaluate the reproductive performance of Friesian cattle and documents their trends under semiarid conditions in Egypt and to study the effects of sire, age at first calving, season and year of calving/birth and parity on first service period, days open, calving interval, number of services per conception, age at first calving and breeding efficiency of a herd of locally-born Friesian cows under Egyptian conditions.

MATERIAL AND METHODS

Data

Data used in this investigation were collected from 2096 records relevant to 482 purebred Friesian cows which belong to the Dairy Unit of Milk and Meat Project of the Faculty of Agriculture, Alexandria University, Alexandria, Egypt located at the northern western part of the Nile Delta (Lat/Lon: 31.2° N 30.0° E). These cows were daughters of 38 sires and each sire had at least three daughters. The records used covered the period from 1985 to 2002. The following six reproductive traits were analyzed: the interval from calving to first service (FSP, day), days open defined as the interval from calving to conception, (i.e. the number of days between parturition and the insemination that resulted in a pregnancy) (DO, day), calving interval, defined as the number of days occurring between two successive parturitions (CI, day), number of inseminations per conception defined as the number of inseminations that a cow required to conceive during the current lactation (NSC, service), age at first calving defined as number of months between date of birth and date of the first parturition of a cow (AFC, month) and breeding efficiency (BE%). Breeding efficiency was calculated using the formula described by Wilcox et al. (1957) as follows:

$$\text{Breeding efficiency (\%)} = \{365 \times (N-1) \times 100\} / D$$

Where N equals the total number of parturitions, and D equals the number of days from the first to the last parturition.

Management

Animals were housed free in shaded open yards, grouped according to their average daily milk yield and fed *ad libitum* on berseem (*Trifolium alexandrinum*) from November to May (green season) and on Sorghum (*Sorghum bicolor*) along with berseem hay from June to October (dry season). Cows were also fed all year around on concentrate supplementary ration containing at least 14 % crude protein and 65 % total digestible nutrient. Feeding allowances were offered according to milk production and physiological status as recommended by NRC (1982). Water was also available *ad libitum*. In general, cows were artificially inseminated during the first two heats which occurred after 60 days post partum using imported frozen semen. Heifers were artificially inseminated for the first time in the first two heats once they attained 350 kg of live body weight. Pregnancy diagnoses were carried out routinely at 60 days after service by rectal palpation. If conception did not occur or the cows were seen in oestrus, the cows were inseminated again. The cows were machine milked twice a day at 06.00h and 18.00h. The calves born were artificially suckled after calving to weaning excluding colostrums' period.

Statistical analysis

Least squares analyses of variance with unequal subclass numbers (General Linear Mixed Model procedures using SAS, 1999) were used to determine the effects of sire (as random effect), age at first calving, season and year of calving/birth and parity (as fixed effects) on FSP, DO, CI, NSC. Age at first calving was classified into four groups as follows: <29, 29-32, 33-36 and >36 months of age. Months of calving were pooled in four season classes. The four seasons of the year were taken into account as follows: winter (December to February), spring (March to May), summer (June to August) and autumn (September to November). The 18-year period studied (1985-2002) was classified into six periods of three years as follows: 1985-1987, 1988-1990, 1991-1993, 1994-1996, 1997-1999 and 2000-2002.

The statistical model used was as follows:

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

Where,

Y_{ijklmn} : An observation of each trait.

u : The overall mean.

s_i : The random effect of the i^{th} sire, (1-38)

p_j : The fixed effect of the j^{th} parity (1, 2, 3and 7 and over),

a_k : The fixed effect of the k^{th} age at first calving (<29, 29-32, 33-36 and >36 mo),

b_l : The fixed effect of the l^{th} season of calving (winter, spring, summer and autumn).

c_m : The fixed effect of the m^{th} year of calving (85-87, 88-90,....and 2000-2002).

e_{ijklmn} : The random effect assumed to be distributed with mean zero and variance $\sigma^2 e$.

The same statistical model was used to analyze breeding efficiency after excluding parity and substituting season and year of calving by season and year of birth. The model used to analyze BE was used also to analyze AFC after excluding AFC classes. In all statistical models there were no 2-way interactions ($P > 0.05$); therefore, final models considered only the main effects.

RESULTS AND DISCUSSION

Overall means

The least squares means and standard errors of traits under investigation as affected by random and fixed effects are presented in Tables 1, 2 and 3. The overall mean of FSP was 88.4 days (Table 1). This value was lower than the estimate (102.5 days) found by Kassab and Salem (1993) on a similar Friesian herd in Egypt. Long FSP might be the main reproductive disorder of high yielding dairy cows (Lucy, 2001). Other studies (Topps, 1977 and Holness and Jeffers, 1980) showed that lactational anoestrus is reported to be responsible for a longer interval between first service and conception, and for longer calving intervals in general. This is due to prolactin secretion which suppresses the release of gonadotropins from the pituitary gland, resulting in delays in ovulation and first oestrus after parturition. The time of ovarian cyst formation seems to have an influence on reproductive performance in dairy cows (Gossen and Hoedemaker, 2006).

Calving interval has been extensively analysed and reported. It is probably the best index of a cattle herd's reproductive efficiency (Mukasa-Mugerwa, 1989). Days open is the part of the calving interval that can be shortened by improved herd management. Long DO and consequently prolonged CI may affect the overall economic revenues of the dairy herd. The least squares means of DO and CI reported in the present study were 130.7 and 403.1 days, respectively (Tables 1 and 2). These values were lower than the estimates (141 and 422 days, respectively) reported by Shalaby et al. (2001) on a similar Friesian herd in Egypt. Several authors have stressed the importance of timely heat detection. Bozworth et al. (1972) reported that the calving interval is primarily a management decision, with the length of CI depending largely on the operator's attitudes and reproductive goals. The interval in many herds could be reduced by breeding cows on first heat after 45 days postpartum, after first examining the cows for normal reproductive tracts. El-keraby and Aboul-Ela (1982) reported that the longer DO in dairy cows may be caused by several

factors (i.e. silent estrus, missed estrus due to weak symptoms, frequency and timing of estrus detection, feeding season and milk production).

Table 1. Least squares means (LSM), standard errors (SE) and level of significance of first service period (FSP) and days open (DO) as affected by different factors

Factor	FSP (day)		DO (day)	
	No	LSM±SE	No	LSM±SE
Overall mean	2096	88.4±1.1	1922	130.7±1.9
Sire		NS		**
Age at first calving		**		NS
< 29	830	87.8±2.7	754	135.6±4.5
29 - 32	628	81.1±2.7	578	128.9±4.6
33 - 36	429	80.0±3.2	408	129.4±5.2
> 36	209	92.6±4.5	182	128.9±7.6
Season of calving		**		*
Winter	493	84.3±3.0	496	132.2±5.0
Spring	534	91.7±3.0	461	137.8±5.1
Summer	491	79.7±3.0	443	130.3±5.0
Autumn	578	85.7±2.8	522	122.6±4.8
Year of calving		**		**
1985-87	232	72.5±7.1	215	105.3±12.2
1988-90	345	64.3±5.3	333	98.1±8.9
1991-93	380	80.6±3.8	344	129.7±6.4
1994-96	484	87.4±3.0	471	126.5±4.8
1997-99	426	100.0±3.3	359	136.8±5.6
2000-02	229	107.5±5.2	200	188.1±8.8
Parity		**		**
1 st	451	91.6±2.9	428	142.6±4.8
2 nd	398	100.7±3.0	370	148.3±4.8
3 rd	357	78.2±3.1	341	123.6±5.0
4 th	298	86.3±3.6	279	127.8±5.9
5 th	251	83.9±4.1	226	125.5±6.8
6 th	171	82.3±4.8	146	126.1±8.2
7 th and over	170	74.4±5.4	132	121.1±9.6

*: Significant at $P < 0.05$, **: significant at $P < 0.01$ and NS: Not significant ($P > 0.05$).

The greatest variation from one herd to another in DO, calving to first estrus, and calving to first service has been attributed to differences in practices for detection of estrus (Bozworth et al., 1972 and Foote, 1975).

Number of services per conception is another widely used index of fertility. The overall mean of NSC obtained in the present study, adjusted for other factors, was 2.1 services (Table 2). Similar estimate of NSC (2.0 services) was reported by Kassab and Salem (1993). High NSC results from either failure to conceive at a given service and/or failure to maintain pregnancy thus requiring repeated service.

Table 2. Least squares means (LSM), standard errors (SE) and level of significance of calving interval (CI) and number of services per conception (NSC) as affected by different factors

Factor	CI (day)		NSC (service)	
	No	LSM±SE	No	LSM±SE
Overall mean	1921	403.1±1.9	1868	2.1±0.1
Sire	38	**		**
Age at first calving		NS		NS
< 29	761	406.6±4.4	778	2.0±0.1
29 - 32	585	402.6±4.5	551	2.2±0.1
33 - 36	393	402.8±5.3	371	2.1±0.1
> 36	182	400.4±7.7	168	2.1±0.2
Season of calving		*		NS
Winter	448	406.5±5.0	443	2.1±0.1
Spring	476	409.4±5.2	479	2.1±0.1
Summer	449	404.8±6.5	433	2.3±0.1
Autumn	548	394.3±4.7	513	2.0±0.1
Year of calving		**		*
1985-87	214	378.3±12.0	232	1.7±0.3
1988-90	319	371.1±8.8	345	1.8±0.2
1991-93	330	404.8±6.5	378	2.3±0.1
1994-96	449	401.8±5.0	486	2.3±0.1
1997-99	405	412.2±5.5	427	2.3±0.1
2000-02	204	450.2±8.6	---	-----
Parity		**		NS
1st	431	415.5±4.8	451	2.2±0.1
2nd	378	419.1±4.8	378	2.1±0.1
3rd	327	396.3±5.2	311	2.3±0.1
4 th	281	402.0±5.9	253	2.0±0.1
5 th	218	395.6±6.9	204	2.1±0.2
6 th	149	399.8±8.3	141	2.0±0.2
7 th and over	137	393.1±9.5	130	2.0±0.2

*: Significant at $P < 0.05$, **: significant at $P < 0.01$ and NS: Not significant ($P > 0.05$).

Age at first calving is one of the important factors contributing to economic return and is determined partially by farmer policy. The overall mean of AFC was 30.7 months (Table 3). Lower estimate (27.1 months) of AFC of Friesian cattle in commercial herds in Egypt was depicted by Sadek et al. (1994). A reduction in AFC will minimize the raising costs and shorten the generation interval and subsequently maximize the number of lactations per head. In general, earlier first calving increases lifetime productivity of cows. For example, Meaker et al. (1980) showed that, despite lower first conception rates, Africander heifers calving first at 2 years old produced 0.6 more calves over their productive lifetime than those calving first at 3 years old, while Pinney et al. (1962) estimated the increase to be 0.8 of a calf. USDA (2002) showed that mean AFC in 2002 was inversely related to herd size. Within herd, AFC was

25.5 months when herd size was <100 cows and it was 24.6 months when herd size was >500 cows. It is recommended that heifers calve between 23 and 25 month of age, accordingly, it is demonstrated that average mean of AFC reported in the present study (30.7 months) is higher than the optimum AFC, it can be decreased by 5-7 months. However, Pirlo et al. (2000) working on Italian Holstein-Friesian concluded that reduction of AFC to 24 and 23 months of age seemed to be more profitable than reducing age to 22 months. Mureda and Mekuriaw (2007) mentioned that different factors advance or delay AFC. Environmental factors, especially nutrition, determine pre-pubertal growth rates, reproductive organ development, and onset of puberty and subsequent fertility. Substantial evidence exists that dietary supplementation of heifers during their growth will reduce the interval from birth to first calving, probably because heifers that grow faster cycle earlier and express overt estrus.

The overall mean of BE was 90.1 % (Table 3). Lower estimate of BE (84.7) was reported by Kassab and Salem (1993) on Friesian cows in Egypt. This indicates higher reproductive efficiency of the herd under investigation.

Table 3. Least squares means (LSM), standard errors (SE) and level of significance of age at first calving (AFC) and breeding efficiency (BE) as affected by different factors.

Factor	AFC (month)		BE (%)	
	No	LSM±SE	No	LSM±SE
Overall mean	482	30.7±2.1	427	90.1±0.6
Sire	38	**		NS
Age at first calving				NS
< 29			155	89.7±1.3
29 - 32			134	90.5±1.2
33 - 36			90	90.3±1.4
> 36			48	89.7±2.0
Season of birth		NS		NS
Winter	103	29.9±0.4	96	89.5±1.5
Spring	92	30.9±0.5	83	89.4±1.6
Summer	160	30.7±0.4	134	88.8±1.3
Autumn	127	31.2±0.4	114	92.5±1.4
Year of birth		**		*
1982-84	131	30.8±1.0	101	96.±3.4
1985-87	53	28.8±1.0	51	89.3±3.1
1988-90	102	31.7±0.7	98	90.6±2.4
1999-93	105	28.1±0.6	95	89.0±2.2
1994-96	91	33.8±0.7	82	84.8±2.3

*: Significant at $P < 0.05$, **: significant at $P < 0.01$ and NS: Not significant ($P > 0.05$).

Many factors influence reproductive performance of lactating dairy cows. The differences in the results found by different authors could be attributed to Management factors such as accuracy of heat detection, use of proper inseminating techniques, proper semen handling, and appropriate herd health policies as reported by Hillers et al. (1984). They added that other factors

which, to a large extent, are beyond the immediate control of management may impact fertility. These factors include milk production of the cow, age of the cow, and season of year. Although these factors cannot be controlled easily by management, an understanding of their relationship to fertility is important for proper interpretation of reproductive records of a herd. Shalaby et al. (2001) reported that the variation in the reproductive traits of Friesian cows raised under Egyptian conditions may be due to the differences among Friesian herds in management policies for breeding practices and/or to the poor experience in estrus detection which lead to delay fertile insemination and consequently long calving interval. Mureda and Mekuriaw (2007) studied the reproductive performances of 304 crossbred (Holstein Friesian × Zebu) dairy cows in Eastern lowland of Ethiopia. They concluded that developing feed resource, effective reproductive health management and reliable AI service could be management options to mitigate some of the reproductive problems.

Effect of sire

Sire had highly significant ($P < 0.01$) effect on DO, CI, NSC and AFC, but had no significant effect on FSP and BE (Tables 1, 2 and 3). Several authors confirmed the significant effect of sire on DO (Oudah et al., 2001; Shalaby et al., 2001 and Oudah et al., 2008), AFC (Soliman and Khalil, 1991; Soliman and Hamed, 1994 and Oudah et al., 2001) and NSC (Oudah et al., 2001). Meanwhile, non significant effect of sire on AFC was indicated by Khattab and Sultan (1990) and Oudah et al. (2008). Significant effect of sire on BE was obtained by El-Barbary et al. (1987). The highly significant ($P < 0.01$) effect of sire on DO, CI, NSC and AFC indicating that sire selection may be used as useful tool for the genetic improvement of these reproductive traits.

Effect of age at first calving

The influence of AFC on FSP was highly significant ($P < 0.01$) and not significant on DO, CI, NSC and BE (Tables 1, 2 and 3 and Figure 1). Cows had age at first calving more than 36 months had the longest FSP (92.6 ± 4.5) and cows had AFC less than 29 months had 87.8 ± 2.7 days FSP. Meanwhile cows with AFC ranged between 29-32 and 33-36 months of age had shorter FSP (81.1 ± 2.7 and 80.0 ± 3.2 days, respectively). The present results were in close agreement with those of Dam et al. (1988) who used herd health and production records of 1161 Holstein-Friesian heifers from 22 Michigan dairy herds to study the effect of AFC upon reproductive efficiency. They found that AFC was not significantly related to reproductive efficiency. They also recommended that it would, therefore, appear that the dairy producers they studied could inseminate their heifers at an earlier age, and thereby increase production per day of life, without suffering serious detrimental effects in reproductive efficiency. The present results also are in agreement with a review on reproductive performance of female *Bos indicus* (zebu) cattle by Mukasa-Mugerwa (1989) who revealed that most data suggest that it is advantageous to breed heifers as early as is

physiologically possible. The insignificant effect of AFC means that heifers can calve at an early age without any deleterious effect on DO, CI and BE. Sadek et al. (1994) reported that the effect of AFC on BE was not significant. On the other hand, Wolff et al. (2004) studied the environmental effects of AFC on reproductive performance of 10494 Black-and-White Holstein heifers in Brazil and found that the effect of AFC on DO and CI was highly significant ($P < 0.01$).

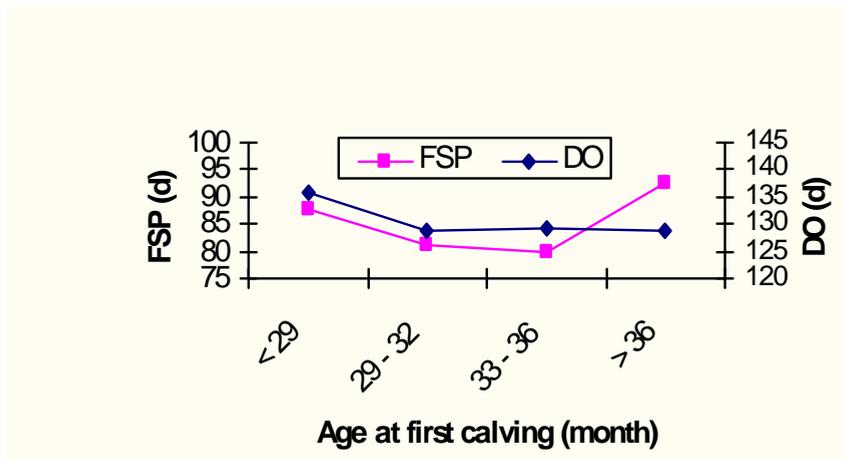


Fig. 1. Effect of AFC on FSP and DO

Effect of season of calving/birth

The effect of season of calving on FSP and DO was significant. Cows calving in spring had longer FSP (91.7 ± 3.0 days) and DO (137.8 ± 5.1 days) than those calved in summer (79.7 ± 3.0 and 130.3 ± 5.0 for FSP and DO, respectively), autumn (85.7 ± 2.8 and 122.6 ± 4.8 for FSP and DO, respectively) or winter (84.3 ± 3.0 and 132.2 ± 5.0 for FSP and DO, respectively) (Table 1 and Figure 2a). However, Kassab and Salem (1993) indicated that season of calving had insignificant effect on FSP. The effect of season of calving on CI was significant ($P < 0.05$) (Table 2 and Figure 2b). Cows calving in spring had longer CI (409.4 ± 5.2 days) compared with those calved in summer (404.8 ± 6.5 days), autumn (394.3 ± 4.7 days) or winter (406.5 ± 5.0 days). The data of the present study do not suggest a close relationship between calving season and reproductive performance, although cows calving in autumn (September to November) showed the shortest calving interval (394.3 ± 4.7 days) (Table 2). These cows were thus mated in the previous November and December. During this period, in Egypt, the environmental temperature is nearly optimal and green fodder (berseem) is available for good fertility. In this respect, Oliveira (1974), working with Nellore cattle, observed that animals calving in the dry season had an average subsequent calving interval of 13.9 months, compared with 14.5 months for those that calved in the wet season. Landais et al. (1980) found that cows calving in October in Côte d'Ivoire usually conceived again in the following January while those calving in January were unlikely to conceive

during the subsequent mating period. Galal et al (1981) reported calving rates of 70%, 75% and 85% for local Ethiopian cows in dry, wet and humid region research stations, respectively. Oyedipe et al. (1982), working with White Fulani heifers, found calving intervals of 15.3 and 18 months for the dry and wet seasons, respectively.

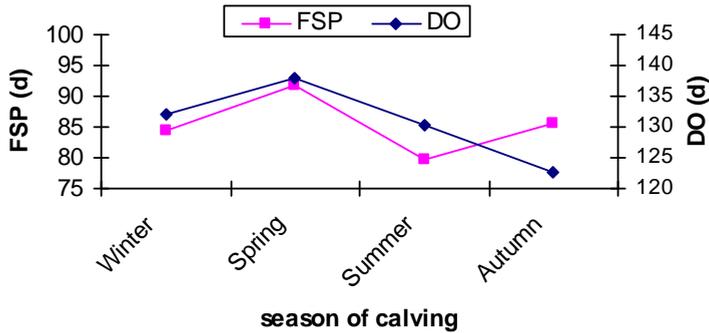


Fig. 2a. Effect of calving season on FSP and DO

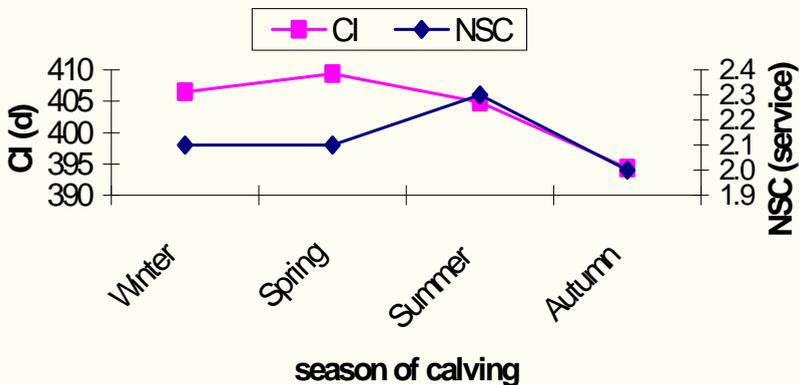


Fig. 2b. Effect of calving season on CI and NSC

The authors suggested that the difference was due to the fact that cows calving in the dry season could take advantage of improved nutritional conditions during the subsequent rainy season to meet their total requirements for maintenance, growth and lactation. Pedron et al. (1989) found that cows calving in July had better reproductive performance. Highly significant effect of season of calving on DO and CI was depicted by Abou-Bakr et al. (2006). Melendez and Pinedo (2007) analyzed 120,309 lactations of Holstein cattle

distributed in 187 herds in Chile during the period from 1990 to 2003. They found that season and year of calving had significant effect ($P < 0.05$) on CI, DO, NSC. However, El-Barbary et al. (1992) indicated that season of calving had insignificant influences on Do and CI.

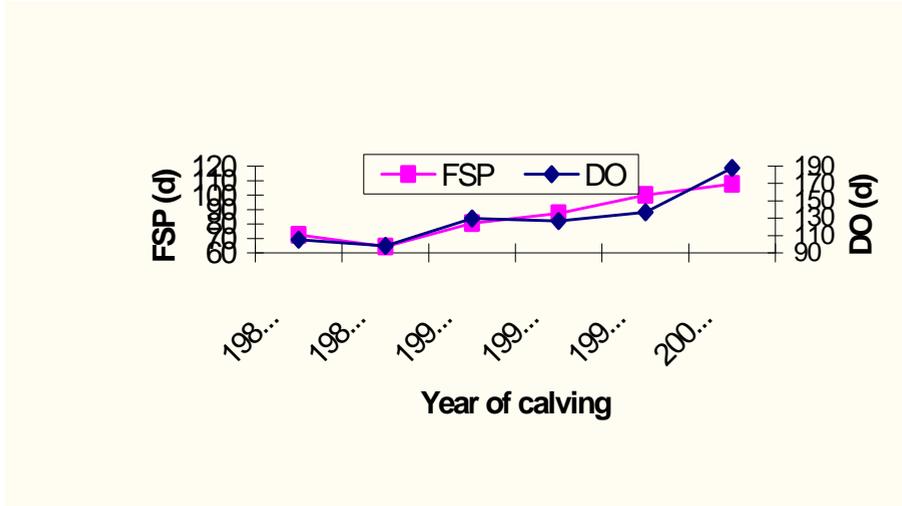


Fig. 3a. Effect of calving year on FSP and DO

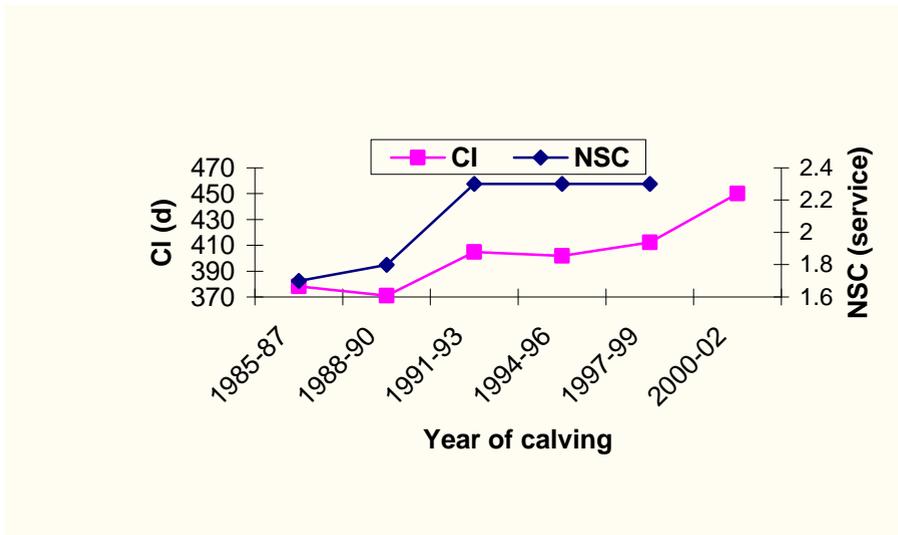


Fig. 3b. Effect of calving year on CI and NSC

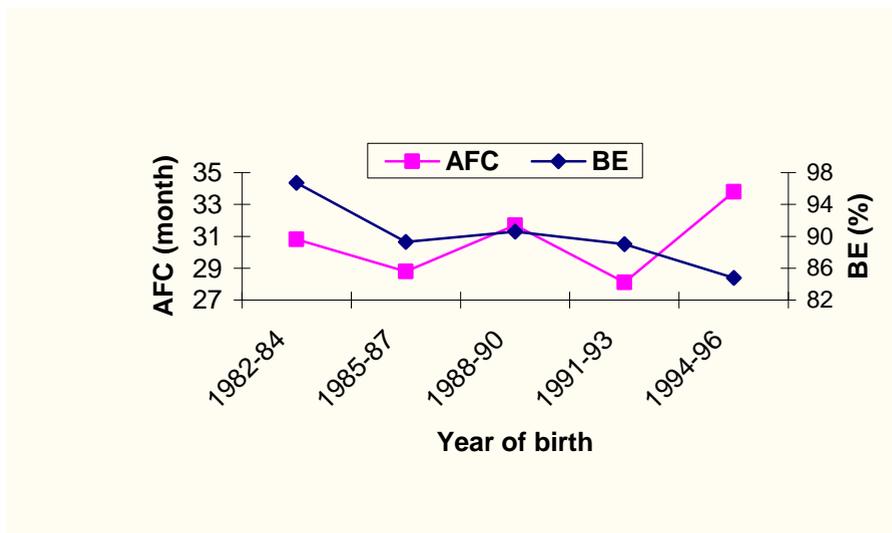


Fig. 3c. Effect of year of birth on AFC and BEC

Season of calving had insignificant influence on NSC (Table 2 and Figure 2b). The same effect was reported by Kassab and Salem (1993). In spite of the insignificant effect of season of calving on NSC, it could be noticed that the higher NSC (2.3 services) in summer season, where the highest temperature in Egypt all year round, compared with the other seasons. On the other hand, El-Amin et al. (1981) concluded that NSC was influenced by month of calving. El-keraby and Aboul-Ela (1982) working on a governmental herd of 384 purebred Friesian cows located at the northern part of the Nile Delta in Egypt reported that there was a marked and significant ($P < 0.01$) variation among different seasons of calving in NSC which was 1.67, 2.20, 1.69 and 1.71 in summer, autumn, winter and spring, respectively.

Although season of birth had insignificant effect on both AFC and BE (Table 3). Heifers born in winter had shorter AFC (29.9 ± 0.4 months) than those born in other seasons (ranged between 30.7 ± 0.4 and 31.2 ± 0.4 months). The present results in agreement with several previous studies. Wagenaar et al. (1986) found a mean AFC of 50.2 ± 9.1 months in 146 Fulani-type dams in Niger and reported that none of the factors tested for in the least squares analysis (herd, season and year of birth of dam, sex of the calf) significantly affected this parameter (AFC). Saeed et al. (1987) found that year of birth significantly ($P < 0.001$) affected AFC in Kenana cattle in Sudan but that month of birth did not. Sodakar et al. (1988) found that BE was not significantly affected by season of birth. Contrary, Sabino et al. (1981) found that month of birth significantly affected AFC. Miranda et al. (1982) found that AFC in Brazilian Nellore heifers was significantly affected by month of birth where calves born from January to May tended to be younger at first calving than

those born between June and December. Wolff et al. (2004) working on 10494 Black-and-White Holstein heifers, from 68 herds, to study environmental factors affecting AFC and 16232 cows were used from 67 herds to study DO and CI during 1991-2000 in Brazil. They found that the effect calving month was highly significant ($P<0.01$) on the AFC.

The significant effect of season of calving/birth on some reproductive traits could be attributed to the changes in climatic conditions and feeding regimes during different seasons. Some authors (De Kruik, 1975) have suggested that the seasonal variation in reproductive activities could be due to the difference in photoperiod among seasons or to seasonal differences in nutrition and/or housing systems. El-keraby and Aboul-Ela (1982) said that a possible cause of these differences is the difference in the vitamin content in the diet between the dry (summer and autumn) and green (winter and spring) feeding seasons.

The increase in global temperature may also negatively affect reproductive performance. Lucy (2001) pointed out that one component of reproductive decline in dairy cattle may involve the changing global environment. Reproduction in lactating dairy cows is extremely sensitive to heat stress because of the high metabolic rates associated with lactation (Wolfenson et al., 2000). Bradley (2000) mentioned that the decade of the 1990s was the warmest since the beginning of instrumental temperature recording. Therefore, higher ambient temperatures will add to reproductive loss by causing heat stress in the summer. In a study by Al-Katanani et al. (1999) who investigated the 90-day return rates throughout the seasons of the year. They found that infertility in summer was greatest in the highest milk producing cows comparing with other seasons. Consequently, the combined effect of both heat stress and higher milk production for decreasing first-service conception rate in dairy cows was observed in summer season.

Effect of year of calving/birth

Tables 1, 2 and 3 and Figures 3a,b&c show changes occurred in the reproductive traits studied by year of calving/birth from 1985 to 2002. Year of calving/birth had significant ($P<0.05$ or $P<0.01$) effect on all traits studied. The results obtained from the present study showed, generally, that the reproductive performance of the locally born Friesian cows of this herd has decreased during the 18-years period studied (1985-2002). The highest FSP was recorded on cows calved during the years 1991- 2002 (100 to 107.5 days) and the highest DO (136 to 188 days) was recorded on cows calved during the years 1997-2002. Calving interval of Friesian dairy cattle in this herd, adjusted for the other factors, increased from 378.3 days (12.4 months) in 1985-1987 to 450.2 days (14.8 months) in 2000-2002 (72.0 days equal 19.0% of the initial CI) with an annual increase of 4.0 d/year. It is known that the extended calving intervals negatively affect the longevity as a productive life, because the cow has fewer lactation numbers during the same period of herd life compared with cows with shorter calving intervals (Hare et al., 2006). The most important determinant of

CI is the DO because gestation period is considered to be less variable than time to conception. The highest NSC was recorded on cows calved during the years 1991-1999 (2.3 services). NSC increased over the study period, probably due to changes in management. In the present study, the highest AFC was recorded on calves born during the years 1988-1990 (31.7 ± 0.7 months) and 1994-1996 (33.8 ± 0.7 months). The highest BE was recorded on cows born during the years 1982-1984 ($96.7 \pm 3.4\%$).

The significant effect of year of calving/birth on reproductive performance of dairy cows could be attributed to the changes in feeding and managerial systems and environmental conditions which occurred from year to another as well as to differences between years in the quantity and quality of forage available. Busch and Furstenberg (1984) analyzed 483600 inseminations performed by 379 technicians on 623 farms in the USA, which showed that the 90- and 120-day non-return rate differed significantly among inseminators and the inseminator effect was greater than the farm effect. However, non-return rate did not differ among bulls. Pedron *et al.* (1989) studied the relationship between CI and year of birth on 520 Italian Holstein-Friesian heifers from 12 herds during 1974-1981 in northern Italy and found that there was a significant relationship between them. They added that heifers born in later years had shorter calving intervals. This may be attributed to better management conditions. Wolff *et al.* (2004) found that the effect year of calving was highly significant ($P < 0.01$) on the AFC. Abou-Bakr *et al.* (2006) reported highly significant effect of year of calving on DO and CI. However, no significant effect of year of calving on DO and CI was reported by El-Barbary *et al.* (1992).

Poor reproductive efficiency is a worldwide problem affecting the dairy industry. Similar deteriorations in reproductive performance across years in dairy cattle have been observed in other countries. Selection for high milk yield in dairy cattle generally is accompanied by a decline in fertility (Lucy, 2001). Declining in fertility performance over time have been reported recently in dairy populations in many countries, including Ireland (Roche *et al.*, 2000), Canada (Murray, 2003), the United Kingdom (Royal *et al.*, 2000 and Wall *et al.*, 2003), Spain (Gonza' lez-Recio *et al.*, 2004), The Netherlands (Nederlands Rundvee Syndicaat, 2005), USA (Silvia, 1998; Lucy, 2001; USDA, 2002 and Hare *et al.*, 2006), Chile (Melendez and Pinedo, 2007) and Iran (Moussavi and Mesgaran, 2008). Factors causing reproductive decline in Europe and Australia may be different from those in the United States (Lucy, 2001).

In USA, Silvia (1998) summarized records from dairy herds in Kentucky and reported an increase in services per conception of 1.62 to 2.91 from 1972 to 1996. Lucy (2001) observed increasing services per conception, days open, and days to first insemination in 143 dairy herds continuously enrolled in the DHIA record system from 1970 to 1999. In USA also, mean herd CI in US Holstein cattle has increased from 12.8 to 13.3 mo, whereas individual CI for cows has increased from 12.9 to 13.4 mo between 1991 and 2002 (USDA, 2002). In a study by Hare *et al.* (2006), using more than one million lactation records of

Holstein cattle, the CI was estimated to be 13.3 mo, with an annual increase across lactations of 0.90 to 1.07 day/year for all breeds except Jersey which was 0.49 day/year. In Canada, Murray (2003) mentioned that Calving intervals reported by Ontario Dairy herd improvement and Quebec's milk recording organization reveal similar trends over the past 10 years (1993 to 2002). Calving interval has increased about two days per year. In Ontario changed from 409 days (13.4 months) to 426 days (13.9 months) with changed equal +1.7 day/year and in Quebec changed from 399 days to 421 days with changed equal +2.2 day/year. In the United kingdom, wall et al. (2003) working on 43,029 records of first-parity Holstein cows from 1390 sires during 1997 to 2000 and found that there had been an unfavorable decline in the breeding values of all fertility traits over recent years, with CI, FSP, and NSC increasing, and non-return rate after 56 d decreasing (i.e., it is more likely that an animal will return to service). In Spain, Gonzalez-Recio et al. (2004) reported that fertility in Spanish dairy cattle has worsened >10% over the last 14 yr. Days open have increased by about 15 d, and NSC has increased from 1.7 to 2.0. the previous information is similar and consistent with the values for the Friesian cows reported in the present study between 1985 and 2002 taken into consideration the differences in herd size in each study.

Effect of parity

Tables 1 and 2 and Figures 4a&b show the effect of parity on FSP, DO, CI and NSC. Parity had significant ($P<0.01$) effect on FSP, DO and CI and insignificant effect on NSC. The highest FSP was recorded in the 1st and 2nd parities (91.6 ± 2.9 and 100.7 ± 3.0 days, respectively) and thereafter no specific trend was observed. Kassab and Salem (1993) reported highly significant effect of parity on FSP. The highest DO was in the 1st and 2nd parities (142.6 ± 4.8 and 148.3 ± 4.8 days), then DO declined from the 3rd parity and over ranged between 121.1 ± 9.6 and 127.8 ± 5.9 . The same trend was also observed for CI where it reached the maximum during the first two parities (415.5 ± 4.8 and 419.1 ± 4.8 days) and declined thereafter. The significant effect of parity on reproductive performance may be due to the changes in managerial systems and environmental conditions among parties. This result is in agreement with that of Bulman and Wood (1980) who reported that the incidence of silent oestrus was highest in the primiparous cows and decreased with the advance in lactation number. Stahl et al. (1999) demonstrated that first-lactation cows have lower energy balance because they eat less and have energy requirements for growth in addition to lactation. Lower energy balance in first lactation cows was associated with delayed intervals to first ovulation. Several investigators have documented the fact that negative energy balance causes a delay in interval to first ovulation and a delay in interval to first estrus (Lucy et al., 1992). The reason for the delay in interval to first ovulation can be explained partially by greater negative energy balance in modern dairy cows. Bauman and Currie (1980) indicated that lactating cows are generally in negative energy balance

during the early postpartum period because they cannot consume adequate energy in the diet. Negative energy balance reduces postpartum LH pulsatility and, therefore, delays the resumption of ovarian activity (Beam and Butler, 1999 and Butler, 2000). Similar results also were reported by Murray (2003) who reported that measures of fertility tend to get poorer according to lactation number with slight decreases from first to second to third lactation. Abou-Bakr et al. (2006) reported highly significant effect of parity on DO and CI. Mureda and Mekuriaw (2007) reported that parity of cows imparted significant ($p \leq 0.05$) effects on FSP, DO and NSC. However, El-Barbary et al. (1992) depicted that DO and CI were not significantly affected by parity.

Parity had no significant effect on NSC. The NSC was highest at the third lactation (2.3 ± 0.1 service) followed by the first lactation (2.2 ± 0.1 service). However, Sharma and Bhatnagar (1975) found a significant effect of parity on NSC in Sahiwal, Red Sindhi and Tharparkar cattle. The NSC was highest at the fourth lactation. Kumar and Bhat (1979) noted that Haryana heifers needed more services per conception than cows. Mureda and Mekuriaw (2007) found that the NSC significantly different ($P \leq 0.05$) among parity groups in crossbred (Holstein Friesian x Zebu) dairy cows kept in different production systems in Eastern lowland of Ethiopia..

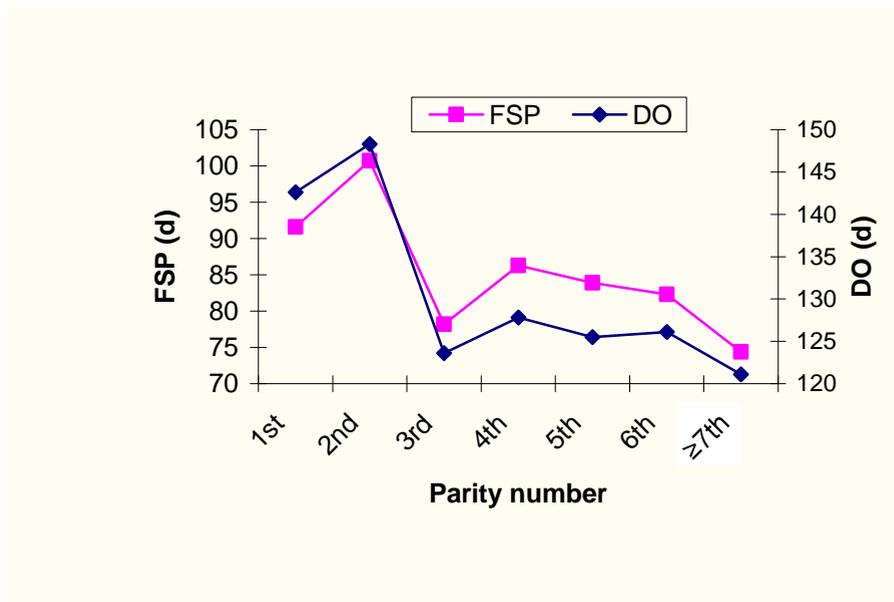


Fig. 4a. Effect of parity on FSP and DO

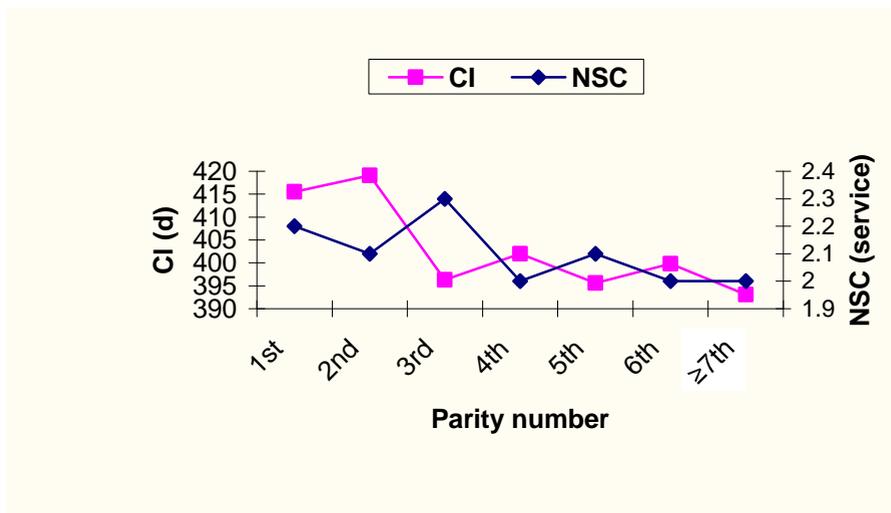


Fig. 4b. Effect of parity on CI and NSC

CONCLUSIONS

Based on the results of this study, the highly significant effect of sire on DO, NSC, CI and AFC indicates that sire selection may be used as a useful tool for the genetic improvement of these traits and thus genetic progress can be maximized only through wise sire selection and AI. Therefore, the adjustments for AFC, season and year of calving/birth and parity seem to be necessary if bulls are to be evaluated for the fertility of their daughters. Longer FSP, DO, and CI; increasing NSC and decreasing in BE have continued with time. Consequently, the results show that sire of the cow, managerial systems and appropriate environmental conditions have significant effects on reproductive performance of Friesian cows in this herd. Good management can overcome these reproductive problems. It is recommended that heifers calve between 23 and 25 months. Accordingly, it is demonstrated that average mean of AFC reported in the present study (30.7 months) is higher than the optimum AFC, it can be decreased by 5-7 months. Further studies on reproduction performance are necessary to elucidate the reasons of reproduction decline overtime and its relationship with milk production.

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