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Genetic Relationship Between Days Open and Days Dry With Milk Yield in a Herd of Holstein Friesian Cattle

Hülya Atil
Faculty of Agriculture, Ege University, Izmir, Turkey.

Abstract

A total of 2897 lactation records of Holstein Friesian cattle from the fields of Dena Farm in Egypt from 1987 to 1993 were used to study relationships of days open (DO) and days dry with milk production. The effect of month and year of calving, sire and cow within sires were also investigated. Month of calving, year of calving, sire and cow within sires significantly influenced milk production. Including DO and dry period (DP) as a polynomial of second degree of production were significant. The partial linear and quadratic regression coefficients of 305 day milk yield on DO and DP were significant being 7.59 ± 0.40 kg/d and -0.37 ± 0.00 kg/d^2, respectively for DO and -9.37 ± 0.54 kg/d and 0.02 ± 0.00 kg/d^2, respectively for DP. Therefore, reduction of DO and DP are a desirable goal of dairyman. Heritability (h^2) estimates for 305 day milk yield, DO, DP were 0.13 ± 0.05, 0.00 and 0.00, respectively. Adjustment of lactation milk yield for DO will not involve genetic influence on milk yield.

Introduction

Days open (DO) from parturition to the subsequent conception affects milk yield and estimated breeding values (EBV) of cows and sires (Bar-Anan and Soller, 1979; Thompson *et al.*, 1982; Makuza and McDaniel, 1996). With more days open, cows have more time to renew the body fat that is used for yield during the next lactation and the converse may be expected. Relationships of these factors with milk yield are complex and are affected by management and environmental conditions (Schaeffer and Henderson, 1972).

Conception at <100 day postpartum (Funk *et al.*, 1987; Louca and Legates, 1968; Sadek and Freeman, 1992) and short dry period of <40 day (Funk *et al.*, 1987; Khattab and Ashmawy, 1988) depress milk yield during the subsequent lactation. High milk yield appears to be antagonistic to early conception because high yielding cows may not conceive as readily as low yielding cows (Laben *et al.*, 1982) and cow with more DO may have less interference from pregnancy on lactation milk yield. The usual management recommendation is a 60 day dry period (Khattab and Ashmawy, 1988).

The range of h^2 estimate from the literature for various fertility traits (i.e., days open and calving interval) is from 0.00 to 0.12 (Everett *et al.*, 1966; Khattab *et al.*, 1987; Abdel Glil, 1996; Yener *et al.*, 1998b). Repeatability ranged from 0.00 to 67 (McDowell, 1972) which indicate that environmental influence are larger than genetic influences and this little change would be expected by selecting for fewer days open.

The objectives of this study are: (1) estimate phenotypic and genetic parameters for 305 day milk yield, days open and days dry, (2) estimation of sire breeding values for 305 day milk yield.

Materials and Methods

They were 2897 lactation records made by Holstein Friesiar cattle available for the present study. Animals are a part of the herd of Dena Farm far from Cairo City by 80 km. Records were produced during the period 1987-199; inclusive. Abnormal records affected by diseases or by disorders such as abortion were excluded. Also, record, with lactation period shorter than 150 days were discarded. Total number of sires and daughters per sire were 234 and 12.16, respectively. All sires were used at random and artificial insemination were used. The genetic analysis included the sire which have at least 5 daughters.

Animals were allowed to graze during the period from December to May. During the rest of year, they were give concentrates and rice straw. Heifers were attempted for service for the first time when they reached 18 months of 350 kg. Cows usually were served when seen in oestrus two months after calving. Rectal palpation for pregnance diagnosis was performed 60 days after the last service. Cows in lactation were machine milked twice daily. Two months before the expected next calving date, the cows already not dry were dried off. The length of days open was computed as the interval between the date of parturition and the date of successful mating or by subtracting the mean of gestation period, 275 days, from the actual calving interval if the date of successful mating was unknown Traits studied are 305 day milk yield (305 dMY), days open (DO) and dry period (DP).

Analysis for the least squares analysis of variance, the following general linear model was used:

$$Y = X\beta + Z\alpha + e$$

where Y was a vector of observations for each of the traits X was a known fixed design matrix, β was an unknown vector of fixed effects representing the mean, year and month of calving and parity, Z was a known design matrix, a was an unobservable random vector of effects of sire and cow within sire and e was an unobservable random vector of errors with mean zero and variance - covariance matrix $I\sigma^2e$.

To study the effects of DO and DP on 305 dMY, the previous model was used including the effects of DO and DP as a polynomial regression of a second degree. Estimates of sire, cow within sire and remainder components of variances and covariances were computed according to Methods II of Henderson (1953). Estimates of heritability (h^2) was calculated as four times the ratio of σ^2_s (sire variance components) and $\sigma^2_{c:s}$ (cow within sire variance components) over ($\sigma^2_s + \sigma^2_{c:s} + \sigma^2_e$).

Approximate standard error of h^2 was computed according to Swiger *et al*. (1964). Estimates of genetic correlation (with standard errors) and phenotypic correlation were estimated as described in Harvey (1987).

Results and Discussion

Means, standard deviations (SD) and coefficient of variability (CV%) for different traits are presented in Table 1. Mean of 305 day milk yield was 5006 kg. The present mean was higher than those estimated by Khattab and Ashmawy (1988), Ghanem *et al*. (1991), Mansour (1992), Abdel Glil (1996) and Onenec (1997) which ranged from 2388 to 4790 kg. While, the present mean was lower than that estimated by Kaya (1996) (5334 kg) working on Holstein Friesian cattle in Turkey. The mean of DO 124 was similar to estimate reported by Mansour (1992) (121d). While, lower than those reported by Sallam *et al*. (1990) (158d). Makuza and McDaniel (1996) using two herds of Holstein Friesian from Zimabwe (herd1) and North Carolina (herd2). They found that DO ranged from 118 to 123d for herd1 and from 118 to 132d for herd2. Mean of DP was 100d. The present mean was higher than estimate reported by Abdel Baru *et al*. (1992) (75d). An estimate of 111 and 84d were reported by Yener *et al*. (1998a) using two herds of Holstein Friesian cattle. Pour management of Friesian cattle in Egypt lead to such high variation of CV's of DO and DP. The differences between the performance found here and those reported by other workers could be attributed to one or more of following reasons: (1) the herds were treated under different climatic and managerial conditions and or (2) different herds could possibly be genetically and phenotypically different from each other.

Table 1: Means, standard deviations (SD) and coefficients of variability for different traits studied.

Traits	Mean	SD	CV(%)
305 dMY, kg	5006	1325.9	26.49
DO, d	124	83.7	67.39
DID, d	100	64.7	64.76

Results (Table 1) show that animals calving in spring months had the highest 305 day milk yield than those calving during the other reasons. These results agree with Ragab *et al*. (1973), Khattab and Ashmawy (1988), Khattab and Sultan (1991), Afifi *et al*. (1992), Kaya (1996) and Yener *et al*. (1998a). Khattab and Ashmawy (1988) working on Friesian cattle in Egypt, found that milk yield in the different seasons are 2983, 3157, 3030 and 3040 kg for winter, spring, summer and autumn calves, respectively. The high yield in spring calves could be attributed to the favourable climatic conditions for abundant growth and availability of good quality Egyptian clover (berseem) during the increasing.stage of lactation.

Year of calving had a significant effect of 305 day milk yield (Table 2). The present results are in close agreement with those finding by Mostageer *et al*. (1986), Sallam *et al*. (1990), Afifi *et al*. (1992), Khattab *et al*. (1994), Kaya (1996) and Yener *et al*. (1998a). The effect of year of calving may be due to different nutritional, managerial practices and phenotypic trend.

Milk yield reached it is maximum in the third lactation and decreased somewhat thereafter. Khattab and Ashmawy (1990) reported that the first lactation averaged 2728 kg and the mean increased to reach 2882 kg in the third lactation. This is logically due to the increase in body weight combined with advancing age and to the full development of the secretory tissue of the udder. Also, Kaya (1996) working on Holstein Friesian in Turkey arrived at the same results and found that the average 305 day milk yield were 4696 kg, 5352 kg, 5691 kg, 5739 kg and 5694 kg for 1^{st}, 2^{nd}, 3^{rd}, 4^{th} and 5^{th} or greater lactation, respectively.

Least squares analysis of variance of 305 day milk yield is presented in Table 3. Effects of month of calving, year of calving, parity, as a fixed effects, days open and days dry as a regression were significant ($p<0.01$).

Including DO as a polynomial regression of the second degree in the model yielded significant ($p<0.01$, Table 3), partial linear and quadratic regression coefficients of 305 day milk yield on DO, being 7.59 $\pm$ 0.40 kg/mo and -0.37 $\pm$ 0.00 kg/mo^2, respectively (Table 2). The curvilinear relationship of 305 day milk yield on DO is similar in trend to results reported by other workers from cattle (Schaeffer and Henderson, 1972; Khattab and Ashmawy, 1988; Sallam *et al*., 1990; Abdel Glil, 1996; Yener *et al*., 1998a). Funk *et al*. (1987) reported that lactation yield increased rapidly as current DO increased up to 100 days, the yield increased at a slower rate for longer period. Therefore from the economic standard point, reduction of DO is a desirable goal of dairymen.

Partial linear and quadratic regression coefficients of 305 day milk yield on dry period were significant, being -9.37 $\pm$ 0.54 kg/d and 0.017 $\pm$ 0.00 kg/d^2, respectively. Dias and Allaire (1982) found that cows with calving interval less than 340 days required at least 95 days dry for increase milk production in two consecutive lactation. The present results are in line with those obtained by Khattab and Ashmawy (1988) and Makuza and McDaniel (1996). The present results indicate that maximum production in the current lactation was attained when cows are breed as early as possible after parturition.

Table 2: Least squares constants and standard error (SE) for factor affecting 305 day milk yield (305 dMY)

Classification	N	Const.	SE
Least square mean	2897	4860.2	53.87
Month of calving			
1	219	227.5	87.38
2	182	252.7	86.25
3	198	202.8	84.51
4	156	-160.2	85.60
5	168	-97.5	84.98
6	203	-150.3	78.43
7	325	-152.4	64.76
8	383	-192.6	59.84
9	376	-41.4	61.42
10	239	13.4	74.14
11	225	33.7	81.07
12	223	64.4	83.18
Year of calving			
87	223	-536.8	294.86
88	498	189.7	190.39
89	625	661.2	99.97
90	731	-10.6	50.96
91	414	52.7	120.24
92	249	-29.1	196.90
93	157	-327.1	272.13
Parity			
1	802	-344.6	255.19
2	764	249.4	150.01
3	567	360.8	66.07
4	477	168.2	87.12
5	232	-110.9	164.55
6	55	-322.9	251.23
Regressios			
DO, Linear		7.59	0.40
DO, Quadratic		-0.37	0.00
DP, Linear		-9.37	0.54
DP, Quadratic		0.017	0.00

Sire of the cow and cow within sires had highly significant effect on 305 day milk yield (Table 2). Cow evaluation and selection are important in herd improvement scheme. The ultimate aim of an evaluation is to enable breeders to compare their animals by the estimated producing ability. The present results are same of Khattab and Sultan (1991) and Soliman and El-Menshawy (1994).

Estimates of h^2 for 305 day milk yield was 0.13 ± 0.05 (Table 4). Lower estimate of h^2 for milk yield were reported by Weller *et al*. (1986), Sallam *et al*. (1990) and Abdel Glil (1996) which ranged from 0.07 to 0.16.

Heritability estimates for DO and DP were zero (Table 4). Lobo *et al*. (1984) found h^2 estimates for DO derived from the sire components of variance were 0.01, 0.05 and 0.05 in first, second or later and all lactation, respectively. They also reported that the regression of daughter on dam for 449 daughter dam pairs were 0.02+0.00. Also, low heritability estimates for DO were also reported by Berger *et al*. (1981) (0.02-0.06), Hansen *et al*. (1983) (0.02 0.03) and Khattab *et al*. (1987) (0.01). The low estimated of h^2 indicate that a major part of variation in this character was environmental and selection would not be effective is bringing about genetic improvement. Better management can therefore play an important role in improving such that in conclusion value of h^2 for 305 day milk yield indicated that it can be improved milk yield through selection. Phenotypic correlation between 305 day milk yield and each of DO and DP were 0.24 and -0.16 (Table 4). The present results indicated that milk yield increased as DO increaser Also it is increase as DP decreased. Olds *et al*. (1979) estimated that each additional days open resulted in 4.5 kg more 305 dMY.

Table 3: Least squares analysis of variance for factors affecting 305 day milk yield (305 dMY)

Source of variation	df	F value
Sire	233	1.07**
Cow:sire	586	2.27**
Month of calving	11	2.74**
Year of calving	6	44.72**
Parity	5	24.45**
Regressions		
DO, Linear	1	345.57**
DO, Quadratic	1	69.51**
DP, Linear	1	297.74**
DP, Quadratic	1	97.04**
Remainder mean squares	2051	819634.75

**: ($p<0.01$)

Table 4: Heritability estimates with standard errors (on diagonal), genetic correlation with standard errors (below diagonal) and phenotypic correlation (above diagonal) between different traits studied.

Traits	305 dMY	DO	DP
305 dMY	0.13±0.05	0.24	-0.16
DO	0.00	0.00	0.50
DP	0.00	0.00	0.00

Sire values for 305 day milk yield were estimated using best linear unbiased production (BLUP). Two sets of sire transmitting ability were used set1 (corrected data for years month of calving and days open) and set1 (corrected data only for year and month of calving). Estimates of sire transmitting ability (ETA's) as deviation from the meal ranged from -519 to 481 for set1 and from -522 to 496 for set2. The present results show large differences among sires in 305 day milk yield, which indicated that high potential for rapid genetic improvement in milk yield of Holstein Friesian through selection. El-Chaife (1981) working on Friesian X Native cows in Egypt, reported that the range of expected breeding value for 305 day milk yield were large and ranged from -802 and 344 kg. Abdel Glil (1996) with 1655 lactation records of Friesian cattle for 163 sires (each with 5 or more daughters) found that predicted sire value (BLUP) for 305 day milk yield ranged from -466 to 68 kg.

The simple correlation coefficients between two sets were positive and high (0.98) while simple correlation between the difference between (set1 - (set2 - set1)) were negative and not significant (0.03). The present results suggested that adjustment of lactation records for days open would not involve genetic influence on yield and would not be valuable for either unbiased sire evaluation or cow evaluation.

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