Arch. Tierz., Dummerstorf 43 (2000) 6, 583-590

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Genetic relationship between days open and days dry with milk yield in a herd of Holstein Friesian cattle

Summary

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 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 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±0.54kg/d and 0.02±0.00kg/d^2, respectively for DP. Therefore, reduction of DO and DP are a desirable goal of dairymen.
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.

Key Words: days open, days dry, lactation, genetic relationship, heritability

Resumen

Titulo del Articulo: **Relación Genética Entre Días Abres y Días Secas Con Rendimiento de la Leche en un Rebaño de Holstein Frison Vacuno**
Un total de 2897 registradas de lactacion de Holstein Frison vacuno de Dena granja en Egipto de 1987 a 1993 se usaron a estudiar las relaciones de días abres y días secas con producción de leche. El efecto del mes y año de parto, padre y vaca dentro de padres también se investigó.
Mes de parto, año de parto, padre y vaca dentro de padres influyó la producción de leche significativamente.
Icludiando días abres y períodos secos como una polinomial grado segundo de la producción era significativos. Coeficientes de regresión lineal parcial y cuadrático de 305 día leche rendimiento días sobre dias abres y períodos secos eran significativos, estando 7.59 ± 0.40 kg/día y -0.37 ± 0.00kg/día^2 respectivamente por dias abres, -9.37 ± 0.54 kg/día y 0.02 ± 0.00kg/día^2 respectivamente por períodos secos. Por eso, reducción de días abres y períodos secos son una meta deseable de ganaderos lecheros.
Heritabilidad estima para 305 día leche rendimiento, días abres, períodos secos eran 0.13 ± 0.05, 0.00 y 0.00, respectivamente. Ajuste de rendimiento de leche de lactacion para días abres no envolverán influencia genética en rendimiento de leche.

Palabras claves: Dias abres, dias secas, lactacion, relación genetica, heritabilidad

Zusammenfassung

Titel der Arbeit: **Beziehungen zwischen Zwischentragezeit und Trockenstehzeit zum Milchertrag einer Holstein-Friesian-Herde in Ägypten**
An 2897 Laktationen einer Holstein-Friesian-Herde in Ägypten aus den Jahren 1987 bis 1993 wurden genetische Beziehungen zwischen Zwischentragezeit und Trockenstehzeit zum Milchertrag untersucht. Es konnte nachgewiesen werden, daß Kalbemonat und -jahr sowie Väter und Mütter innerhalb der Väter einen signifikanten Einfluß auf den Ertrag ausüben. Als signifikante lineare und quadratische Regressionskoeffizienten zwischen Milchertrag und Zwischentragezeit wurden 7,59 ± 0,40 bzw. –0,37 ± 0,00 kg/Tag und für Trockenstehzeit -9,37 ± 0,54 bzw. 0,02 ± 0,00 kg/Tag geschätzt. Höhere Leistungen in der Folgelaktation sind demnach durch kürzere Zwischentrage- bzw. Trockenstehzeiten zu erwarten, so dass die Verkürzung beider Perioden ein wünschenswertes Ziel ist. Die geschätzten h^2 Werte für die 305-Tage-Milchleistung, Zwischentragezeit und Trockenstehzeit betrugen 0,13 ± 0,05, 0,00 und 0,00. Die letzten beiden Merkmale ließen demnach keinen genetischen Einfluß auf den Milchertrag erkennen.

Schlüsselwörter: Zwischentragezeit, Trockenstehzeit, Milchertrag, genetische Beziehungen, Heritabilität

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 and 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; KHATTAB and ASHMAWY, 1988 and SADEK and FREEMAN, 1992).

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 and 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 and 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.

Material and Methods

They were 2897 lactation records made by Holstein Friesian 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 1987-1993 inclusive. Abnormal records affected by diseases or by disorders such as abortion were excluded. Also, records 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 given concentrates and rice straw. Heifers were attempted for service for the first time when they reached 18 months or 350 kg. Cows usually were served when seen in oestrus two months after calving. Rectal palpation for pregnancy 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 if 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 (305dMY), 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, α 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 ÖNENC (1997) which ranged from 2388 to 4790 kg. While, the present mean was lower than that estimated by KAYA (1996) (5334kg) 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 Zimbabwe (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 BARY 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.
Results (Table 2) show that animals calving in spring months had the highest 305 day milk yield than those calving during the other seasons. 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.

Table 1
Means, standard deviations (SD) and coefficients of variability for different traits studied (Mittelwert, Standardabweichung und Variationskoeffizienten untersuchter Merkmale)

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

Year of calving had a significant effect of 305 day milk yield (Table 2). The present results are in close agreement with those founding 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's maximum in the third lactation and decreased somewhat there after. 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± 0.40 kg/mo and -0.37 ± 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 and 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 ± 0.54 kg/d and 0.017 ± 0.00 kg/d^2, respectively. DIAS and ALLARIE (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 agree with results 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) (Least-Squares-Konstanten und Standardfehler der Einflußfaktoren auf die 305 Tage-Milchleistung)

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
Regressions			
DO, Linear		7.59	0.40
DO, Quadratic		-0.37	0.00
DP, Linear		-9.37	0.54
DP, Quadratic		0.017	0.00

Table 3
Least squares analysis of variance for factors affecting 305 day milk yield (305 dMY) (Least-Squares-Analyse der Varianz von Einflußfaktoren auf die 305 Tage-Milchleistung)

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)

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 agree with results obtained by KHATTAB and SULTAN (1991) and SOLIMAN and EL-MENSHAWY (1994).

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 (Heritabilitätsschätzungen mit Standardfehler (auf der Diagonalen), genetische Korrelationen mit Standardfehler (unterhalb der Diagonalen), phänotypische Korrelationen (oberhalb der Diagonalen) zwischen den untersuchten verschiedenen Merkmalen)

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

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. (1962) found h^2 estimates for DO derived from the sire components of variance were 0.01, 0.05 and 0.09 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 estimates of h^2 indicate that a major part of variation in this character was environmental and selection would not be effective in 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 though 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 increased. 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.

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.

Acknowledgements

I would like to thank Prof. Dr. A. S. KHATTAB for providing the data, his helpful discussion and his valuable comments.

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Received: 1998-10-23

Accepted: 2000-10-10

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