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A Comparison of Different Methods of Estimating Sire Transmitting Ability of Some Milk Traits in a Herd of Holstein Friesian

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Abstract
A total of 1931 normal first lactation records of Holstein Friesian cows kept at Dena Farm in Egypt during the period from 1987 to 1994 were used to estimate phenotypic and genetic parameters for 90 and 305 day milk yield (dMY) and lactation period (LP). In addition, 76 bulls with at least ten daughters were used to compare three methods of sire transmitting ability. A least squares analysis of variance show significant effect of month and year of calving and age at first calving for different traits studied, except the effect of age at first calving on LP. Heritability estimates for 90 and 305 dMY and LP were 0.39 ± 0.08, 0.27 ± 0.07 and 0.14 ± 0.05, respectively. Genetic and phenotypic correlations between different traits were positive and significant. Sires with at least ten daughters were evaluated by best linear unbiased prediction, least squares means and regression of the future daughters mean on the present daughters mean. The product moment correlations between different traits studied were positive and high (-0.96).

Introduction
Milk production cannot be measured on males, thus sire genetic evaluation must be based either on records of female ancestors or on records of the progeny (progeny test). Evaluation on the basis of progeny test results has much greater accuracy than pedigree evaluation (Van Vleck, 1979).
There are many different methods of sire breeding value estimated by different workers in different countries. El-Chaife (1981), Abubakar *et al*. (1986), Vu and Tiwana (1988), Abdel Glil (1991 and 1996), Rege (1991), Khattab (1992), Khattab and Mourad (1992), Metry *et al*. (1994) and Dutt *et al*. (1996) used the Best linear Unbiased Prediction (BLUP). Fahmy (1972), Vu and Tiwana (1988) and Khattab (1992) used average of daughters or least squares means for sire effect. Khattab *et al*. (1987) and Vu and Tiwana (1988) estimated sire breeding values by the regression of the future daughters mean on the present daughters mean.
The objective of this study were to estimate genetic and phenotypic parameters for first milk traits; for example 90 or 305 dMY and lactation period (LP) and to compare three methods of estimating sire transmitting ability for Holstein Friesian cattle in Egypt.

Materials and Methods
Data: A total of 1931 first lactation milk records of Holstein Friesian cows maintained at Dena Farm in Egypt during the period 1987 to 1994 were used. The number of sires and average of daughters per sire were 76 and 24.79, respectively. Sires with less than ten daughters were excluded. Artificial insemination using frozen semen was used. Traits studied were first 90 day milk yield, 305 day milk yield and lactation period. More information of the data, feeding system and management of that herd were described by Atil and Khattab (1999).

Estimating of Genetic Parameters: Data were analysed using Mixed Model Least Squares and Maximum Likelihood Computer Program of Harvey (1987). The mixed model used for the analysis included the fixed effects of year and month of calving as a fixed effects, age at first calving (AFC) as a regression and sire as a random effect on each of 90 dMY, 305 dMY and LP. Estimates of sire and residual components of variances and covariances were computed according to II of Henderson (1953). Estimates of heritability (h^2), genetic correlations (r_g) with standard errors (SE) and phenotypic correlation (r_p) were estimated according to Harvey (1987).

Estimating of sire transmitting ability (ETA's): Abubakar *et al*. (1986) suggested that ten daughters per sire are considered a minimum number for the evaluation of sires using best linear unbiased prediction (BLUR) procedures in Tropical areas. Khattab *et al*. (1987) using another set of Friesian cattle in Egypt, reported that the accuracy of sire evaluation increases as the number of daughters per sire increased. They also suggested that it is necessary to estimate the sire evaluation based on a large number of daughters per sire. Therefore, transmitting ability of sires at least ten daughters will be examined.

Three methods of sire transmitting abilities were followed:

Best Linear Unbiased Prediction (BLUP)
The above model can be written in matrix notation as:

$$Y = Xf + Zs + Wb + e$$

Where Y was a vector of observations for each trait, X was a known fixed design matrix, f was an unknown vector of fixed effects representing the mean, year and month of calving, Z was a known design matrix, s was an unobservable vector of random sire effect, W was a vector of covariate variable (independent variable), *b* was a vector of partial regression of Y on W and e was unobservable random vector of errors with mean zero and variance - covariance matrix 10^2e.

The mixed model equations (Henderson, 1953) are

$$\begin{bmatrix} X'X & X'Z & X'W \\ Z'X & ZZ+G & Z'W \\ WX & W'Z & W'W \end{bmatrix} * \begin{bmatrix} f \\ s \\ b \end{bmatrix} \begin{bmatrix} X'Y \\ Z'Y \\ W'Y \end{bmatrix}$$

* = where $G = (4 - h^2) / h^2$ for each trait was added to the diagonal of sire effects in the matrix.

Least Squares Means (LSM): Constants of each bull were obtained by using a model including sire, year and month of calving as a fixed effects and age at first calving as a regression.

Regression of The Future Daughters Mean On The Present Daughters Mean (REG):

$$REG = b\,[D - x]$$

where $b = n / (n + k)$, n is the number of half sib daughters, k is equal $((4 - h^2)/h^2)$, D is the traits adjusted to year and month of calving as a fixed and age at first calving as a regression and x is the least squares mean of the herd. Product moment correlations for the three methods of sire transmitting ability for each bull were computed.

Results and Discussion

Least squares means of 90 dMY, 305 dMY and LP are 1911±63 kg, 5139±164 kg and 281±7 d, respectively. The present means of 90 dMY and were higher than those reported by Hussein (1996) using another set Holstein Friesian cattle in Egypt, being 1748 kg and 4938 kg, respectively. Also, the present mean of LP was lower than that reported by Khattab and Sultan (1991) (341 d). The differences between the present estimates and those reported by other workers could be due to different climatic conditions and management. Herds could be possibly the genetically different on be caused by different models used.

Least squares analysis of variances for 90 dMY, 305 dMY and LP are presented in Table 1. Significant ($p<0.01$) effects of month and year of caving on each of the traits studied were found. These results are agreement with the findings reported on Friesian raised in other countries by Milagres *et al.* (1989), Rege (1991), Kaya (1996), Makuza and McDaniel (1996) and Kelm *et al.* (1997). Differences in milk yield and lactation period attributed to month and year of calving were interpreted to be due to climatic, nutritional and managerial conditions which changed from one year or month of calving to another.

Estimates of partial linear and quadratic regression coeficients of 90 dMY and 305 dMY an age at first calving were significant ($p<0.01$), being 4.03 ± 1.20 kg/mo and -0.34 ± 0.036 kg/mo^2, respectively for 90 dMY and 8.49 ±3.58 kg/mo and 0.56± 0.11 kg/mo^2, respectively for 305 dMY. The curvilinear relationships of milk yield on age at first calving were reported by Sallam *et al.* (1990), Khattab and Sultan (1991), Mansour (1992) and Khattab *et al.* (1994). The present results suggested that reduction in age at first calving is desirable to prolong the lenght of herdlife and to economic the cost of rearing the heifers.

The partial linear and quadratic regression coefficients of LP on age at first calving were non significant. Sallam *et al.* (1990) and Khattab and Sultan (1991) found similar results. The present results indicate the importance of considering, the effect of year and season of calving and age at first calving in the model used for describing productive traits for unbiased sire evaluation.

Results obtained in the present study show that the sire of the heifers had a highly significant effect on 90 dMY, 305 dMY and LP ($p<0.01$, Table 1), acounting for 9.62, 6.85 and 3.54 per cent, of the total variance for 90 dMY, 305 dMY and LP, respectively. This is similar to results of Basu *et al.* (1982), Abubakar *at al.* (1986), Milagres *et al*. (1989), Abdel Glil (1991 and 1996) and Khattab and Sultan (1991) which ranged from 1.6 and 10 percent.

Heritability estimates (h^2), genetic correlations (r_g) and phenotypic correlations (rp) between different traits studied are presented in Table 2. Estimates of h^2 for 90 dMY and 305 dMY were 0.39±0.08 and 0.27±0.07 (Table 2). The present means and moderate and similar to those, estimates reported Ragab *at al.* (1973), Basu *et al.* (1982), Khattab and Sultan (1991), Abdel Glil (1996) and Kaygisiz and Vanli (1997) which ranged from 0.26 to 0.48. The present results concluded that the genetic improvement in milk production traits can be achieved trough selective breeding values.

Heritability estimate for LP was 0.14±0.05 (Table 2). This estimate is in agreement with those reported by Ragab *et al.* (1973) (0.21) and Khattab and Sultan (1991) (0.18).

Genetic and phenotypic correlations between 90 dMY and 305 dMY were 0.56±0.12 and 0.51, respectively (Table 2). The present results indicate that 90 dMY can be a good indicators for production in 305 dMY. These results are in agreement with other estimates (Ragab *at al.* 1973; Khattab and Sultan, 1991; Abdel Glil, 1991, 1996; Kaya, 1996).

Genetic and phenotypic correlation between LP and each o 90 dMY and 305 dMY were positive and significant ($p<0.01$, Table 2). The present results indicate that there was a positive phenotypic association between milk and lactation period.

Sire values for 90 dMY, 305 dMY and LP were estimated by using the procedure of best linear unbiased prediction (BLUP), least squares means (LSM) and the regression

Table 1: F ratios for factors affecting 90, 305 dMY and lactation period (LP)

		F-ratio		
Source of Variation	d.f.	90 dMY	305 dMY	LP
Sire	75	3.64**	2.82**	1.91**
Month of calVing	11	4.61**	0.91	2.66**
Year of calving	7	37.03**	37.93**	15.22**
RegressionsAFC linear	1	11.26**	5.62**	1.46
AFC , quadratic	1	94.65**	27.72**	2.27
Remainder mean squares	1835	153919.00	1374676.00	4201.00
Number of records = 1931				

"Significant (p<0.01)

Table 2: Estimates of heritability (on diagonal), genetic (below diagonal) arid phenotypic (above diagonal) correlations for productive traits

Traits correlated	90 dMY	305 dMY	LP
90 dMY	0.39±0.08	0.51	0.11
305 dMY	0.56±0.12	0.27±0.07	0.52
LP	0.92±0.13	0.54±0.15	0.14±0.05

Table 3: Product moment correlations between estimates of different methods of estimating sire transmitting abilities for productive traits

	90 dMY			305 dMY			LP		
Methods	BLUP	LSM	REG	BLUP	LSM	REG	BLUP	LSM	REG
BLUP									
LSM	0.98			0.98			0.96		
REG	1.00		1.00	1.00	0.98		1.00	0.96	

the future daughters mean on the present daughters mean (REG). Number of daughters per sire ranged from 10 to 77, Estimates of sire transmitting abilities as deviations from the mean for 90 dMY ranged from -205 to 245 kg for BLUP values, from -374 to 543 for LSM values and from -227 to 280 kg for REG values. With the range being 450, 917 and 507 kg, respectively. Similary, El-Chaife (1981) working on Friesian X Native cows in Egypt, found that the range of breeding values of 17 sires for 100 day milk yield ranged from -56 to 88 kg. Khattab and Mourad (1992) working on Egyptian buffoloes found that the estimation of sire transmitting ability for 90 dMY ranged from -24 to 37 kg. Estimates of sire transmitting abilities for 305 dMY ranged from -506 to 675 kg for BLUP values, from -964 to 895 kg for LSM values and from -531 to 492 for REG values, with the range being 1181, 1859 and 1023 kg, respectively. Similary, Abubakar *et al.* (1986) with 15512 lactation records of daughters of 138 sires (each with ten or more daughters) found that predicted sire values (BLUP) in 305 dMY ranged from -400 to 400 kg. Abdel Glil (1991) with 1653 lactation records for daughters of 163 sires (each with 5 or more daughters) found that predicted sire values (BLUP) ranged from -466 to 681 kg. Also, Zarnecki *et al.* (1990) found that the expected breeding values for 305 dMY ranged from -481 to 571 kg. In Egyptian buffaloes, Khattab and Mourad (1992) found that the estimation of sire transmitting ability for 305 dMY ranged from 147 kg to 154 kg. Also, Metry *et al.* (1994) working on 316 buffoloes cows sired by 77 sires, found that expected breeding values for 305 dMY ranged from -424 to 247 kg. They suggested that potential genetic improvement of milk yield by mass selection was estimated at 2.2 percent per year. The present estimates showed large genetic differences between sires for 90 dMY and 305 dMY, which indicate the high potential for rapid genetic improvement in milk production of Friesian cattle raised in Egypt through selection.

Estimates of sire trasmitting ability for LP ranged from -16 to 19 d for BLUP values, -59 to 51 d for LSM values and from -18 to 21 d for REG, with the range being 35, 110 and 39 d, respectively. El-Chaife (1981) working Fresian X Native cows in Egypt, found that sire values for LP ranged from -36 to 46 d. Also, Khattab (1992) working on Friesian cattle in Egypt, found that the sire values for LP ranged from -29 to 29 d.

The similarity of ranges of BLUP and REG values show the suitability of these two methods for estimating sire transmitting ability for the three traits studied.

The product moment correlations between estimates of sire transmitting abilities for different traits (Table 3) were positive and high (0.96).

Khattab (1992) arrived at the same conclusion by using another herd of Friesian cattle. The product moment correlations between BLUP and LSM estimates were higher than the estimates of 0.71 and 0.88 reported by Glil and Parmar (1988) and Vu and Tiwana (1988) working on Red Dane X Sahiwal and Murrah buffoloes, respectively. The high product moment correlations of ETA's between 90 dMY and 305 dMY for the three methods, indicated that sire evaluation could be possible using initial milk yield in order to decrease the time required for progency test. This will reduce the cost of evaluation, and decrease the generation interval to increase the annual genetic gain. Also, the high product moment correlations between different methods for different traits, indicated that the three methods were reported to succeed for estimating sire transmitting ability.

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