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SIRE EVALUATION FOR MILK PRODUCTION TRAITS OF FRIESIAN CATTLE IN EGYPT

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ABSTRACT

A total of 970 normal lactation records of Friesian cows kept at Sakha farm, Ministry of Agriculture, Egypt during the period from 1968 to 1992 were used to estimate means, phenotypic, environmental and genetic correlations as well as heritability for TMY, 305 DMY and LP. The sire effects on milk production traits and estimates of sire transmitting abilities for TMY and 305 DMY were calculated. The results obtained could be summarized as follows:-

1. The actual means of TMY, 305 DMY and LP were 4467, 3623 kg and 409 day, respectively.
2. Year of calving had highly significant effects ($P< 0.01$) on TMY and 305 DMY and significant ($P< 0.05$) on LP.
3. Month of calving had highly significant effect ($P< 0.01$) on TMY and significant effect ($P< 0.05$) on LP, but non significant on 305 DMY.
4. Sire had highly significant ($P< 0.01$) effects on TMY and 305 DMY, but non significant on LP.
5. Heritability ($h^2 \pm SE$) for TMY, 305 DMY and LP were 0.45±0.11, 0.54±0.12 and 0.09±0.08, respectively.
6. Phenotypic correlations between TMY, 305 DMY and LP were positive and highly significant ($P< 0.01$) (0.70 and 0.69) and the corresponding value between 305 DMY and LP (0.15) was positive and highly significant ($P< 0.01$). Values of the environmental correlations between traits under study were positive and highly significant ($P< 0.01$). All genetic correlations between milk production traits were positive and highly significant ($P< 0.01$), and the values of genetic correlations between TMY with each of 305 DMY and LP were 0.99±0.05 and 0.67±0.24, respectively, the corresponding value between 305 DMY and LP was 0.62±0.39.
7. Estimates of transmitting ability ranged from -849 to 1220 kg for TMY and -468 to 956 kg for 305 DMY, additionally, the 50 percent of sire showed positive (BLUP) for the TMY and 305 DMY.
8. Rank correlations among expected values of sires for TMY and 305 DMY was 0.99.

INTRODUCTION

Nowadays it is clear that Friesian cattle play an active role in milk production in Egypt. This situation was reflected in the large number of Friesian herds. In spite of these herds were established as imported pure or local Friesian, the actual needs of raising or maintaining the level of production represent the role of breeders.

No doubt on the role of sire evaluation for milk traits on the basis of the first lactation milk records. Many studies showed more additive genetic control in the first lactation than later lactations (Tong *et al.*, 1979 and Rege,

1991). On the same hand, Rogers *et al.* (1989) found that the accuracy of sire evaluation increased by using more first lactation milk records.

The objective of this study were to estimate means, genetic parameters heritability for milk production traits, phenotypic, environmental and genetic correlations, sire effects and sire breeding values for milk production traits (TMY, 305 DMY and LP) by using milk production records of Friesian cows in the first lactation under Egyptian conditions.

MATERIALS AND METHODS

Data for this study were obtained from the Friesian cattle herd raised at Sakha farm, located in the Northern Delta, Kafr El-Sheikh, Egypt. Data were collected over a period of 25 years from 1968 to 1992. A total of 970 normal lactation records of Friesian cows in first lactation were used in this study. The number of sire and cows were 126 and 970, respectively. Cows were kept on field of Egyptian clover (*Trifollum alexandrinum*) to graze *ad libitum* through the period from December to May. During these months, cows that were heavy milker and those in the least 2 months of pregnancy were supplemented with extra dry concentrates proportional to their weight and production. During the other months of the year, cows were fed on concentrate mixture along with rice straw and limited amount of clover hay when available as the feeding system of the farm.

Heifers were attempted for service for the first time when they reached 18 months or 350 kg. Cows in estrus were usually served two months after calving. Rectal palpation for pregnancy diagnosis was performed 60 days after the last service. Cows were machine milked twice daily.

Traits studied were total milk yield kg (TMY), 305 day milk yield kg (305 MY) and lactation period day (LP) in first lactation.

Statistical analysis:

Data for the first lactation was analyzed using least squares and maximum likelihood program of Harvey (1990). The mixed model used for the analysis included the fixed effects month and year of calving, and weight at calving and days open as a covariate and the random effect of sire on each of total milk yield (TMY), 305 day milk yield (305 DMY) and lactation period (LP).

Estimation of genetic parameters:

Estimates of sire and residual components of variance and covariance were computed according to model of Henderson (1953). Estimates of heritabilities (h^2) were calculated by paternal half sibs method according to the formula:

$$h^2 = 4\,\sigma^2 s / \sigma^2 s + \sigma^2 e$$

Where: σ^2 s = the sire component variance, σ^2 e = the error component of variance.

Estimates of standard error of heritability were computed according to the approximate formula given by Swiger *et al.* (1964). Estimates of genetic and phenotypic and environmental correlations between different traits were calculated according to Harvey (1990).

Best li near unbiased prediction (BLUP): Sire transmitting ability (ETA) for different studied traits were estimated by using BLUP using first lactation records. Sir with five daughters or more were studied.

In matrix notation, the model can be written as:

$$Y = xB + Zs + Wb + e$$

Where, Y was a vector of observations for each traits, x was a known fixed design matrix, B was an unknown vector of fixed effects representing the mean and year-month subclasses, Z was a known design matrix, s was an unobservable vector of random sire effects, W was a vector of covariate variable (age at first calving), b was a vector of partial regressions of Y on W and e was an unobservable random vector of errors with mean zero and variance – covariance matrix 1 σ^2 e.

The mixed model equations (Henderson, 1973) are:

$$\begin{bmatrix} - & - & - \\ x\,x & xz & XW \\ - & - & - \\ Z\,x & ZZ + K & ZW \\ - & - & - \\ W\,x & WZ & WW \end{bmatrix} \begin{bmatrix} F \\ \hat{S} \\ b \end{bmatrix} = \begin{bmatrix} - \\ XY \\ - \\ ZY \\ - \\ WY \end{bmatrix}$$

Where $K = (4 - h^2) / h^2$ for each traits, which was added to the diagonal of sire effects in the matrix, h^2 being the heritability estimate.

The above analysis was carried out to estimate sire and remainder components of variance and to predict sire transmitting abilities for each traits.

The rank correlations were computed using the Spearman formula to evaluate the ranking of the bulls by BLUP method.

RESULTS AND DISCUSSION

Means, standard deviation and coefficient of variation for total milk yield (TMY), 305 day milk (305 DMY) and lactation period (LP) are shown in Table 1. The means of TMY, 305 DMY and LP were 4467, 3623 kg and 409 days, respectively at the first lactation.

Table 1. Means, standard deviation (SD) and coefficient of variation (CV%) for milk yield traits.

Milk yield traits	Mean	SD	CV %
Total milk yield (kg)	4467	2073	46
305 day milk yield (kg)	3623	1458	40
Lactation period (day)	409	90	22

The overall means of the studied traits obtained in the present study lies within the range of estimates reported in the literature for Friesian in Egypt. However, the lower values than that obtained in this study for TMY were reported by Abdel-Glil (1996), Shalaby (1996), Marzouk (1998), Badawy and Oudah (1999) and Alemam (2002), being 2461, 3490, 3698, 2828 and 3103 kg, respectively. While, the higher values were reported by Tag El-Dein (1997), El-Awady (1998), Hussein (2000) and Farrag *et al.* (2000) being 5465, 5032, 4765 and 4765 kg, respectively.

The lower values than that obtained in the present study for 305 day milk yield were reported by Abdel-Glil (1996), Marzouk (1998) and Badawy and Oudah (1999), being 2165, 3211 and 2545 kg, respectively. The higher values were reported by Tag El-Dein (1997), El-Awady (1998), Hussein (2000) and Farrag *et al.* (2000) being 5037, 4530, 4566 and 4566 kg, respectively.

The means of the lactation period reported in this study were higher than reported by Shalaby (1996), Tag El-Dein (1997), Marzouk (1998), Hussein (2000) and Farrag *et al.* (2000) being 331, 328, 333, 309 and 309 days, respectively, by using Friesian cows in Egypt.

Table 2 showed that year of calving had highly significant effects ($P< 0.01$) on each of total milk yield and 305 day milk yield, while only significant effect on lactation period. These results are in agreement with Khattab (1992) and Hussein (2000) on Friesian raised in Egypt. Also, month of calving had highly significant effect ($P< 0.01$) on total milk yield, these results are in agreement with Khattab and Sultan (1990), while non significant effects on 305 day milk yield, these results are in line with Shalaby (1996), but month of calving had significant effect ($P< 0.05$) on lactation period are in accordance with Shalaby (1996) by using Friesian cows in Egypt.

The differences between present results and these reported by different authors may be due to the differences in one or more of the reasons: genotype, management, climate, conditions, number of animals and/or methods of the statistical analysis.

The effect of sire on each of TMY and 305 DMY was highly significant effect ($P< 0.01$) as shown in Table 2. These results are in agreement with Khattab (1992), Hussein (2000), Farrag *et al.* (2000) and Aly *et al.* (2001). While, the effect of sire was non significant effect on LP, these results agreed with Tag El-Dein (1997) and Alemam (2002) revealed that non significant effect of sire on LP by using Friesian cows in Egypt.

Estimates of partial linear regression coefficient of TMY and 305 DMY on age at first calving (AFC) were positive and significant ($P< 0.05$), while LP on AFC was not significant, also quadratic terms were not significant (Table 2). The linear relationship of TMY and 305 DMY on AFC were followed similar trend as these reported by Khattab and Sultan (1990), Abdel-Glil (1991), and Khattab (1992) using another sets of Friesian cattle in Egypt.

The partial linear and quadratic regression coefficients of TMY, 305 DMY and LP on days open (DO) were positive and non significant.

Table 2. F-rations factors affecting total milk yield (TMY). 305 day milk yield (305 DMY) and lactation period (LP).

S.O.V.	d.f.	TMY F.	305 DMY F.	LP F.
Sire	125	1.845**	2.056**	1.146^{NS}
Year of calving	24	16.242**	25.172**	1.781*
Month of calving	11	2.321**	1.694^{NS}	2.070*
Reg.				
AFC Linear	1	4.673*	22.581**	2.120
AFC Quad.	1	0.130	1.137	0.023
D-O Linear	1	0.719	0.175	2.308
D-O Quad.	1	0.888	1.417	0.300
Remainder	805	1393890.06	476755.89	7533.84

Heritability (h^2), phenotypic, environmental and genetic correlations of studied traits are given in Table 3. Estimates of heritability of both TMY and 305 DMY are 0.45±0.11 and 0.54±0.12, respectively. Values were similar to that of El-Awady (1998) (0.43 and 0.51) for TMY and 305 DMY, respectively. Heritability values of both of TMY and 305 DMY obtained in the present study were higher than these values reported by the different authors working on Friesian cattle in Egypt, which ranged from 0.05 to 0.38 (i.e. Tag El-Dein, 1997; Badawy and Oudah, 1999; Hussein, 2000 and Farrag *et al.*, 2000). On the other hand, lower estimate of heritability (0.62) for 305 DMY on Friesian cows was reported by Khattab (1984).

Heritability estimates for LP was 0.09±0.08 (Table 3). This estimate is in agreement with El-Awady (1998) (0.08) and it is higher than Badawy (1994) (0.05), Hussein (2000) (0.05) and Farrag *et al.* (2000) (0.05).

Thus, the values of h^2 estimates for studied production traits lead to conclude that improvement in milk yield and lactation period could be achieved through selection.

Estimates of phenotypic correlations between different traits studied are given in Table 3. The phenotypic correlations between TMY with both of 305 DMY and LP (0.70 and 0.69) as well as between 305 DMY and LP (0.15) were positive and highly significant, also the phenotypic correlations between 305 DMY and LP (0.15) was positive and highly significant ($P< 0.05$), which were similar to that of Shalaby (1996), Hussein (2000) and Farrag *et al.* (2000) by using Friesian cows in Egypt.

The environmental values of correlations were nearly similar to the phenotypic correlations and emphasize the large environmental influences on studied milk production traits. However, these values were less than the values of the genetic correlations (Table 3). This may be due to more contribution of additive genetic deviation. Khattab (1992) came to the same conclusion.

Genetic correlations between TMY and each of 305 DMY and LP were (0.99±0.05 and 0.67±0.24), were positive respectively and highly significant ($P< 0.01$) as shown in Table 3. The genetic relationship indicate that milk yield in 305 DMY could be consider as a good indicator for total milk yield. The high significant ($P< 0.01$) and positive value (0.15) of correlations

between 305 DMY and LP, was in agreement with the findings of Badawy (1994) (0.19) and El-Barbary *et al.* (1999) (0.19) on different set of Friesian cows in Egypt.

Table 3. Heritability estimates (on diagonal), phenotypic and environmental correlations (below diagonal) and genetic correlations (above diagonal) for production traits.

	TMY	305 DMY	LP
TMY	0.45±0.11	0.99±0.05**	0.67±0.24**
305 DMY	0.70** (0.42**)	0.54±0.12	0.62±0.39**
LP	0.69** (0.78**)	0.15** (0.08**)	0.09±0.08

** : P< 0.01.

Table 4 shows the sires evaluation using the procedure of best linear prediction (BLUP) method for each sire had at least 5 daughters. Additionally Table 5 shows the range (minimum and maximum) and percentage of positive sires. It could be noticed that the BLUP estimates of TMY ranged from -849 to 1220 kg with total range 2069 kg. In this respect, the BLUP estimates for TMY ranged from -732 to 677 kg (Abdel-Glil, 1991), indicated that BLUP estimates for TMY ranged from -530 to 744 kg (Hussein, 2000) and estimates ranged from -530 to 744 kg (Farrag *et al.*, 2000) by using Friesian cows in Egypt.

Sire transmitting abilities for 305 day milk yield was ranged from -468 to 956 kg with the range being 1424 kg. In comparing our results with other workers in Egypt, Abdel-Glil (1991) recorded range from -466 to 680 kg; El-Awady (1998) found range from -336 to 529 kg and Hussein (2000) stated range from -444 to 602 kg, as well as Farrag *et al.* (2000) obtained range from -444 to 602 kg for 305 DMY of Friesian breed.

Table 5 shows that about 50% of the sires had positive values for BLUP estimates for 305 DMY as well as TMY. The results of Hussein (2000) and Farrag *et al.* (2000) on Friesian cattle in Egypt are in agreement with the present results. They found that the sires had positive values for BLUP were 51.5 and 51.5% for TMY and 305 DMY, respectively.

Thus, the large genetic differences among sires in milk production traits (TMY and 305 DMY), focusing the light on the importance of selecting the sire of high potential improvement milk yield traits. In the same trend, Hussein (2000) came to the same conclusion.

Rank correlation among expected breeding values of sires:

The high positive value (0.99) of rank correlation among expected values of sires for TMY and 305 DMY lead to early selection on the basis of 305 DMY in state of TMY. The present results are in agreement with Badawy and Oudah (1999), they found that rank correlation value by BLUP methods for TMY and 305 DMY 0.96, Hussein (2000) on Friesian cows in Egypt, found that value of rank correlation between TMY and 305 DMY was 0.97, as well as value for rank correlation between TMY and 305 DMY 0.97 reported by Farrag *et al.* (2000) on the same breed.

Table 4. Best linear unbiased prediction (BLUP) estimates of Friesian sires.

Code sire	No. of daughter	TMY	305 DMY	Code sire	No. of daughter	TMY	305 DMY
799	8	144	54	52681	18	147	283
52186	5	129	403	52976	5	78	147
53898	7	354	92	52249	6	22	162
54271	7	-54	5	53263	13	280	137
54114	8	-635	-459	53900	21	-676	-603
53521	9	275	67	53831	26	-849	-301
52809	5	46	-00	53730	21	315	173
54007	10	-490	-114	52396	6	103	11
54801	5	297	44	53881	9	609	366
54398	25	-138	63	53272	6	173	-100
53950	13	167	192	33639	8	-28	-33
52348	14	-372	-282	52440	16	-79	-272
52839	9	-230	-267	32161	7	-214	-156
52213	7	-154	-265	52420	10	-386	-402
53853	9	-432	-161	54223	7	1220	207
53921	14	-10	90	54700	5	343	483
54024	15	173	-468	1187	6	-181	-4
58169	7	-130	-188	58125	14	-85	3
54142	7	-692	-182	56309	6	-59	52
55329	8	-433	-227	58115	9	41	79
58391	9	-10	-19	54058	5	147	225
57893	8	141	180	58304	5	-137	-91
55375	7	-236	-234	58498	11	-228	-136
57958	7	190	183	57748	7	282	82
29080	15	206	143	54889	9	-60	42
72	5	23	-11	54817	13	-74	-107
57322	6	-185	-98	56	5	12	71
117	10	-86	-100	30522	5	154	-65
317523	5	214	33	58599	23	-107	1
551	5	137	-48	70278	6	-49	-50
56358	17	79	117	58449	8	23	-5
58506	6	-67	-35	730	13	18	40
1515	11	595	412	55360	18	365	378
457	8	-255	-179	56715	6	-283	-153
1	16	-105	34	53650	10	213	-22
57378	5	-15	-20	56337	5	-171	-59
58593	5	263	157	58597	12	-179	-93
56252	9	-10	-111	310756	8	247	296
573	11	-68	-42	55519	11	-306	-261
55490	6	-259	-181	316229	5	-116	-27
51663	9	140	-60	55852	6	-115	-125
109	34	75	-74	632	6	923	956
55420	7	-215	-213	586	8	-8	32
1124	6	190	123	473	15	128	218

Table 5. Range (minimum and maximum) of sire transmitting abilities estimated by BLUP for total milk yield (TMY) and 305 day milk yield (305 DMY) and sire positive percentage.

Traits	Minimum	%	Maximum	%
TMY (kg)	-849	50	1220	50
305 DMY (kg)	-468	50	956	50

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تقييم طلائق ماشية اللبن الفريزيان لصفات إنتاج اللبن فى مصر

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تم إستخدام بيانات ٩٧٠ سجل إدرار اللبن فى الموسم الأول لأبقار الفريزيان بمزرعة سخا التابعة لمعهد بحوث الإنتاج الحيوانى – وزارة الزراعة خلال الفترة من ١٩٦٨ حتى ١٩٩٢ وذلك لدراسة تأثير كل من سنة الولادة وشهر الولادة وتأثير الأب على كل من إنتاج اللبن الكلى ، إنتاج اللبن خلال ٣٠٥ يوم وطول موسم الحليب ودراسة تأثير الطلائق على صفات إنتاج اللبن ومعامل التوريث لها وكذا دراسة الإرتباط المظهرى والبيئى والوراثى لهذه الصفات ودراسة المقدرة العبورية لهذه الطلائق وكذا إرتباط الرتب لها.

كانت النتائج المتحصل عليها كما يلى:-

١- بلغ متوسط إنتاج اللبن الكلى ، ٣٠٥ يوم ، طول موسم الحليب: ٤٤٦٧ كيلوجرام ، ٣٦٢٣ كيلوجرام ، ٤٠٩ يوم على التوالى.

٢- كان لسنة الولادة تأثير عالى المعنوية ($P< 0.01$) على كل من إنتاج اللبن الكلى ، وإنتاج اللبن خلال ٣٠٥ يوم ومعنوى ($P< 0.01$) على طول موسم الحليب.

٣- كان لشهر الولادة تأثير عالى المعنوية على إنتاج اللبن الكلى ($P< 0.01$) ومعنوى على طول موسم الحليب ($P< 0.05$) وغير معنوى على إنتاج اللبن فى ٣٠٥ يوم.

٤- تأثير الطلوقة كان عالى المعنوية على كل من إنتاج اللبن الكلى وإنتاج اللبن خلال ٣٠٥ يوم ($P< 0.01$) وغير معنوى على طول موسم الحليب.

٥- تقديرات قيم المكافىء الوراثى لكل من إنتاج اللبن الكلى ، إنتاج اللبن فى ٣٠٥ يوم ، طول موسم الحليب كانت ٠,٤٥ ، ٠,٥٤ ، ٠,١٢ على التوالى.

٦- قيم الإرتباط المظهرى بين إنتاج اللبن الكلى مع كل من إنتاج اللبن خلال ٣٠٥ يوم ، طول موسم الحليب ٠,٧ ، ٠,٦٩ على التوالى وبين إنتاج اللبن فى ٣٠٥ يوم وطول موسم الحليب ٠,١٥ ، قيم الإرتباط البيئى بين إنتاج اللبن الكلى مع كل من إنتاج اللبن فى ٣٠٥ يوم وطول موسم الحليب ٠,٤٢ ، ٠,٧٨ على التوالى وبين إنتاج اللبن خلال ٣٠٥ يوم مع طول موسم الحليب ٠,٠٨ ، قيم الإرتباط الوراثى بين إنتاج اللبن الكلى مع كل من إنتاج اللبن خلال ٣٠٥ يوم وطول موسم الحليب كانت موجبة وعالية المعنوية وبلغت ٠,٩٩± ٠,٠٥ ، ٠,٦٧ ± ٠,٢٤ على التوالى وبين إنتاج اللبن فى ٣٠٥ يوم مع طول موسم الحليب ٠,٦٢ ± ٠,٣٩

٧- قيم المقدرة العبورية للطلائق كانت من -٨٤٩ إلى ١٢٢٠ كيلوجرام لصفة إنتاج اللبن الكلى و -٤٦٨ إلى ٩٥٦ كيلوجرام لإنتاج اللبن فى ٣٠٥ يوم وكانت أعلى قيم لإنتاج اللبن الكلى ١٢٢٠ كجم وإنتاج اللبن خلال ٣٠٥ يوم ٩٥٦ كجم وكانت نسبة الطلائق ذات القيم الموجبة ٥٠% لكل من الصفتين (إنتاج اللبن الكلى وإنتاج اللبن فى ٣٠٥ يوم).

٨- كانت قيم معامل إرتباط الرتب بين كل من إنتاج اللبن الكلى وإنتاج اللبن فى ٣٠٥ يوم موجبا وعاليا ٠,٩٩