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ESTIMATES OF GENETIC PARAMETERS AND SIRE EVALUATION FOR GROWTH TRAITS IN FRIESIAN CALVES IN EGYPT

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ABSTRACT

Data used in this study were collected over a period of ten years (from 1985 to 1994) from two farms belonging to the Egyptian Company for Meat and Milk Production, Ministry of Agriculture, Egypt. Live body weights of 1110 Friesian calves (650 male and 460 Female) progeny of 22 sires were used in the present study. Sires with at least 10 daughters were used in the statistical analysis using Harvey (1990) program.

Unadjusted means of birth weight, weight at three, six, nine and twelve months of age were 30.1, 78.7, 121.8, 165.1 and 204.4 kg, respectively. Average daily gain were 0.556, 0.521, 0.498, 0.468 and 0.502 kg/day during the period from birth to three months of age, 3 to 6.6 to 9.9 to 12 and from birth to twelve months of age. Heritability estimates of birth weight, weight at 3, 6, 9 and 12 months of age were 0.12, 0.19, 0.10, 0.17 and 0.18 and for daily gain from birth to three months of age, 3 to 6.6 to 9.9 to 12 were 0.19, 0.03, 0.07 and 0.18, respectively. Genetic correlations among both weights at different ages all ranged from 0.25 and 0.99. All genetic correlations between body weights and body weight gains were positive except, that between birth weight and each of gain from birth to three months of age and from three to six months of age, and between weight at three months and each of gain from three months to six months of ages and gain from nine to twelve months of age. Sire transmitting abilities (ETA's) ranged from –1.138 to 1.046 for birth weight, from –2.423 to 2.939 for weight at three months of age, while ETA estimates for daily gain from G0-3 and G3-6 were 0.059 and 0.017 kg/day, respectively. All Spearman rank correlation coefficients among ETA's of studied traits were positive. The results indicated the presence of great variation in growth traits. Selection would lead to improve the growth rate in Friesian calves under Egypt conditions.

Keywords: Friesian, growth traits, genetic parameters, sire evaluation, Egypt.

INTRODUCTION

Despite its reputation as dairy animal, Holstein-Friesian has a considerable contribution in beef production. Rapid growth is an important goal for increasing meat production. Since long ago, it was found that growth parameters such as mature weight and general maturity rate, estimated from weights taken periodically during the life of the animal, can be used to evaluate development of animals (Brody, 1945). Body weights at early stage of life play an important role in determining the animal weights in respective ages. Growth performance must be evaluated precisely for the important breeds introduced to a new environment, Friesian cattle are the most widespread exotic dairy cattle and considered as potential dual-purpose for milk and meat production. High heritability values for mature weight have been found by Northcutt *et al.* (1993) and Bullock *et al.* (1993). They added that selection based on this characteristic should be effective.

The objective of the present study was to estimate the genetic parameters and evaluate sires for body weight and daily gain traits at different ages in Friesian calves in Egypt.

MATERIALS AND METHODS

Data were collected over period of ten years (from 1985 to 1994) from two farms belonging to the Egyptian company for meat and milk production, Ministry of Agriculture, Egypt. The first farm (Fariskur) is situated at the Northern part of Nile-Delta, about 8 km south Domietta city, and the other farm (Showha) is situated at the Northern part of Nile-Delta, about 8 km south of Mansoura city. Data represented growth performance of 1110 Friesian calves. The calves were (650 males and 460 Females) progeny of 22 sires. The calves were progeny of locally born Friesian cows in Egypt.

The calves were allowed to suckle the colostrum from their dams immediately after birth and then artificially suckled on natural milk twice daily till weaning. During the suckling period, calves were fed concentrate and green fodder (*Trifoloum alexandrinum*) in the winter and green maize or hay in the summer beside suckled milk. Concentrates (calf meal) consisted of 48% yellow maize, 17% cotton seed cake, 10% wheat bran, 10% rice starch residue, 10% linseed meal, 2% molasses 1% limestone, 1% bone meal and 1% salt. The calves were housed in individual pens during suckling period. After suckling period, calves were free housed in open yards in groups according to their age. Birth weight was recorded to the nearest one kg within 24 hours after the birth then live body weight was recorded biweekly until four months of age, then after the live body weights were recorded monthly.

Traits studied were body weight at birth (W0), 3 (W3), 6 (W6), 9 (W9) and 12 (W12) months of age. Daily body weight gains were estimated between the previous periods: birth to 3 (G0-3), 3 to 6 (G3-6), 6 to 9 (G6-9), 9 to 12 (G9-12) and from birth to 12 month of age (G0-12).

Data were analyzed using linear mixed model least squares and maximum likelihoods (LSMLMW) computer program of Harvey (1990). The following model was used for statistical analysis of factors affecting body weight and daily body weight gains at different ages.

$$Y_{ijklmn} = \mu + s_i + F_j + SEA_k + M_l + YR_m + bL_1 (\overline{X_1} - X_i) + bQ_1 (X_1 - \overline{X_j})^2 + e_{ijklmn}$$

Where:

Y_{ijklmn} = the individual observation,

μ = the overall mean,

s_i = the random effect of the i^{th} sire within farm I = 1 to 22,

F_j = the fixed effect of the j^{th} farm j = 1 and 2,

SEA_k = the fixed effect of the K^{th} season of birth K = 1 winter, 2 spring, 3 summer and 4 autumn,

M_1 = the fixed effect of the 1^{th} sex of calves L = 1, male & 2 female;

YR_m = the fixed effect of the m^{th} year of birth, m = 1985 to 1994;

bL_1 & bQ_1 = partial linear and quadratic regression coefficients, respectively for different body weight and body weight gains on birth weight,

X_1 = birth weight, $\overline{X_i}$ = average birth weight, Kg;
e_{ijklmn} = residual term assumed to be random and distributed as a normal distribution with mean zero and variance σ^2;

The same model without any covariate was used to analyze the weight at birth.

Heritability estimates (h^2) were computed by the paternal half-sib method according the formula; $h^2 = 4\sigma^2 s/(\sigma^2 s + \sigma^2 e)$

Estimates of heritability (h^2) and genetic (with standard errors), phenotypic and environmental correlation coefficients among different traits were computed by the LSMLMW program of Harvey (1990). All estimates were based on 1110 calves.

Estimation of sire transmitting ability (ETA's):

Transmitting abilities of sires with at least 10 daughters were evaluated, consequently the number of sires used in estimating ETA's were 22 sires. Sires-transmitting ability (ETA's) for the different studied traits were estimated by Best Linear Unbiased prediction (BLUP). Data used for estimating BLUP values; were one set of cross-classified non interacting random effect (sire) according to Harvey (1990) where BLUP estimates for random sire effects absorbed by maximum likelihood were obtained as follows:

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

Y = a vector of observations for each trait,
X = a known fixed design matrix,
f = an unknown vector of fixed effects representing the mean of farm, six of calves, season and year of birth,
Z = a known design matrix,
s = an unobservable vector of random sire effects,
W = a vector of covariate variables (independent variables), birth weight,
b = a vector of partial regression coefficient of Y on W,
e = an unobservable random vector of error with mean and variance covariance matrix $1\sigma^2 e$.

The above analysis was carried out to estimate sire and remained components of variance and to predict sire transmitting abilities (ETA's) of sires for each trait. Rank correlation coefficients among sire transmitting abilities (ETA's) for different traits were estimated using the spearman formula (Snedecor, 1956).

RESULTS AND DISCUSSION

Unadjusted means, standard deviations (SD) and coefficients of variation (CV%) of body weight (Kg) and daily gains (kg/d) from birth to 12 months of 1110 Friesian male and female calves are presented in Table 1. The present finding of birth weight (W0) was lower than those recorded by Omar (1984) being 39.4 kg, Kertz *et al.* (1997) (40 kg). Regarding the weaning weight (W3) in the present study (78.7 kg), it was nearly similar to that (79.9 kg) found by Nigm *et al.* (1984). However, it was lighter than that (192.3 kg) obtained by Emam (2000). The present average weight at six months (W6) of the Friesian calves was 121.8 kg. It was lower than that 165 kg reported by Andrew (1997). The average live body weight at nine months (W9) in the present study was 165.1 kg. This estimate was similar to that of Pacheco *et al.* (2003), 162.3 in Holstein bull's, but it was lower than that 257.9 kg by Davis and Hathaway (1956) on Holstein Friesian. The overall means of weight at twelve month (W12) in the present study was 204.4 kg. On the contrary Kertz *et al.* (1997) recorded yearling live body weight of 327 kg. The observed differences in body weight may be due to the effect of breed, management, number of animals, plan of nutrition and other factors.

Table 1: Unadjusted means (Kg), standard deviation (SD) and coefficient of variation (CV%) for live body weight and daily gain at different ages.

Trait	Means (k/g)	(SD)	(CV%)
Body weight (kg)			
W0 (at birth)	30.1	4.38	14.6
W3 (at 3 months)	78.7	10.33	13.1
W6 (at 6 months)	121.8	13.13	10.8
W9 (at 9 months)	165.1	18.02	10.9
W12 (at 12 months)	204.4	27.09	13.3
Daily gain (kg/d)			
G0-3 (from birth to 3 months)	0.556	0.131	23.6
G3-6 (from 3 to 6 months)	0.521	0.130	25.0
G6-9 (from 6 to 9 months)	0.498	0.149	30.0
G9-12 (from 9 to 12 months)	0.468	0.210	44.9
G0-12 (from birth 12 months)	0.502	0.087	17.3

The present means of average daily gains (ADG) were 0.556, 0.521, 0.498, 0.468 and 0.502 kg/day during the period from birth to three months of age, from 3 to 6, from 6 to 9, from 9 to 12 and from birth to twelve month of age, respectively (Table 1). Omar (1984) found that the ADG from birth to three month of age was 616 g/day. Oudah (2002) found that the ADG was 620 g/day from birth to weaning. Abdel Aziz *et al.* (2003) found that the ADG in the same period was 682 g/day, Kertz *et al.* (1997), reported that the ADG from birth to three months of age, from 3 to 6, 6 to 9 and from 9 to 12 months of age were 0.82, 0.93, 0.94 and 0.94 kg/day, respectively. The differences between present estimate and those of other investigators may be related to genetic differences, managerial practices and/or system of feeding that would affect live body weights and growth rates.

Heritability (h^2), genetic and phenotypic correlations for body weights and daily gains in different ages are presented in Tables (2 and 3). Heritability estimates in the present study for birth weight, 3, 6, 9 and 12 month of age were 0.12 ± 0.06, 0.19 ± 0.08, 0.10 ± 0.05, 0.17 ± 0.07 and 0.18 ± 0.08, respectively (Table 2). These estimates indicated that genetic change could be made by selection for body weight. In the same time the weaning weight (W3) generally has higher h^2 estimate lead to the effective selection at the weaning weight. Heritability of Friesian calves for weight at birth and 6 months of age were 0.14 ± 0.14 and 0.096 ± 0.30, respectively (Abdel-Moez, 1996). Jensen *et al.* (1995) obtained heritability value of 0.35 for birth weight on Holstein heifers. Khan and Akhtar (1995) showed the h^2 of weaning weight was 0.84 on Friesian. Also, heritability estimates of weaning weight was 0.53 by Afifi and Soliman (1971), 0.43 by Maarof *et al.* (1988) and 0.27 by Oudah (2002) in Friesian calves in Egypt. Thus, heritability values for body weight at different ages indicated that selection based on this character could be effective and the mature weight can be genetically altered through selection.

The genetic correlations among body weights at different ages were positive ranged from 0.25 to 0.99 Table (2). It could be noticed that the values of genetic and phenotypic correlations among weights in early and late age were small; however these values of the genetic as well phenotypic among weights were high with advanced with ages. Oudah (2002) found that the genetic and phenotypic correlation coefficients between birth weight and weaning weight were small and positive 0.147 and 0.185, respectively.

Table 2: Heritability and standard errors (SE) (on diagonal), genetic ± SE (above diagonal) and phenotypic (below diagonal) correlations for body weight at different ages.

Trait	W0	W3	W6	W9	W12
W0	0.12 ± 0.06	0.25 ± 0.33	0.25 ± 0.42	0.32 ± 0.32	0.29 ± 0.32
W3	0.37	0.19 ± 0.08	0.89 ± 0.14	0.71 ± 0.19	0.25 ± 0.29
W6	0.23	0.59	0.10 ± 0.05	0.99 ± 0.08	0.71 ± 0.21
W9	0.16	0.41	0.72	0.17 ± 0.07	0.90 ± 0.08
W12	0.15	0.32	0.51	0.71	0.18 ± 0.08

Heritability (h^2) estimates for daily gain at different periods in the present study were relatively low and ranged from 0.03 ± 0.03 to 0.19 ± 0.08 (Table 3). In this respect, Abdel-Moez (1996) showed that the heritability estimate of average daily gain from birth to weaning was 0.11 ± 0.04. While, Mason *et al.* (1972) and Al-Amin (1979) found that the heritability of daily gain from birth to three months of age were 0.20 and 0.61, respectively on Friesian calves. Oudah (2002) showed that the heritability estimate of average daily gain from birth to weaning age (105 days) was 0.281 however, higher estimates of heritability were recorded by Tawonezvi (1989), for birth weight and for preweaning daily gain were 0.44 and 0.37, respectively. Also, Andrew (1997) reported the heritability estimates for (W6) Holstein was 0.14 and daily gain from 6 – 8 month was 0.17. The moderate h^2 estimates for W3 and ADG from G 0-3 in the present study (0.19 ± 0.08) may recommend to select calves for their own genetic merit for weight and gain using W3 as selection criterion rather than other weight.

Table 3: Estimates of heritability, standard errors (SE) (on diagonal) genetic ± SE (above diagonal) and phenotypic (below diagonal) correlations for daily gain at different ages.

Trait	G0-3	G3-6	G6-9	G9-12	G0-12
G0-3	0.19 ± 0.08	-0.26 ± 0.55	0.45 ± 0.37	-0.43 ± 0.34	0.24 ± 0.30
G3-6	-0.13	0.03 ± 0.03	1.04 ± 0.68	1.17 ± 0.67	1.09 ± 0.43
G6-9	-0.29	0.01	0.07 ± 0.05	0.86 ± 0.35	1.11 ± 0.15
G9-12	0.05	-0.02	0.08	0.09 ± 0.05	0.78 ± 0.15
G0-12	0.31	0.35	0.49	0.72	0.18 ± 0.07

The genetic and phenotypic correlations between different body weights and daily gain at different ages are presented in Table (4). It could be noticed that all genetic correlation between body weight and body weight gains were positive except that between birth weight and each of daily gain from birth to three months of age and from three to six months of age as well as between weight at three months and each of daily gain from three to six months of ages and daily gain from nine to twelve months of ages which was negative.

Table 4: Genetic, standard errors and phenotypic correlations (between parentheses) between body weight and daily gain at different periods.

Trait	G0-3	G3-6	G6-9	G9-12	G0-12
W0	-0.16 ± 0.34 (-0.09)	-0.46 ± 0.57 (-0.05)	0.70 ± 0.38 (0.01)	0.17 ± 0.39 (0.06)	0.17 ± 0.34 (-0.02)
W3	1.00 ± 0.001 (0.99)	-0.19 ± 0.54 (-0.13)	0.47 ± 0.37 (-0.03)	-0.44± 0.33 (0.05)	0.25 ± 0.3 (0.33)
W6	0.86 ± 0.15 (0.59)	0.28 ± 0.54 (0.71)	0.95 ± 0.37 (-0.01)	0.11 ± 0.43 (0.02)	0.74 ± 0.20 (0.51)
W9	0.68 ± 0.20 (0.41)	0.64 ± 0.38 (0.54)	0.98 ± 0.11 (0.69)	0.46 ± 0.34 (0.07)	0.92 ± 0.08 (0.71)
W12	0.24 ± 0.30 (0.32)	1.01 ± 0.42 (0.35)	1.09 ± 0.15 (0.49)	0.81 ± 0.14 (0.73)	1.00 ± 0.001 (0.99)

In this respect, Shibata and Kumazaki (1984) found that genetic and phenotypic correlation of birth weight with preweaning average daily gain and weaning weight were -0.19 and 0.40, while preweaning average daily gain showed highest genetic and phenotypic correlation with weaning weight (0.95 and 0.98, respectively). Lengyel *et al.* (2001) reported that the genetic and phenotypic correlations between weaning weight and preweaning average daily gain were strong and positive. Denise *et al.* (1988) also reported that negative genetic correlation (-0.49) between birth weight and preweaning gain.

The values of estimated sire transmitting abilities (ETA's) for body weights at birth to twelve months of age are present in Table (5). The current ETA's were estimated as deviation from the means and were ranged from (-1.138 to 1.046) for birth weight, from (-2.423 to 2.939) for weight at three month, from (-1.799 to 2.354) for weight at six month, from (-3.435 to 5.725) for weight at nine month and from (-6.847 to 9.451) for weight at twelve months of age. Regarding the values of ETA's of daily gain in different studied periods Table (5), the range of ETA for daily weight from birth to 3 months of age, from 3 to 6, from 6 to 9, from 9 to 12 and from birth to 12 months of age was 0.059, 0.017, 0.046 and 0.044 kg/day, respectively. In spite of wide range of breeding value for traits in the present study. The selection could not effective for birth weigh (reproductive disorders). In the other side, higher breeding value and wide range for the weaning weight (5.36), suggests the existence of genetic variation between sires and hence the possibility of sire selection for growth traits. However, in the case of breeding value for daily gain (Table 5) shows that the range of breeding value for G0-3 was (0.059) higher than that from G3-6 (0.017) to be predict the gain traits. Which mean that using each of body weight or daily gain traits in breeding program could be improve the other traits.

Table 5: Minimum, maximum and range of estimated sire transmitting ability for growth traits.

Traits	BLUP estimates			Traits	BLUP estimates		
	Min.	Max.	Range		Min.	Max.	Range
W0	-1.138	1.046	2.180	G0-3	-0.027	0.032	0.059
W3	-2.423	2.939	5.360	G3-6	-0.009	0.009	0.017
W6	-1.799	2.354	4.150	G6-9	-0.013	0.033	0.046
W9	-3.435	5.725	9.150	G9-12	-0.037	0.034	0.071
W12	-6.847	9.451	16.29	G0-12	-0.018	0.026	0.044

The Spearman rank correlation coefficients among ETA's for different studied traits are presented in Tables (6 and 7). All correlation coefficients were high and positive. Therefore, The present results indicated that the breeders can choose the traits which are economically important for them and can rank the animals based on the appropriate EBVs or index. Selection of the superior animals from this ranking allows breeders to make genetic progress in those economically important traits. In this respect, Oudah (2002) found that Spearman rank correlation coefficient between ETA's of average daily gain and weaning weight was 0.998. Meanwhile, the corresponding coefficient between ETA's of birth weight and each of average daily gain and weaning weight were low and negative (-0.170 and 0.170, respectively).

Table 6: Rank correlation coefficients among sire transmitting ability (ETA's) for live body weight and daily gains at different ages.

Trait	W0	W3	W6	W9
	Body weight			
W3	0.84			
W6	0.83	0.95		
W9	0.84	0.91	0.98	
W12	0.83	0.88	0.94	0.97
	G 0-3	**G 3-6**	**G 6-9**	**G 9-12**
	Daily gains			
G3-6	0.81			
G6-9	0.87	0.91		
G9-12	0.80	0.89	0.89	
G0-12	0.87	0.95	0.96	0.95

Table 7: Rank correlation among sire transmitting abilities (ETA's) of body weight at different ages and daily body weight gains at different periods.

Trait	G0-3	G3-6	G6-9	G9-12	G0-12
W0	0.84	0.82	0.85	0.82	0.83
W3	1.00	0.81	0.86	0.80	0.87
W6	0.95	0.93	0.90	0.84	0.94
W9	0.91	0.95	0.96	0.87	0.97
W12	0.88	0.95	0.96	0.95	0.99

Conclusion

The present results indicated that the wide variation observed in growth traits could be used to improve the growth rate in Friesian calves under Egyptian conditions. The moderate hertabilities, high value of correlations and wide range of sire transmitting ability could be used for improving the growth traits of animals by selecting the good sires in breeding programs.

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تقدير المعايير الوراثية وتقييم الطلائق لصفات النمو فى عجـول الفريزيـان فـى مصر.

ناظـم عـبد الرحمن شلبى، محمد نجيب العريـان، محمـد عبـد الـرحمن مـصطفى و منال كمال إسماعيل
قسم إنتاج الحيوان – كلية الزراعة – جامعة المنصورة، رقم بريـدى ٣٥٥١٦– المنـصورة – مصر.

أجريت هذه الدراسة على سجلات قطيع الفـريزيان فـى مـزرعتين تـابعتين للـشركة المصرية لإنتاج الألبان واللحوم – وزارة الزراعة – مصر خلال عشر سنوات من سـنة ١٩٨٥ إلى ١٩٩٤م. وبلغ اجمالى عدد العجول والعجلات ١١١٠ (٦٥٠ عجل و٤٦٠ عجلة) بنات لعدد ٢٢ أب. استخدم فى التحليل عشر لكل أب على الأقل وتم تحليـل البيانـات باسـتخدام برنـامج Harvey (1990)، كانت المتوسـطات للأوزان ٣٠,١، ٧٨,٧، ١٢١,٨، ١٦٥,١، ٢٠٤,٤ كجـم لوزن الميلاد والأوزان عند عمر ٣، ٦، ٩، و١٢ شهر، كانت متوسطات معدل الزيادة اليومية فى وزن الجسم لصفات الأعمار من الميلاد إلى ٣ شهور ومن ٣ إلى ٦ شهور ومن ٦ إلى ٩ شـهور ومن ٩ إلى ١٢ شهر ومن الميلاد وحتى ١٢ شـهر ٠,٥٥٦، ٠,٥٢١، ٠,٤٩٨، ٠,٤٦٨، ٠,٥٠٢ كجم/يوم على التوالى.

وبلغت تقديرات المكافئ الوراثى للوزن عند الميلاد وكذلك الأوزان عند عمـر ٣، ٦، ٩، ١٢ شهر ٠,١٢، ٠,١٩، ٠,١٠، ٠,١٧، ٠,١٨ على التوالى. وبلغت تقديرات المكـافئ الـوراثى لمعدل الزيادة اليومية من الميلاد وحتى ثلاثة شهور ومن ٣ إلى ٦ شهور ومن ٦ إلـى ٩ شـهور ومن ٩ إلى ١٢ شهر ٠,١٩، ٠,٠٣، ٠,٠٧، ٠,١٨ على التوالى. وتراوحت معاملات الارتبـاط بين جميع الأوزان المدروسة من ٠,٢٥ إلى ٠,٩٩، وكانت جميع الارتباطات الوراثية بـين وزن الجسم ومعدل الزيادة اليومية موجبة، فيما عدا الارتباط بين وزن الميلاد وكل من معـدل الزيـادة اليومية من الميلاد إلى ٣ شهور ومن ٣ إلى ٦ شهور وبين وزن ٣ أشهر وكل من معـدل النمـو اليومى من ٣ إلى ٦ شهور ومعدل النمو من ٩ إلى ١٢ شهر. وقدرت قـيم المقـدرة العبوريـة للطلائق كانحراف عن المستوى العام للصفة بطريقة أفضل تقدير خطى غير متحـيز للطلائـق. وقد تراوحت المقدرة العبورية ما بين –١,١٣٨ إلى ١,٠٤٦ لصفة وزن الميلاد، ومـن –٢,٤٢٣ إلى ٢,٩٣٩ لصفة الوزن عند ٣ أشهر. كانت قيم المدى لقيم المقدرة العبورية لصفة معدل النمـو اليومى من الميلاد إلى ٣ شهور ومن ٣ إلى ٦ شهور، ٠,٠٥٩، ٠,٠١٧ كجم/يوم, على التـوالى. ويتضح من النتائج المتحصل عليها أن التباين كبير فى صفات النمو, ويشير ذلـك إلـى إمكانيـة التحسين الوراثى بالانتخاب لتلك الصفات لتحسين معدل النمو فى عجول وعجلات الفريزيان تحت الظروف المصرية.