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Genetic and Non Genetic Factors Affecting the Breeding Efficiency in Friesian Cows in Egypt

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ABSTRACT

Friesian cows were estimated from 2793 lactation records for 874 cows sired by 55 bulls covered 25 years (1990-2016) in two herds (Sakha and El-Karada farms) belongs to the Animal Production Research Institute, Ministry of Agriculture and Land Reclamation, Egypt. Data were analyzed by using linear model to determine the main and non-genetic effects. Animal model MTDFREML to determine genetic parameters. Breeding efficiency was estimated by two methods Wilcox and Tomar. The overall means for breeding efficiency by Wilcox and Tomar methods were obtained as 53.09 ± 0.97 and 95.92 ± 0.56, respectively. The coefficients of variation were obtained as 80.38 and 30.72 percent, respectively. Least-squares analysis for examined non-genetic effects of calving month, farm and parity were highly significant except effect year of calving was non-significant of breeding efficiency by Wilcox method. However, the effect year of calving and parity were highly significant except both of month and farm were non-significant of breeding efficiency by Tomar . Whereas, the results showed effect of age at first calving (AFC) and calving interval (CI), Total milk yield (TMY) and Life time milk yield (LTMY) were highly significant on breeding efficiency by Wilcox. The contrast, were non-significant on breeding efficiency by Tomar . Heritabilities estimates for AFC, CI, TMY and LTMY, Wilcox and Tomar were 0.13, 0.17, 0.25, 0.46, 0,37 and 0,37, respectively. The phenotypic correlations of breeding efficiency with AFC, CI, TMY and LTMY were negative and low, where it reached from -0.39 to -0.03 except, AFC and CI with Wilcox it reached 0.09 and 0.19. The genetic correlations with the same traits reached from -0.30 to -0.06 except CI with both of Wilcox and Tomar.

Keywords: Genetic - non - genetic -breeding efficiency -Wilcox – Tomar- Friesian – Egypt.

INTRODUCTION

The importance of Friesian breed as a good producer of milk as well beef production in Egypt lead to a lot of breeding ways to improve this breed. Several ways were conducted to evaluate these ways of improvement. The breeding efficiency is one of the most important measure of productive and reproductive performance which related to the affects in high animal production and reproductive efficiency of livestock as an economically traits in desirable Friesian breed. The efficiency of breeding is an estimated measure based on days from first to last calving as productive life plus age at first calving. Breeding efficiency Lower remains a major problem in dairy herds no doubt that. Poor management is an important cause in reducing production as well a later age at first cowing .However, the genetic potential of the animal must be consider to be determine the of breeding efficiency. Change in herd management to be optimum is away for expression genetic values of traits .In this respect the productive traits (TMY and LTMY) as well reproductive traits (AFC and CI) as length of calving intervals and increase of abortion rates (Goshu, 2005 and Habib *et al*., 2013) were studied Target. Their favorite was a breeding to achieve a high breeding efficiency. In other meaning to solve the problem of deficiency of total lifetime production.

The objectives of the present study were evaluate breeding efficiency of two herds of Friesian cows. In addition examine the genetic and non-genetic factors affecting breeding efficiency, also estimate the heritability of AFC, CI, TMY and LTMY traits affected in the breeding efficiency, and genetic and phenotypic correlations between examined traits age at first calving (AFC) and calving interval (CI), Total milk yield (TMY) and Life time milk yield (LTMY), affecting breeding efficiency for Friesian herd kept at Sakha and El- karad Farms.

MATERIALS AND METHODS

Data

The data covered a period from 1990 to 2016 for (Sakha and El-Karada) Station Farms. The analysis used lactation milk records of 2793 cows from 55 sires and 874 Friesian cows belonging to the Animal Production Research Institute (APRI), Ministry of Agriculture and Land Reclamation. Breeding efficiency was estimated by two methods Wilcox *et al* (1957) and Tomar (1965).These data were analyzed to determine non -genetic effect by general linear model of (SAS, 2004).In addition, genetic parameters are estimated by using MTDFREML.

Feeding and Managements:

The animals were grazing on Egyptian clover (*Trifolium Alexandrinum*) berseem, during December to May. During the rest of the year the animals were fed on a concentration mixture along with rice straw and a limited amount of straw when available. Cows that produce more than 10 kg milk per day and those who were pregnant in the last two months of pregnancy were supplemented with an additional ration. The cows were loosely housed in open sheds and were kept under controlled system of feeding and management practiced in the farms. Cows were artificially immunized by frozen semen. The sires that have fewer than 5 daughters are excluded from the study. Cows were machine milked twice a day.

Statistical analysis:

Data were analyzed using (SAS, 2004). To determine analysis of variance for fixed effects month and year of calving, farm (Sakha and El-Karada), parity, age at first calving , calving interval, total milk yield and life time milk yield. The following fixed model was used:

$$Y_{ijklmnoP} = \mu + M_i + Y_j + F_k + P_l + AFC_m + CI_n + T_O + L_P + e_{ijklmnoP}$$

Where:

$Y_{ijklmno}$ = Breeding Efficiency value of i^{th} month, j^{th} year, k^{th} farm, l^{th} parity .
μ =overall mean;
M_i =fixed effect month of calving (1 to 12);
Y_j =fixed effect of year of calving (1990 to 2016);
F_K =fixed effect of farm, (Sakha and El-Karada);
P_l= fixed effect of parity (1 to ≥10);
AFC_m= effect of age at first calving , CI_n= effect of Calving Interval , T_O =effect of total milk yield and L_P= effect of life time milk yield and
$e_{ijklmno}$=random error term.

Data analyzed to estimate genetic parameters by using the MTDFREML program of Boldman *et al*., (1995). The multi traits animal models were included the random additive effect, permanent environmental and error, fixed effects of month and year of calving, farm and parity, as follows:

$$Y = X\beta + Za + Wpe + e$$

Where: **Y= a vector of observations; β = a vector of fixed effects (month of calving, year of calving, farm and parity); a = a vector of additive genetic effects, pe = a vector of environmental effects contributed by dams to records of their progeny (permanent environmental), W = the incidence matrix relating records to permanent environmental effects and e = a vector of the residual effects. X and Z are incidence matrices relating records to fixed and genetic effects, respectively.**

Estimation of Breeding Efficiency

Breeding efficiency was calculated using the following two methods reported by different researchers.

Breeding efficiency = $\frac{365*(n-1)}{D}$ *100 Wilcox *et al* (1957)

Where **n= no. of total calving D =no. of days from first to last calving**

Breeding Efficiency = $\frac{(365N + 1020)}{(AFC + CI)}$ * 100 Tomar (1965)

Where **N = Total no of calving interval, AFC = Age at first calving , CI = Calving interval.**

RESULTS

The overall means for breeding efficiency estimated by Wilcox and Tomar method were 53.09 ± 0.97 and 95.92 ± 0.56 ,respectively (Table 1).The coefficient of variations were 80.38 and 30.72 per cent, respectively. The corresponds in breeding efficiency found by (Goshu, 2005) using Friesian-Boran crossbred cows was 66.3±0.5% .However, Habib *et al*., (2013) .worked on Red Chittagong cattle recorded overall means 79.4±3.7% and 81.9±1.7% and coefficient of variations 15,9. and 14.6, respectively by using the two methods of evaluation. Raina *et al*., (2016) found that average breeding efficiency of Crossbred cattle ranging from 75% to 85% by Wilcox method and it ranged from 95% to 99% by Tomar method. Lower estimates of breeding efficiency could be related to longer calving interval, which increase in days from first to last calving, increase in puberty age and the length of age at first calving. Also, the increase in the abortion rates throughout the life time must be consider.

Table 1. Unadjusted means, standard deviations (SD) and coefficient of variations (CV %) for breeding efficiency of Friesian Cows.

Variable	N.of records	Mean	SE	S D	Coeff of variation
Wilcox (1957)	1922	53.09	0.97	42.67	80.38
Tomar (1965)	2793	95.92	0.56	29.47	30.72

The result of least squares analysis of variance (ANOVA) for breeding efficiency (Wilcox and Tomar) presented in the table (2). It could be noticed that the effect of month of calving was high significant P<0.001 on the breeding efficiency estimated by Wilcox method and it was non-significant by Tomar method. Raina *et al*., (2016) on crossbred cattle found that effect of season was non-significant on breeding efficiency by two methods.

Year of calving had no significant effect on breeding efficiency by Wilcox method but it was highly significant P<0.001 by Tomar method. Goshu, (2005) analyzed records of 602 Friesian-Boran crossbred cows on Ethiopia, they noticed effect of season and year of calving was significant (P<0.001) on the breeding efficiency. Also, Chandrakar (2011) found that season of birth had non-significant effect using both Wilcox and Tomar methods.

Regarding the effect the farm it showed high significant P<0.001 effect on the breeding efficiency estimated by Wilcox method and non-significant by Tomar method. The present results are agree with the result reported by Sallam *et al*. (2012). The effect of the parity was high significant P<0.001 on both the breeding efficiency estimated by using the Wilcox and Tomar methods (Table 2).

Table 2. Results of the analysis of variance month, year, farm and parity effects in Breeding efficiency of Friesian Cows by Wilcox and Tomar methods.

Traits	F- Value and significance			
	Month of calving	Year of calving	Farm	Parity
Wilcox (1957)	13.4**	1.9^{NS}	78.4**	7.4**
Tomar (1965)	1.8^{NS}	20.6**	8.3^{NS}	7.1**

***P<0.05, **P<0.001 NS- Non-significant**

From table (3) it could be found that the effect of AFC, CI, TMY and LTMY were highly significant P<0.001 on breeding efficiency using Wilcox methods, contrast of non-significant effects for all traits on breeding efficiency by Tomar method could be noticed similar highly significant P<0.001 effects of AFC and CI on breeding efficiency by Wilcox methods were recorded by Sallam *et al*. (2012). On the contrary Chandrakar,(2011) found that AFC had non -significant effect on breeding efficiency by (Wilcox) method and the contrast, of highly significant P<0.001 influence by (Tomar method). He found that CI showed highly significant effect on breeding efficiency by both Wilcox and Tomar methods.

Table 3. Analysis of variance for some traits factors affecting Breeding efficiency by Wilcox and Tomar under investigation on Friesian cattle.

Item	Traits	M S
Wilcox (1957)	AFC	88.68**
	CI	118.24**
	TMY	291.71**
	LTMY	1960.77**
Tomar (1965)	AFC	426.66 NS
	CI	278.21 NS
	TMY	230.75 NS
	LTMY	684.98 NS

P<0.05, **P<0.001 NS- Non-significant

The heritability estimates of breeding efficiency of examined traits by Wilcox and Tomar methods were given in the table (4). . Heritability for AFC, CI, TMY, LTMY , Wilcox and Tomar were 0.13, 0.17, 0.25, 0.46, 0,37 and 0,37 respectively. This values are expected in the productive traits (TMY and LTMY) however in the case of reproductive traits (AFC and CI) it decreased. Chandrakar (2011) revealed that heritability for Wilcox and Tomar were 0.010 ± 0.108 and 0.059 ± 0.123 respectively.

The genetic and phenotypic correlations of breeding efficiency with Age at first calving (AFC), calving interval (CI) , total milk yield (TMY) and life time milk yield (LTMY) are given in table(4). The phenotypic correlations between values of breeding efficiency and AFC were positive by Wilcox and negative by Tomar whereas, the genetic correlations is correlated negatively for the two methods. The results are nearly similar to several studies. This is similar to genetic and negative phenotypic correlations of breeding efficiency with AFC obtained by (Chandrakar, 2011 and Raina *et al*., 2016). The breeding efficiency value of CI was positive by Wilcox and it was negative by Tomar for the genetic correlation However, the phenotypic correlations of breeding efficiency (both of Wilcox and Tomar) with calving interval were positive and low. On contrast, the results of Chandrakar, (2011) revealed that the phenotypic correlations of both Wilcox and Tomar were negatively and very high (-0.788 to -0.951) with calving interval.

The breeding efficiency values of both Wilcox and Tomar showed that TMY and LTMY were correlated negatively with the breeding efficiency .On contrast Raina *et al*., (2016) found that TMY correlated positively with the breeding efficiency by both Wilcox and Tomar methods.

Table 4. Estimates of heritability (on diagonal) and phenotypic (above diagonal) and genetic correlation (below diagonal) of examined traits.

Trait	AFC	CI	TMY	LTMY	Walex	Tomar
AFC	0.13	-0.27	-0.22	-0.69	0.09	-0.25
CI	-0.40	0.17	-0.34	-0.39	0.19	-0.28
TMY	-0.13	-0.09	0.25	-0.14	-0.26	-0.39
LTMY	-0.60	-0.17	-0.02	0.46	-0.03	-0.19
Wilex	-0.06	0.20	-0.07	-0.09	0.37	-0.81
Tomar	-0.16	0.05	-0.30	-0.17	-0.69	0.37

CONCLUSION

In the way of improvement the production as well as the reproduction the breeder of dairy animals such as Friesian cattle in Egypt, a lot of traits related to the production (TMY, LTMY, LL ,DP …) and reproduction (AFC, CI , DO …) are very important to consider. However, from the farm as producer side of view the need to reach the evaluation improvement by recording the total milk yield, number of born calves and life time milk yield. Both of Walex (1957) and Tomar (1965) as simple methods to obtain his goal. The obtained results showed that non-genetic factors such as month of calving, and parity were highly significant on breeding efficiency by Wilcox and effect year and parity were highly significant by Tomar method. This mean that temporary environmental factors play a key role in breeding efficiency, there for changing climatic conditions and good management have a significant role in enhance breeding efficiency. In addition that the Lower estimates of obtained breeding efficiency could be the reason is longer calving interval it means increases days from first to last calving and increase in puberty age associated with length of age at first calving and Increase the abortion rates throughout the life time milk yield of the animal Friesian cows in the examined two herds of the present study.

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العوامل الوراثية وغير الوراثية التي تؤثر على كفاءة التربية في أبقار الفريزيان في مصر

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اجريت هذه الدراسة لقطيع أبقار الفريزيان بمحطتى بحوث الإنتاج الحيواني بسخا وبحوث الانتاج الحيوانى بالقرضا- التابعتان لمعهد لبحوث الإنتاج الحيواني- وزارة الزراعة واستصلاح الاراضى فى الفترة من 1990-2016 بإستخدام 2793سجل حليب 874 بقرةِ و 55 ثور . تم تحليل البيانات باستخدام برنامج SAS لايجاد المتوسطات والتاثيرات الغير وراثيه والـــ MTDFREML بالــــAnimal Model program لتقدير المعايير الوراثيه 0 وقدرت كفاءه التربيه بطريقتين وهما Wilcox and Tomar كان تحليل المربعات الصغرى للتأثيرات غير الوراثية لشهر الولادة والمزرعة والموسم عالى المعنويه باستثناء أن تأثير سنه الولادة على كفاءة التربيه كانت غير معنوية بطريقة Wilcox، كان تأثير سنة الولادة والموسم عالى المعنويه باستثناء كلا من الشهر والمزرعة كانت غير معنويه بطريقه Tomar. في حين أظهرت التأثيرات العمر عند اول ولاده والفتره بين ولادتين وانتاج اللبن الكلى وطول الحياه الانتاجيه معنويا بدرجة كبيرة على كفاءة التربيه بطريقه Wilcox ، ولم تكن معنوية على كفاءة التربيه بطريقه Tomar. و كان المكافىء الوراثى لكلا من العمر عند اول ولاده والفتره بين ولادتين وانتاج اللبن الكلى وطول الحياه وطريقه Wilcoxو طريقه Tomar 0.13 ,0.17 , 0.25, 0.46 ، 0.37و 0.37 على التوالي ، وكانت الارتباطات المظهرية لكفاءة التربية مع العمرعند اول ولاده و الفتره بين ولادتين وانتاج اللبن الكلى وطول الحياه الانتاجيه سلبية ومتدنية. من -0.39 الى - 0.03باستثناء العمر عند اول ولاده مع الفتره بين ولادتين بطريقه Wilcox بلغ 0.09 و 0.19 وفي الوقت نفسه ، وصل الارتباط الوراثي مع نفس الصفات من - إلى -0.30 الى -0.06 باستثناء الفتره بين ولادتين مع كلا من Wilcox and Tomar0العوامل غير الوراثية ذات أهمية كبيرة على كفاءة التربيه وهذا يشير إلى أن العوامل البيئية المؤقتة تلعب دورا رئيسيا في كفاءة التربيه وتغير الظروف المناخية والإدارة الجيدة يكون لها دور كبير في تعزيز كفاءة التربية. انخفاض تقديرات كفاءة التربيه يرجع السبب لطول الفتره بين ولادتين وهو يعني زيادة الأيام من أول إلى آخر ولادة وزيادة سن البلوغ المرتبط بطول العمر عند أول ولادة وزيادة معدل الإجهاض طول حياه الحيوان الانتاجيه .