Abstract T97

Genetic Parameters and Trends for Dairy Traits in Holstein Friesian Under North-African Conditions

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SUMMARY

Few studies have investigated the performance of Holstein Friesian cattle under North-African conditions. Thus, the objectives of this research were to estimate genetic parameters for milk yield (MY, kg), true herd life (THL, d), and age at first calving (AFC, mo), and to compute genetic and environmental trends for MY using information from the Ghot Al-Sultan dairy farm near Benghazi, Libya. The dataset contained MY, THL, and AFC records from 1,968 Holstein Friesian first-lactation cows collected from 1986 to 2002. There were 96 sires and 1,511 dams represented in the dataset. Genetic parameters were estimated using restricted maximum likelihood procedures using a 3-trait mixed model. Fixed effects were year-season (all traits) and the covariates of age at first calving (MY, THL) and lactation period (MY). Random effects were cow and residual. The relationship matrix included 2,935 animals. Computations were carried out using the AIREMLF90 program. Milk yield genetic trends for cows, sires, and dams were estimated using means of breeding values for cows, sires and dams per year as regressions of average cow, sire, and dam mean breeding values on years. The estimates of heritability for MY (0.17 ± 0.04) and AFC (0.14 ± 0.03) were low, whereas the value for THL (0.05 ± 0.04) was close to zero. The estimates of genetic correlations between MY and THL (0.22 ± 0.01), and between MY and AFC (0.19 ± 0.04) were low, and the correlation between THL and AFC was near zero (0.07 ± 0.04). The MY genetic trends were 4.11 ± 0.92 kg/yr for cows, 5.70 ± 1.12 kg/yr for sires, and 2.32 ± 0.81 kg/yr for dams. Although low, the positive MY genetic trends for cows, sires and dams suggested the existence of an effective selection program and reasonable utilization of sires with superior breeding values under Libyan conditions. Conversely, environmental trends were negative for cows, sires, and dams suggesting deterioration of nutrition and management practices during the period covered in this study.

INTRODUCTION

A few studies have investigated the performance of Holstein Friesian under North-African conditions (Djemali and Berger, 1992; Ben Gara et al., 2006; and Hammami et al., 2008 in Tunisia; Ahmed et al., 1996 and Hermas and Elzo, 2013 in Libya). Only one study investigated genetic and environmental trends of breeding values for milk yield under North-African conditions (Hermas and Elzo, 2013). These authors found negative or low genetic trends for milk yield at 120 d and 305 d of lactation in two large government herds located in the mid-coastal area of Libya between Benghazi and Tripoli. Bozrayda et al. (2009) found evidence of genotype environment interaction in milk yield from Holstein Friesian cows imported from Germany which emphasized the importance of assessing genetic and environmental changes in a population over time under a variety of local Libyan conditions. The effectiveness of a genetic improvement program can be measured either as genetic progress per generation (Hallowell et al., 1998) or as genetic trend per year (Bakir and Cilek, 2009). The existence of overlapping generations in dairy cattle populations complicates the estimation of genetic progress per generation. It is substantially easier to measure yearly genetic and environmental means and subsequently regressing these estimated annual genetic and environmental means on year of calving (FAO, 2007). ***Thus, the objectives of this study were to estimate heritabilities, genetic correlations, and phenotypic correlations for milk yield, true herd life, and age at first calving, and to compute genetic and environmental trends for cows, sires, and dams for milk yield from 1986 to 2002 in order to assess the effectiveness of the breeding program and management practices at the Ghot Al-Sultan dairy farm near Benghazi, Libya.***

MATERIAL AND METHODS

Data and Management. Data were obtained from records of Holsteins Friesian dairy cattle collected at the Ghot-al-Sultan farm. This farm is located thirty five kilometers south-east of Benghazi (between 32° and 21° longitude), and it is about three hundred meters above sea level. The climate in this region is Mediterranean. Seasons were summer (June, July, August), fall (September, October, November), winter (December, January, February), and spring (March, April, May). The temperature fluctuates between 6°C and 17°C in winter, and between 18°C and 33°C in summer. The annual rainfall ranges between 200 to 400 mm.

The herd started in 1986 when pregnant heifers were imported from Germany. Since then, replacements have been chosen from the same herd. Artificial insemination was carried out by using imported semen from Germany, Holland and sometimes from local selected bulls. The dataset included 2,096 cow records for productive and reproductive traits at first lactation. The number of sires represented in the dataset was 96 and the number of dams was 1,511. The production system in the farm was semi-open. Cows were fed concentrate seven times a day; three times at the milking parlor; on average 1kg per two liters of milk. Dry cows were treated as if they were producing 10 liters of milk per day. Roughage was also provided (10kg per cow per day) four times a day. In addition, cows were given green pasture instead of dry roughage only in spring at a ratio of 2:3 dry matter. ***Three traits were investigated in this study: 1) Milk yield (MY, kg) which was the actual milk yield in liter at first lactation to avoid selection effects; 2) True herd life (THL, d), which was calculated as the length of time in days from a cow's date of birth to a cow's date of culling; and 3) Age at first calving in months (AFC, mo).***

Editing of Data. Data was from dairy cows that had information on milk production, age at first calving, and true herd life. Animals with limited information, missing pedigree or failed to meet minimum criteria to be parents of the next generation were excluded from the final dataset. Lactation lengths below or above 3 standard deviations from the mean were excluded. ***The final dataset contained records of 1,968 cows, 96 sires, and 1,511 dams.***

Statistical Analysis. Estimates of variances, covariances, heritabilities, and genetic and phenotypic correlations for MY, THL, and AFC were computed using restricted maximum likelihood procedures with a 3-trait mixed model. The computing software was AIREMLF90 (Misztal et al., 2002; Tsuruta, 2014). Fixed effects were year-season (all traits) and the covariates of age at first calving (MY, THL) and lactation period (MY). Random effects were cow and residual. Cow effects were assumed to have mean zero and variance equal to the direct product of the 3 x 3 variance-covariance matrix for the 3 traits times the relationship matrix (2,935 animals). Residual effects were assumed to have mean zero and variance equal to the direct product of 3 x 3 diagonal variance-covariance matrix times an identity matrix. Prior values of genetic and residual variances for each trait were computed using single-trait analyses with the same models. Predictions of additive genetic values (EBV) for cows, sires, and dams were obtained using the genetic parameters obtained at convergence.

Genetic and Environmental Trends. Weighted yearly means of cow, sire, and dam EBV for MY were used to compute the genetic trends from 1986 to 2002 as regressions of EBV yearly means for cows, sires, and dams on year of calving. The environmental value for each first-lactation MY was computed as the difference between a cow's phenotypic record and her EBV. Then, weighted yearly means of environmental values for cows, sires, and dams per year were regressed on year of calving to compute the corresponding environmental trends for MY.

RESULTS AND DISCUSSION

Genetic Parameters. Table 1 shows estimates of additive genetic variances and covariances and phenotypic covariances for the MY, THL, and AFC. All genetic variances were low relative to their phenotypic variances. In particular, the genetic variance for THL was three times lower than the genetic variances for MY and AFC relative to its phenotypic variance. Consequently, although low, the estimates of heritabilities for MY (0.17) and for AFC (0.14) were approximately three times larger than the heritability for THL that was close to zero (0.05; **Table 2**).

Genetic covariance (**Table 1**) and genetic correlations were all positive (**Table 2**). All genetic correlation estimates were low. The highest estimates were between MY and THL (0.22) and between MY and AFC (0.19), and the lowest estimate was between THL and AFC (0.07). Conversely, all phenotypic covariances (Table 1) and correlations were negative (Table 2). Phenotypic correlation estimates ranged from -0.04 between MY and THL to -0.23 between AFC and THL.

All estimates of heritabilities, genetic correlations, and phenotypic correlations had low standard errors. This suggested that these parameters were estimated with reasonable accuracy to be useful for genetic evaluation and selection of animals in this population.

The genetic variance and heritability estimates for MY were close to estimates by Ben Gara et al. (2006); Hammami et al. (2008) in Tunisia. This indicated that selection for MY would continue to be feasible under Libyan environmental conditions. The positive genetic correlation between MY and THL indicated that selecting animals with superior MY would also increase True Herd Life, but at the expense of older ages at first calving. Thus, selection for higher MY the total will not only increase productivity, but profitability will also be expected to increase. These results were in agreement with those obtained by Tsuruta et al. (2004). Higher MY will also be expected to decrease the likelihood of cows being culled, and increase their stayability in the herd (Sewalem et al., 2005).

Table 1. Estimates of additive genetic variances (diagonal), additive genetic covariances (above diagonal) and phenotypic covariances (below diagonal) for Milk Yield, True Herd Life and Age at First Calving

Trait	Milk Yield, kg	True Herd life, d	Age at First Calving, mo
Milk Yield, kg	122,500 kg^2	1,188 kg*d	43.62 kg*mo
True Herd Life, d	-1936 d*kg	237.7 d^2	0.6885 d*mo
Age at First Calving, mo	-130.5 mo*kg	-24.63 mo*d	0.4360 mo^2

Table 2. Estimates of heritabilities (diagonal), genetic correlations (above diagonal) and phenotypic correlations (below diagonal) for Milk Yield, True Herd Life and Age at First Calving

Trait	Milk Yield	True Herd life	Age at First Calving
Milk Yield, kg	0.17 ± 0.04	0.22 ± 0.01	0.19 ± 0.04
True Herd Life, d	-0.04 ± 0.03	0.05 ± 0.04	0.07 ± 0.04
Age at First Calving, mo	-0.10 ± 0.03	-0.23 ± 0.01	0.14 ± 0.03

Genetic and Environmental Trends. Milk yield genetic trends were low and positive for cows, sires, and dams (**Table 3; Figure 1**). As expected, the genetic trend for sires was higher than for cows and dams. This suggested a higher selection intensity for sires than for dams. Environmental trends were negative and larger than genetic trends (**Table 3; Figure 2**), indicating the importance of management and environmental factors for MY under Libyan conditions. These results agreed with results obtained by Gargum et al. (2009), who found a significant difference between the period when the project was managed by a Dutch company (1986 to 1991) and when it was managed by the government (1992 to 2002). In addition, they determined that high values of the Temperature Humidity Index (THI) lowered MY from May to October under coastal Libyan conditions.

Table 3. Estimates of cow, sire, and dam genetic and environmental trends for Milk Yield in a Holstein Friesian dairy cattle under North-African environmental conditions

Trend	Cows	Sires	Dams
Genetic, kg/yr	4.11 ± 0.92	5.70 ± 1.12	2.32 ± 0.81
Environmental, kg/yr	-78.96 ± 2.72	-80.55 ± 2.75	-77.17 ± 2.74

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Figure 1: Milk Yield Genetic Trends for Cows, Sires, and Dams

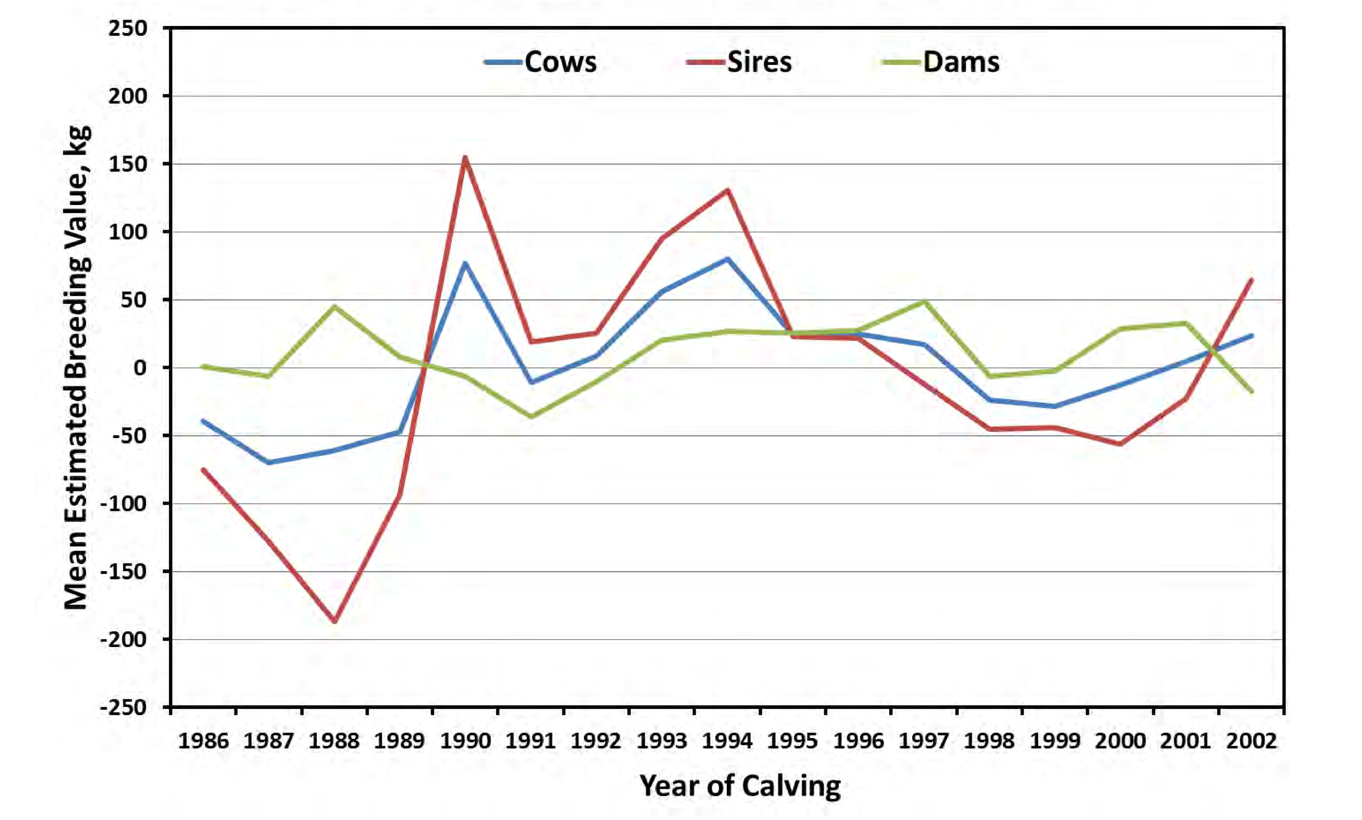
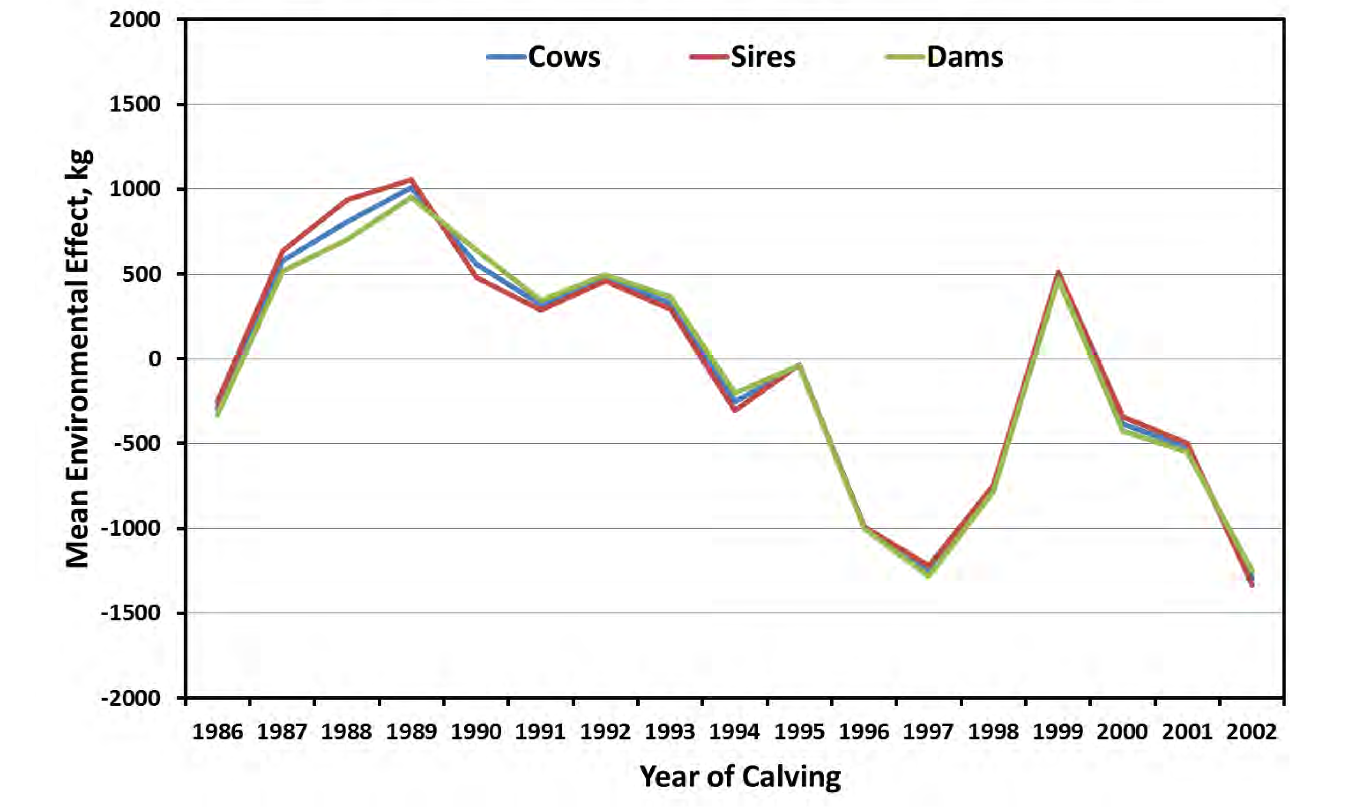


Figure 2: Milk Yield Environmental Trends for Cows, Sires, and Dams



CONCLUSIONS

The positive MY genetic trends for cows, sires and dams obtained here indicated the existence of an effective selection program and reasonable utilization of sires with superior breeding values under Libyan conditions. Conversely, the negative environmental trends for cows, sires, and dams suggested deterioration of nutrition and management practices during the period covered in this study.

REFERENCES

Ahmed, M. K., A. D. Kharoofa, S. A. Salhah, and A. A. Zaied. 1996. Al-Mukhtar J. Sci. 3:9-25.
Bakir, G., and S. Cilek. 2009. J. Anim. Vet. Adv. 8:2553-2556.
Ben Gara, A., B. Rekik, and M. Bouallegue. 2006. Livest. Prod. Sci. 100:142-149.
Bozrayda, S. A., M. Intisar Al-Masli, R.S. Gargoum, et al. 2009. J. Agric. Sci. Mansoura Univ. 34:8709-8717.
Djemali, M., and P. J. Berger. 1992. J. Dairy Sci. 75:3568-3575.
FAO. 2007. Ed. B. Rischkowsky and D. Pilling. Rome, pp. 381-427.
Gargum et al. 2009. J. Agric. Sci. Mansoura Univ. 34:8701-8708.
Hallowell, G. J., J. van der Westhuizen, J. B. van Wyk. 1998. S. Afr. J. Anim. Sci. 28:38-45.
Hammami, H., B. Rekik, H. Soyeurt, et al. 2008. J. Dairy Sci. 91:2118-2126.
Misztal, I., Tsuruta, S., Strabel, et al. 2002. 7WCGALP. Communication 28-07.
Sewalem, A., G. J. Kistemaker, V. Ducrocq. 2005. J. Dairy Sci. 88:368-375.
Tsuruta, S. 2014. University of Georgia, Athens, USA.
Tsuruta, S., I. Misztal, and T. Lawlor. 2004. J. Dairy Sci. 87:1457-1468.