ESTIMATES OF GENETIC AND ENVIRONMENTAL (CO) VARIANCES FOR 305-DAY MILK YIELD AND CALVING INTERVAL IN HOLSTEIN CATTLE

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INTRODUCTION

The ultimate aim of most dairy producers is to maximise profitability. While yields of protein, fat and milk are traits of great importance in this respect, breeding goals should be broadened to include traits other than production, such as health and reproductive traits. In Scandinavia, some fertility traits are already included as breeding objectives in breeding programmes, to counter the deterioration in fertility due to selection for increased milk yield (Solbu and Lie, 1990). In order to estimate breeding values of animals, variance components and genetic parameters are required to estimate breeding values that are needed to select animals. The aim of this study was to estimate variance components and genetic parameters of 305-day milk yield and calving interval.

MATERIAL AND METHODS

Data: Data of this study consisted of lactation records of 750 cows born from 1978 and onwards and recorded between 1982-1997. Data and pedigree information were obtained from the Gelemen State Farm located Black Sea Region of Turkey. Animals had unique identification themselves, most of the animals had also sire and dam identification. In order to eliminate abnormally data from the dataset, animals having calving interval less than 310 and greater then 650 days, and lactation length less then 220 and greater then 550 days were deleted from the data set (Kumlu and Akman, 1999). In addition to that, animals having milk yield less than 2000 kg in lactation and parities more than 7 were also deleted due to less number of observation. Characteristics of the data structure for 305-day milk yield and calving interval are summarised in Table 1.

Table 1. Characteristics of the data structure for 305-day milk yield and calving interval

	305-day milk yield	Calving interval
No. records	1669	955
No. animals	750	433
No. dams	537	331
No. sires	70	54

Statistical analyses: Before the analyses the calving months were grouped into four seasons: December to February (winter), March to May (spring), June to August (summer), and September to November (autumn). Milk records were adjusted for 305-day lactation length. Minitab (1998) was used for preliminary analyses to determine which fixed effects and covariates should be fitted in the statistical models. For the traits the model included calving year, calving month, lactation numbers as fixed effects and direct additive genetic effect and permanent environmental effects as random effects. Genetic parameters and variance components of 305-day milk yield and calving interval were estimated by using ASREML programme (Gilmour et al., 1998), a restricted maximum likelihood (REML) procedure using a derivative free algorithm.

RESULTS

Results of (co) variance components and genetic parameters for 305-day milk yield and calving interval are presented in Table 2.

Table 2. Estimates of (co) variance components and genetic parameters with standard errors for 305-day milk yield and calving interval

Traits	σ^2_A	σ^2_C	σ^2_E	h^2	R	c^2
305-day milk yield	143248	167007	556058	0.16	0.35	0.19
s.e	2.81	3.63	21.75	0.055	0.031	0.053
Calving interval	234	0.021	3764	0.058	0.058	0.000
s.e	1.33	0.0000	17.11	0.0436	0.0400	0.0519

σ^2_A: direct additive genetic variance; σ^2_C: permanent environmental variance σ^2_E : error variance, h^2: heritability, r: repeatability, R: permanent environmental variance as a proportion of phenotypic variance

Heritabilities of 305-day milk yield and calving interval of Holstein cows raised in Gelemen State Farm were found 0.16±0.055 and 0.058±0.0436, respectively. Estimates of repeatability were 0.35±0.031 and 0.058±0.0400 for 305-day and calving interval, respectively. The estimates of permanent environmental maternal effects (c^2) were 0.19±0.053 for 305-day milk yield and close to zero for calving interval. Estimates of genetic and phenotypic correlation between traits were summarised in Table 3. Estimates of genetic and phenotypic correlation were 0.69±0.300 and 0.18±0.033 respectively.

Table 3. Genetic (above the diagonal) and phenotypic (below the diagonal) correlation between 305-day milk yield and calving interval with standard errors

Traits	305-day milk yield	Calving interval
305-day milk yield	-	0.69±0.300
Calving interval	0.18±(0.033)	-

DISCUSSION

Corresponding literature results varied. Heritability obtained in this study was lower than the heritabilities estimated for Holsteins cows by several authors (Dong and Van Vleck, 1988; Van Vleck et al. 1988; Castillo et al. 1997) using REML methodology. In another study, Hansen et al. (1983) estimated the heritability of 305-day milk yield as 0.16, 0.11 and 0.10 for cows in first, second and third lactation respectively. Bagnato ve Oltenacu (6) reported h^2 of 0.22, 0.19 and 0.16 for 305-day milk yield for cows in first, second and third lactation corrected for mature body weight.

Heritability estimates of calving interval were generally low. This was reported by several authors. Metz and Politiek (1970) reported h^2 of 0.02 for calving interval. In another study, Dong and Van Vleck (1988) reported h^2 of calving interval between 0.14-0.16. This results show that environmental effects (feeding, management etc.) has a significant impact on calving interval rather than genetic effects.

Estimation of genetic correlation between 305-day milk yield and calving interval were reasonably high (0.69±0.300). This result in agreement with those of Distl et al. (1985) who reported an estimate 0.73 and close to results reported by Seykora and Daniel (1983) and Pereira et al. (1994) whose reports ranged from 0.48 and 0.66. However, there are several estimates in the literature, which are lower than the present study. Bagnato and Oltenacu (1993), Campos et al. (1994), Pryce, J.E. (1997) reported that correlation as 0.29, 0.17, 0.22 and 0.18 respectively. The positive correlation between milk yield and calving interval indicate that selection for high milk yields leads to deterioration in fertility. However, this correlation may be misleading. If high milk producing cows are given more opportunities to rebreed, or if breeding is delayed in high production cows, the association between production and fertility will be biased by management decisions (Philipson, 1981; Bagnato and Oltenacu, 1993). Parameter estimate for calving interval is most likely to biased in this respect (Pryce, 1997).

Phenotypic correlation between milk yield and calving interval shows quite or complete similarity with the values ranged between 0.15 and 0.28, which were calculated from a series of data and reported by Dong and Van Vleck (1988), and the value of 0,18 calculated for Brown Swiss cattle by Akbulut (1996). Contrary to this study, Dong and Van Vleck (1988) predicted correlation between milk yield and calving interval quite low (between 0,09-0,12).

CONCLUSION

Heritability and repeatability predicted for milk yield of Holsteins reared in Gelemen State farm were quite similar to the reported values predicted for the same breed before. It is interesting that heritability and repeatability of calving interval quite low, but genetic correlation between calving interval and milk yield is high. This means that when milk yield gets high calving interval also get longer and this situation can occur frequently. To reduce the adverse affects of this situation, when the productivity gets high, it is necessary to be careful and attentive during pregnancy.

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