GENETIC PARAMETERS OF TEST-DAY MILK YIELD OF HOLSTEIN COWS

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SUMMARY

Data from 17.968 records from 2,130 first lactations of Holstein cows calved between 1988 and 1991, daughters of 136 sires, were analyzed. The data set was divided into ten subsets based on days in milk. Traits studied were test-day milk yield (M1 to M10) and 305d milk yield (M305). These traits were adjusted for some environmental effects: class of age at calving, interval from calving to first test-day and herd-year-season. Restricted Maximum Likelihood estimates of (co)variances components were obtained from two-trait analyses under a sire model. Estimates of heritabilities for M1 to M10 ranged from 0.04 to 0.32 and the largest value was found in the second half of the lactation (M5 to M7). Heritability estimate for P305 was 0.32. Genetic correlation estimates between individual test-day and M305 ranged from 0.78 to 1.00. The results suggested that test-day yields, mainly in mid lactation, can be used in genetic evaluation instead of 305d milk yield, because estimates of heritability have practically the same magnitude. Moreover, early selection can reduce generation interval.

Keywords: dairy cattle, test-day, genetic parameters.

INTRODUCTION

Standardized 305-d milk yield (M305) has been used in the genetic evaluation of dairy breeds. To avoid the use of extension factors, test-day yields could be used, and models that include them in the analysis viabilize an alternative to the definition of selection criteria (Swalve, 1995b). Those models are more flexible and any information on test-day milk yield can be used.

Genetic parameters of test-day milk yields were estimated by several authors, including Van Vleck and Henderson 1961, Keown and Van Vleck 1971, Auran 1976, Danell 1982, Swalve 1995a, and Gadini 1997. For these authors, selection based on some test-day yields can result in decreasing generation interval, minimization of selection bias because of culling after first lactation, and a substantial reduction in costs on milk yield recording for the farmers. Therefore, this study aimed to evaluate the possibility of utilization of test-day milk yield as a selection criterium for dairy animals.

MATERIALS AND METHODS

Data used in this study are from first lactations of Holstein cows freshning from 1988 to 1991.

Traits were test-day milk yields and 305-d milk yield (M305). Test-day milk yields were defined as the sum of all weights of milk in 24 hours (Pander *et. al.* 1992).

Lactations without a record between 4 and 45 days after calving were eliminated. Because interval between tests were not always of 30 days, classes of 30 d were defined. Therefore, tests in the first class were defined as first day day milk yield (M1), and so on, til the 10^{th} interval (M10).

Informations after the 10^{th} test-day, or from lactations with less than 2 test-day records, or from herds with less than 10 records were discarded. Sires with less than 5 daughters or serving in only one herd were also culled.

A data set with 17.968 test-day records from 2,130 first lactations of Holstein cows, sired by 136 bulls, was used. Each test-day milk yield was analyzed pairwised with M305.

Two calving seasons were defined: a rainy season, from October to March, and a dry season, from April to September. Classes of herd-year season had at least 4 observations. Age of cow at calving was split into 5 classes: 1.5 to 2.1 years; 2.2 to 2.4, 2.5 to 2.7, 2.8 to 3.1, and 3.2 to 3.5 years. Also, the interval between calving to first test-day was split into 4 classes: 4 to 14, 15 to 24, 25 to 34, and 35 to 45 days.

Data were analyzed by REML with a derivative free algorithm developed by Boldman *et al.* (1995), using a sire model as follows:

$$\mathbf{y} = \mathbf{X}\beta + \mathbf{Za} + \mathbf{e}$$

where $\mathbf{y}$ = vector of dependent variables (M1 to M10 and M305); β = vector of fixed effects (class of age at calving, herd-year-season, interval calving-first test-day); $\mathbf{X}$ e $\mathbf{Z}$ = incidence matrices relating observations to the fixed and random effects; a = vector of sire effects, and $\mathbf{e}$ = vector of random residual effects. $E(\mathbf{y}) = X\beta$; $E(\mathbf{a}) = E(\mathbf{e}) = 0$. $Var(\mathbf{a}) = G = G_0 \otimes I_s$ e $Var(\mathbf{e}) = R = R_0 \otimes I_n$, where $\mathbf{G_0}$ = matrix of additive genetic covariance; $\mathbf{R_0}$ = matrix of residual effects; $\mathbf{I}$ = identity matrix of order n (number of records) or s (number of sires), and $\otimes$ = direct product operator.

From test-day 3 on, the interval between calving-first test-day was not included in the analyses, since a preliminary study indicated that this effect was significant only for M1 and M2.

RESULTS AND DISCUSSION

Estimates of heritability for Ml to M10 and for M305, and estimates of genetic correlation between M1 to M10 and M305 are presented in Table 1. In general, these heritability estimates showed the same trend found in the literature, where largest values are observed between test-days 5 and 7. In the last 2 tests, estimates were lower than those cited previously. However, Kathenbrink and Swalve (1993), cited by Swalve (1995b), obtained estimates equal to .09 and

.05 for the last 2 test-days respectively. Those reduced estimates are due, in part, to small number of observations in the respective data set, where only better cows remained.

Genetic correlations varied from .78 to 1.0, with largest estimates found in mid-lactation. However, for the first and last test-days estimates were equal to 1.0, opposite to previous reports, where smaller values than those estimated for mid-lactations are found. This fact can be explained in part by the smaller number of records in the data sets, mainly when the MTDFREML was used, because there is a trend of convergence to +1 or -1, or for a local maxima. This fact could be indicating that a larger data set is needed for obtaining better estimates (Van Vleck 1992).

Table 1 Heritability estimates (h^2) of test-day milk yields (M1 to M10), genetic and phenotypic correlations (rg and rp) between test-day milk yields and 305-d milk yield (M305) of first lactations of Holstein cows

Trait	h^2	rg	rp
M1	0.20	1.00	0.56
M2	0.20	0.80	0.64
M3	0.20	0.92	0.97
M4	0.20	0.96	0.97
M5	0.32	0.89	0.76
M6	0.20	0.95	0.78
M7	0.24	1.00	0.95
M8	0.16	0.93	0.91
M9	0.12	0.78	0.74
M10	0.04	1.00	0.73
M305	0.32		

CONCLUSIONS

Based on the results presented and discussed in this study, one can concluded that genetic correlations between test-day milk yields and 305-d milk yield are large and positive, indicating that test-day milk yields could be utilized in place of M305 in genetic evaluations of dairy animals. The largest estimates of heritability in mid-lactation suggested that M5 could be used as selection criterion, leading to a reduction in the generation interval.

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