GENETIC PARAMETERS OF TEST DAY MILK, FAT AND PROTEIN YIELDS

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ABSTRACT
Test day measurements on first lactations of Holstein cows were used to estimate genetic parameters for test day production traits. Traits were milk, fat or protein yields at test day, in 10 intervals based on days in milk. The data set was divided into five subsets and the traits were analyzed with a series of two-trait animal models to obtain REML covariance estimates. Fixed effects were classes for days in milk within test day interval and age at calving, and herd-test date. Pooled heritabilities for test day traits were small, varying from .14 for milk to .12 for fat and protein test day yields . Each test-day yield was highly genetically correlated with the adjacent test day yield throughout the lactation. Among test day milk and protein yields, all correlations were consistently positive and high. Genetic correlations of mid lactation test day milk yields and all test day fat yields were small, and near zero. Genetic correlations of all test day protein yields with initial fat yields were positive and large, and with fat yields in mid lactation were close to zero.
Key words: test day covariances, Holstein.

INTRODUCTION
Test day records are usually obtained at monthly intervals and combined to provide standardized 305-d yield, the traditional measure of production used for genetic evaluation of dairy cattle. Use of test day records as primary source of information for genetic evaluations has been the object of interest of several authors in recent years (Meyer *et al.* 1989; Reents *et al.* 1994; Rekaya *et al.* 1995; and Wiggans and Goddard 1996b). These authors listed some of the advantages of using test day records for genetic evaluations, including more accurate estimation of environmental effects and more accurate definition of contemporary groups that include all animals measured the same day, no need for extension factors, and improved accuracy of evaluation for yields of milk components from information on milk yield.
Wiggans and Goddard (1996a) proposed a multi-trait model where test day records from milk, fat and protein yields for first and later lactations, pre-adjusted for age at calving and stage of lactation, were fitted with an animal model in a two-step analysis to adjust for effects of herd-test day and herd-year-season. Knowledge of the covariance structure among milk yields and milk components yields is necessary to account for all relationships among traits .

MATERIAL AND METHODS
Test day records were provided by Mid States Dairy Processing Center, Ames, IA (USA), and correspond to first lactations of Holstein cows in eight Midwestern states, initiated between 1989 and 1993. Edits were based on lack of proper identification, lack of birth, calving or test

day date, code indicating non-normal records, sire serving in only one herd, test day intervals less than 21 days, lack of first measurement between days 5 and 45, or test interval longer than 75 days. The study was undertaken with 104,153 first lactations in 3228 herds of daughters of 1046 sires, in 3228 herds. Data were randomly split into five subsets based on herd identifier, with subsets varying in size from 19,233 to 21,714 records, and the pooled estimates were given by the arithmetic means from the five subsets. Traits were defined by dividing the lactation into 10 intervals based on days in milk.

Data were analyzed by REML with a derivative-free algorithm developed by Boldman *et al.* (1995), using a two-trait animal model. Traits analyzed were each test day yield of milk, fat and protein, with traits considered pair-wise within each test day interval and also across the ten test day intervals (TD) of the lactation. Fixed effects were defined as 18 classes of age at calving, each one with interval of 30 d; 60 classes of days in milk, in 5 d intervals; and herd-test date (HTD), as proposed by Meyer *et al.* (1989) and Ptak and Schaeffer (1993).

RESULTS AND DISCUSSION

Variances of milk and fat yields declined slightly with the advance in the lactation, while variances of protein yield were more constant across the lactation. Pooled heritabilities for the thirty traits were small, being on average .13 for milk, .10 for fat, and .11 for protein. Empirical standard errors for all estimates were consistently small, ranging from .005 to .018. Dong *et al.* (1988) verified that misidentification of animals can reduce estimates of heritability, but genetic and phenotypic correlations were reported not to be affected by completeness of relationships for an animal model.

As recommended by Meyer et al. (1989), the inclusion of HTD in the model did reduce environmental variances, but pooled estimates of environmental covariances were still large when compared to other reports.

Genetic correlations were always large between adjacent test days for milk yield (Figure 1). When tests were contiguous, estimates were at least .94, decreasing to .55 when records were nine TD apart. Genetic correlations among fat and protein test day yields followed the same pattern (Figures 2 and 3).

Phenotypic correlations between same test day milk and fat yields were large (.60 to .80) but decreased as number of intervals between test days increased. Estimates of genetic correlations were small compared to those reported by Pander *et al.* (1992), varying from -.20 between initial fat test day yield and final milk yields, to .60 , between initial test day milk and fat yields (Figure 4). Between mid lactation milk yields and all test day fat yields, genetic correlations declined to almost zero by TD 6, although the empirical standard errors of the estimates were larger at these points. Pander *et al.* (1992) reported the same decrease in estimates at mid-lactation, when the estimates went from .64 (milk and fat TD 1), to .11 (fat in TD 1 and milk in TD 5). This same trend was apparent, but not as accentuated, among test day fat and protein yields (Figure 6).

Genetic correlations between test day milk and protein yields (Figure 5) were consistently positive and large, varying from .60 to .90 for most of the test day combinations. Phenotypic and environmental correlations were negative for the same test day, but nearly zero for different test days.

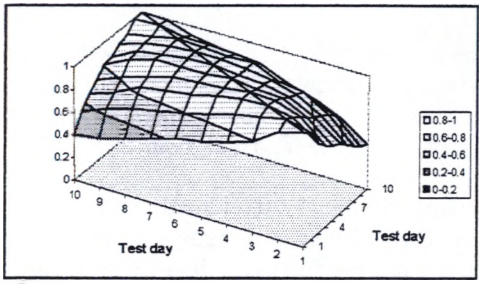

Figure 1. Genetic correlations among test day milk yields.

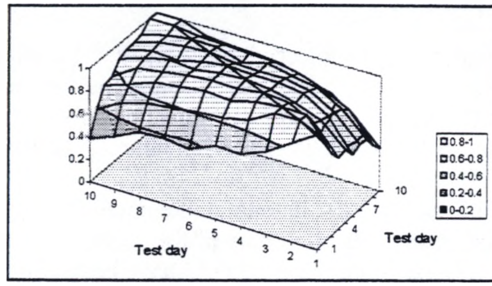

Figure 2. Genetic correlations among test day fat yields.

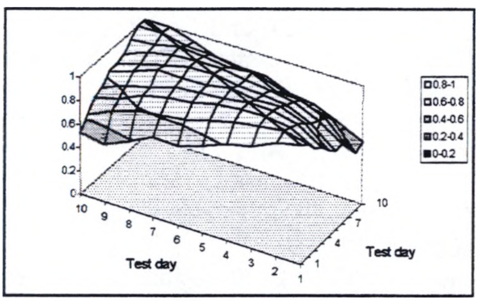

Figure 3. Genetic correlations among test day protein yields.

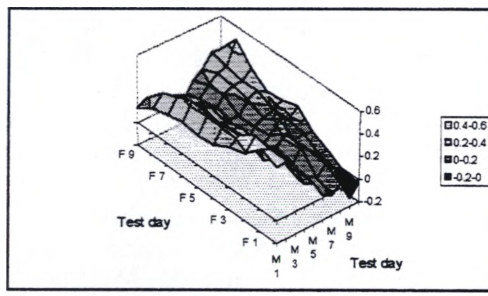

Figure 4. Genetic correlations among test day milk (M1-M10) and fat yields (F1-F10).

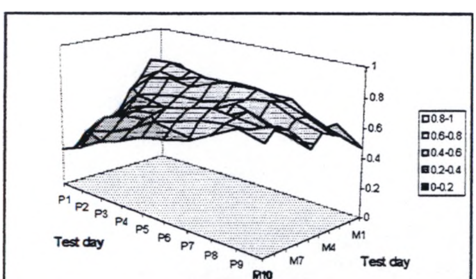

Figure 5. Genetic correlations among test day milk (M1-M10) and protein yields (P1-P10).

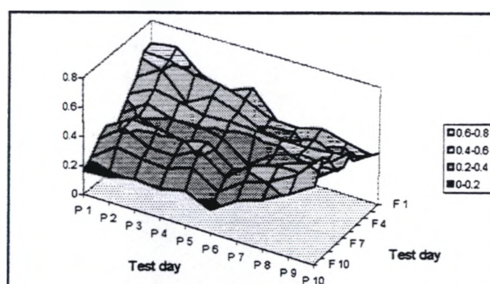

Figure 6. Genetic correlations among test day fat (F1-F10) and protein yields (P1-P10).

CONCLUSIONS

Analyses of test day records from first lactation Holstein cows from the Midwest USA resulted in low estimates of heritability for all production traits. The even smaller estimates for yields at first test day confirmed that there is more variation not accounted for by the model in the initial stage than in later stage of lactation.

Estimates of genetic correlations between consecutive test day milk, fat and protein yields were large, but became significantly smaller as the time interval between test days increased. Genetic correlations between same day milk and fat yields are small, specially in the mid stages of lactation, while genetic correlations between milk and protein test day yields are high and positive.

The use of herd-test date to create contemporary groups, giving a better adjustment to specific effects at the collection date of the record, is recommended for test day analyses. However, in this data set, other factors could have been affecting test day production traits mainly in initial and mid stages of lactation.

REFERENCES

Boldman, K..G., Kriese, L.A., Van Vleck, L.D. , Kachman S.D. and Van Tassell, C.P. (1995) A manual for use of MTDFREML. USDA-ARS, Clay Center(NE), USA. 114 p.

Dong, M.C., Van Vleck, L.D. and G.R. Wiggans (1988) *J. Dairy Sci.*, **71**:3047-3052.

Meyer, K., Graser, H. and Hammond, K. (1989) *Livestock Prod. Sci.*, **21**:177-199.

Pander, B.L., Hill, W.R., and Thompson, R. (1992) *Anim. Prod.*, **5**:11-21.

Ptak, E. and Schaeffer, L.R. (1993) *Livestock Prod. Sci.*, **34**:23-34, 1993.

Reents, R., Dekkers, J.C.M. and Schaeffer, L.R. (1994) Proc. World Congress on Genetics Applied to Livestock Production, 5. Guelph, Canada. **17**. 120-122.

Rekaya, R., Bejar, F., Carabaño, M.J. and Alenda, R. (1995) Proc. Interbull Annual Meeting. Prague, Czech Republic.

Wiggans, G.R. and Goddard, M.E. (1996a) Proc. Interbull International Meeting. Veldhoven, Netherlands.

Wiggans, G.R. and Goddard, M.E. (1996b) *J. Dairy Sci.* , **70** (suppl.):144.