Estimation of Genetic Parameters for Test Day Milk Yields of Moroccan Holstein Cows Using a Random Regression Test Day Model

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Introduction

In recent years, the use of test day models in genetic evaluation of dairy cattle instead of 305-d lactation models received an increased interest. Test day models use test day records collected during the lactation instead of 305-d lactation yields used by traditional models. Somme advantages of test day models include the ability to account for environmental effects, the ability to ensure a more accurate evaluation of sires and cows due to using a larger number of information per cows, and the ability to accommodate recording milk plans and reduce the cost by making fewer measurements (Wiggans and Goddars, 1997; Gengler et al., 1999).

Test day models have been described using various models, such as multiple-trait models, covariance function models, random regression models (Swalve, 2000). The most interesting form of these models is the random regression model. With such models, lactation curves are modeled as function of random additive genetic effects. Several functions are used to estimate genetic parameters and to model the shape of lactation curves with random regression models (Jamrozik and Schaeffer, 1997; Kirkpatrick et al., 1994; Gengler et al., 1999; Strabel et al., 2005).

In many countries, test day models have already been implemented, or are being developed (Strabel et al., 2005). Currently, test day models allow great flexibility and seem to be the method of choice in countries like Morocco where a genetic evaluation system is lacking up to now. The first step toward the possible application of test day models in Morocco is to estimate the genetic parameters of test day milk yields records under Moroccan conditions. Thus, the present study was planned to estimate (co)variances component of test day milk yields of the first 3 lactation using random regression test day animal model.

Material and methods

Data were obtained from Holstein cows calving between 1998 and 2008 in 224 herds from 17 geographic regions. These data were collected by external Livestock Service of the Agricultural Ministry of Morocco. Official milk recording system practiced in Morocco is classified as A4 type. Originally data included test day yields for milk and fat percentage. However, because of the small number of records of fat yields only data of milk yields were analyzed in this study. Data were restricted to the first 3 lactations, test day records between 5 and 365 days, milk yields from 1.5-85 kg, age at first, second and third calving between 20

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and 45 months, between 32 and 59 months and between 42 and 74 months, respectively. Also, only cows with more than 5 test day records and herds with more than 4 cows by year of calving were kept.
Four calving seasons were distinguished: January to March, April to June, July to September and October to December. Also, three subclasses (20 to 27, 28 to 30 and >31 months) for first lactation, three subclasses (30 to 40, 41 to 45 and >46 months) for second lactation and three subclasses (41 to 53, 54 to 58 and >59 months) for third lactation were defined for age at calving. Table 1 presents the characteristics of edited data.

Table 1: data structure for the analysis

	1^{st} lactation	2^{nd} lactation	3rd lactation
Test day records used in the analysis	73 739	52 035	33 661
Mean milk yields (kg)	18.4	19.8	20.9
Number of cows with records	7 978	5 592	3 753
Number of herds	212	208	188
Average number of test day records per cow	9	9	9

Statistical analyses. The model used in this study was a multiple-lactation random regression test day model. The matrix notation of the model is $\mathbf{y} = \mathbf{Xb} + \mathbf{Q_3}(\mathbf{Za} + \mathbf{Wh}) + \mathbf{Q_4Zp} + \mathbf{e}$ .Where $\mathbf{y}$ = a vector of test day milk yields; $\mathbf{b}$ = a vector of fixed effects: herd x test day and age x season of calving x classes of 25 DIM; $\mathbf{a}$ = a vector of random regression coefficients for additive genetic (**AG**) effect; $\mathbf{p}$ = a vector of random regression coefficients for permanent environmental (**PE**) effect; $\mathbf{h}$ = a vector of random regression coefficients for herd x year of calving common environmental (**HY**) effect; $\mathbf{e}$ = a vector of residual effects; $\mathbf{Q_3}$ = a matrix of 3 modified Legendre Polynomials (constant, linear and quadratic) and $\mathbf{Q_4}$ = a matrix of 4 modified Legendre Polynomials (constant, linear, quadratic and cubic) as defined by Gengler et al. (1999); and $\mathbf{X}$, $\mathbf{Z}$ and $\mathbf{W}$ = incidences matrices relating observations to various effects.
Variances components were estimated by EM-REML method using REMLF90 package of Misztal et al. (2002). Genetic parameters on 305-d scale were obtained similarly to the approach applied by Druet et al. (2003).
Residuals were calculated for each DIM as difference between $\mathbf{y}$ and $\hat{\mathbf{y}}$ where $\hat{\mathbf{y}}$ was the predicted value estimated by the fitting model. Mean values of these residuals over DIM were calculated and used as criterion to qualify the fitting model.

Results and discussion

The daily AG, PE, HY and R variances for milk yields across parity are given in figure 1. The values of PE and HY variances declined from the onset of lactation, attaining minimums at 180 and 230 DIM and increasing thereafter. In the opposite, the values of AG variances were slightly higher in the middle of lactation than at the beginning and the end of lactation as found by Druet et al. (2003). Also, the AG and HY variances were very smaller than PE. However, the HY variances were larger than AG variances, especially in the beginning and the end of lactation. The trends of PE and HY variances were similar to trends reported by Santellano-Estrada et al. (2008) and Hammami et al. (2008). The magnitude of the values of

AG and PE variances were very close to those obtained in countries with the same climate and same dairy systems, like Tunisia (Hammami at al., 2008).

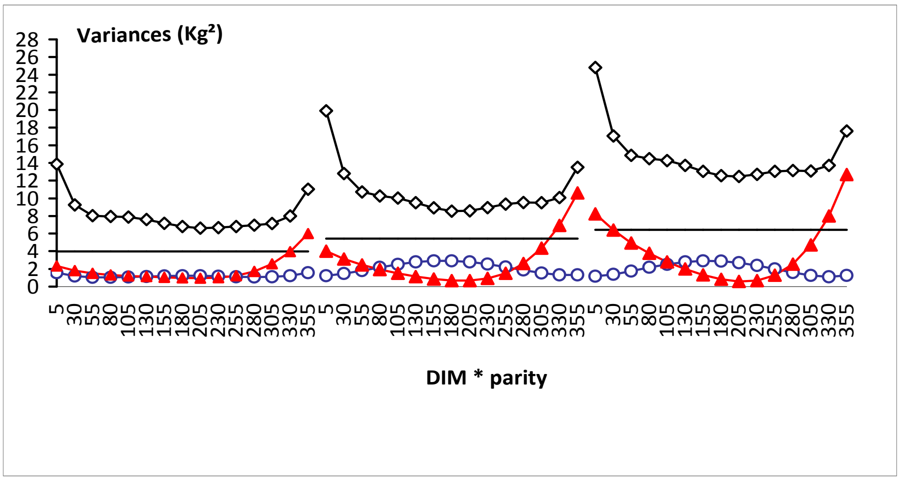

Figure 1: additive genetic (AG) (circle), permanent environmental (PE) (square), herd x year of calving common environmental (HY) (triangle) and residual variances (R) (trait) of milk yields for the three first lactations of Moroccan Holstein.

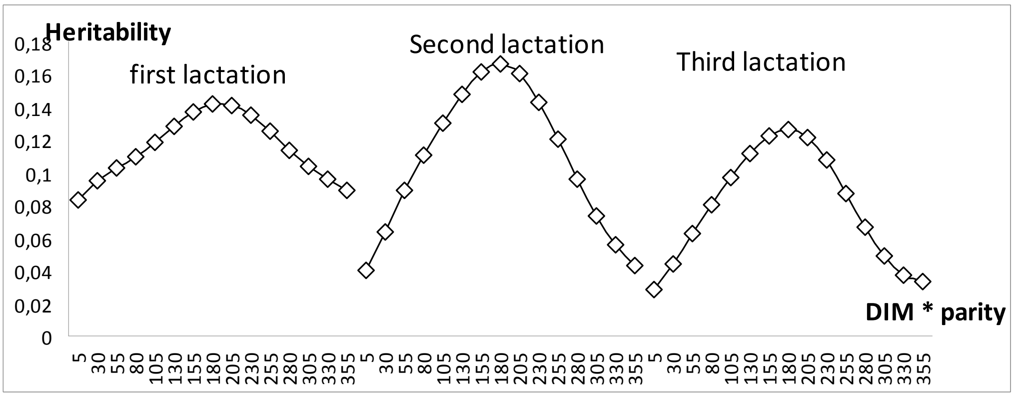

Figure 2: heritability estimates of test day milk for the first three lactations

Figure 2 shows heritabilities of test day milk yields for the first three lactations. In general, the values of heritabilities were higher in middle of lactation than the edges of lactation. The values obtained in this study were similar to those reported by Hammami et al. (2008). However, they were smaller than those obtained by Druet et al. (2003). Figure 3 presents the genetic correlations among test day milk yields at same DIM in the first three lactations. The genetic effects for test day milk yields in the middle of lactation were higher than at the edges. The genetic correlations of test day milk between the first and second lactations were higher than the correlations between the first and third lactations. However, the correlations between the first and second were similar than those between the second and the third lactations.

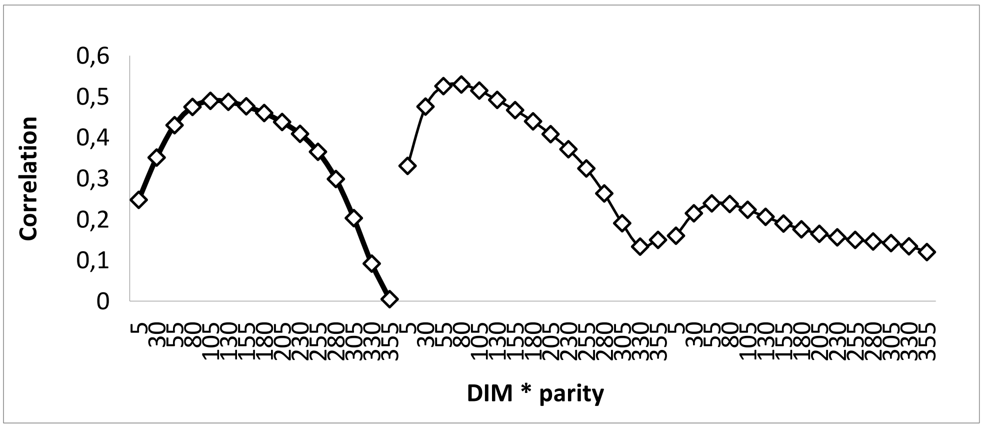

Figure 3: genetic correlations among test day milk for pairs of lactations.

Conclusion

The genetic parameters estimated in this study were the first results of analyzing Moroccan data using a random regression test day model. Generally, the genetic parameters estimated were similar to those obtained in countries with the same climate and dairy management, like Tunisia. Although this study was limited to milk yields, it initiates and illustrates the usefulness of random regression test day model for genetic evaluation of Moroccan dairy cattle, where records are costly to obtain for farmers.

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