Non-genetic influence on test day milk and fat yields data of Moroccan Holstein-Friesian cows

A. Tijani
Ecole Nationale d'Agriculture de Meknès,
B.P. : S/40, Meknès, 50000, Morocco
e-mail : atijani@enameknes.ac.ma

Summary
A total of 116,634 monthly test-day records of milk and fat yields from 11,278 lactations of 7725 Holstein-Friesian cows from 192 herds in 17 areas of Morocco involved in the official milk recording program were used to investigate environmental effects on test-day milk and fat yields. Mean and standard deviation for milk and fat yields were 17.6 kg and 6.5 kg, 636.8 g and 222.8g, respectively. Mixed linear model was used in order to explain total variation. The effects of the area of production, herd, age at calving, year and season of calving, stage of lactation were very highly significant ($p<0.0001$) for test day milk and fat yields. Day in milk (DIM) was the most contributing effect to the variation followed by region of production and age at calving. Milk and fat yields were high at the beginning in the lactation and decreased since the 54 day in milk. Differences between the beginning and the end of lactation for milk and fat yields were 10.1 kg and 123.8 g, respectively. Test day milk and fat yields were high in spring and low in Summer months.
Keywords: Holstein-Friesian cows, test day milk and fat, environmental effects, Morocco.

Introduction
In Morocco, genetic evaluation system of dairy sires and cows was based on 305 day lactation. Lactation yields are estimated from monthly test day yields records. In recent years, a new approach called "test day model" was developed to predict breeding values of dairy cattle. Test day model is based on monthly test day records instead of 305 day lactation. Several studies had confirmed the advantages of using monthly test day yields to estimate breeding value with greater precision as early as possible and also to reduce substantially the cost of milk recording for the farmer (Ptack & Schaeffer, 1993; Swalve, 1995). Thus, the interest of implementing test day models is increasing world-wide. The challenges in developing test day model are the adjustment of environmental effects affecting test day yields and the estimation of genetic parameters that are required for implementing an evaluation system (Jamrozik & Schaeffer, 1997; Veerkamp & Goddard, 1998; Tijani et al., 1999).

The objective of this study was to evaluate the influence of environmental factors such as parity, herd, production year, etc. on monthly test day records of Holstein-Friesian cows enrolled in the Moroccan official milk recording program.

Materiel and methods

Data
Data used in this study were provided by the Animal Improvement Service of the Ministry of Agriculture. They came from Holstein-Friesian cows involved in the Moroccan official milk recording program. Data analysed were restricted to test days recorded by type A method for which the first measurement of milk yield and analysis of fat percentage had occurred between 7 and 45 days after calving. Lactation length was fixed at 365 days. Test day yields obtained after the 12^{th} test day record, or from lactation with less than 3, or from herd with

less than 4 cows were discarded. The final data set involved 116,634 monthly test day records of milk and fat yields from 11,278 lactations of 7725 cows.

Data were classified according to the following factors: year of calving (1990 to 1998); season of calving (4 levels); age at calving (21 levels) within parity (first, second and third) ; herds (192 levels); area of production (17 levels); and twelve levels of DIM interval.
Traits studied were test day milk yield and test day fat yield computed from milk yields and fat percentage.

Statistical Analysis

The test day milk and fat yields were analysed with the following mixed model:

$$Y_{ijklmnop} = \mu + Ar_i + H_j (Ar_i) + YC_k + SC_l + Pag_m + Sl_n + c_o + e_{ijklmnop}$$

Where $Y_{ijklmno}$ = test day yields of trait p (milk or fat) for cow o, μ = overall mean, Ar_i = fixed effect of area of production i, H_j = fixed effect of herd j nested within level of area of production i, YC_k = fixed effect of year of calving, SC_l = fixed effect of season of calving, Pag_m = fixed effect of parity- class of calving age, SL_n = fixed effect of stage of lactation, c_o = random effect of individual lactation, and $e_{ijklmno}$ = random residual.

The random factor of cow o was considered to account for the variability associated with each lactation. Covariance matrices of random effects are $\mathbf{I}\sigma_o^2$ and $\mathbf{I}\sigma_e^2$, respectively, and fixed effects were estimated by ordinary least squares. Solutions for fixed effects and variance components estimates associated with random factors were obtained using SAS MIXED and VARCOMP procedures (SAS, 1994).

Result and discussion

Unadjusted means and standard deviations of test day records of milk and fat are in Table 1. Test day yields of milk and fat averaged 17.6 kilograms and 636.8 grams, respectively. The variability of yields tended to decrease progressively from the beginning to the end of lactation. The decrease of standard deviations indicated that yields tend to be more variable at the beginning than at the middle of lactation. These findings are in agreement with results from other studies (Ptack & Schaeffer, 1993; Swalve, 1995).

Table 1. Row mean and standard deviation of test day milk (kilograms per day) and fat (grams per day) yields.

		Milk			Fat	
DIM	Interval[1]	MDIM[2]	Mean	SD	Mean	SD
1	7-35	23	21.7	3.2	770.0	226.0
2	36-65	54	21.8	6.7	768.3	225.8
3	66-95	84	20.7	6.5	734.4	219.6
4	96-125	115	19.6	6.1	700.3	211.8
5	126-155	146	18.4	5.8	663.5	201.4
6	156-185	176	17.4	5.6	630.8	192.4
7	186-215	207	16.4	5.3	597.5	182.6
8	216-245	237	15.3	5.1	563.5	181.3
9	246-276	267	14.2	4.9	528.3	176.1
10	276-305	297	13.2	4.8	491.9	170.4
11	306-336	327	12.4	4.6	463.3	168.3
12	337-367	358	11.8	4.7	443.8	168.6

1DIM interval of test day yields.
2MDIM= mean DIM at which the test day occurred.

Table 2 shows the analysis of variance for test day milk and fat yields. The effects of herd, area, age at calving, stage of lactation, season and year of calving were very highly significant ($p<0.0001$) for the two traits. The four most important influences on test day milk and fat in a decreasing order were: stage of lactation, region of production, age at calving and season of calving. Similar results have been obtained in several studies on dairy cattle (Strabel & Szwaczkowski, 1995; Karaca, 1997).

Table 2. Analysis of variance for test day milk and fat yields

		Milk			Fat	
Source[1]	df[2]	F	Prob	df[2]	F	Prob
Area	16	151.98	0.000	15	197.96	0.000
Herd (area)	182	40.51	0.000	167	40.84	0.000
PAg	20	112.67	0.000	20	103.16	0.000
SL	11	7404.85	0.000	11	5405.45	0.000
SC	3	92.96	0.000	3	103.69	0.000
YC	8	37.42	0.000	8	42.01	0.000

1YC=year of calving; SC=season of calving; PAg=Parity- Age at calving, SL=stage of lactation.
2 df = degrees of freedom.

Least square means of the traits studied for the main environmental factors are given in table 3. The highest values for milk and fat yields were observed in January-March and October-December seasons of calving. Seasonal variation in cow performance are due to the great availability of pasture and forage in early winter and spring. A relevant difference (about 1 kg of milk/day) can be observed between summer and winter calving. The effect of age at calving and parity was very important. The lowest values of milk and fat yields were obtained for younger cows at first parity. These values tended to increase with the increase of age at calving and parity.

Milk and fat yields showed a clear tendency to decrease gradually from the beginning to the end of lactation. Differences between these two stages of lactation for milk and fat yields were 10.1 kg and 123.8 g, respectively. The peak of lactation occurred at around the 6^{th} week of lactation (54 day in milk). The same trend was reported in the literature.

Conclusions

This study is the first work on test day milk and fat yields in Moroccan dairy cattle. Results obtained confirm expected influences of environmental effects such as herd, region of production, stage of lactation, season of calving, etc. Stage of lactation was the most important factor affecting milk and fat yields. For this reason, test day milk records must be adjusted for all these environmental effects before indirect use in the actual genetic evaluation system or for direct use to implement Moroccan test day model.

Table 3. Least-square means (kilograms per day) of milk and fat yields.

Factor		Milk		Fat	
	Levels	Mean (kg)	SE	Mean (g)	SE
Season of calving	January-March	16.6	0.69	614.7	2.52
	April-June	16.3	0.68	601.8	2.48
	July-September	16.2	0.65	595.2	2.35
	October-December	17.0	0.66	629.0	2.44
Stage of lactation	DIM1	21.3	0.68	767.2	2.46
	DIM2	21.4	0.67	764.5	2.44
	DIM3	20.3	0.67	730.7	2.43
	DIM4	19.3	0.67	698.0	2.43
	DIM5	18.1	0.66	661.2	2.43
	DIM6	17.7	0.67	629.2	2.43
	DIM7	16.0	0.68	595.8	2.43
	DIM8	14.9	0.67	562.2	2.44
	DIM9	13.8	0.67	525.7	2.46
	DIM10	12.6	0.70	486.4	2.55
	DIM11	11.9	0.76	457.9	2.79
	DIM12	11.3	0.87	443.4	3.21
Parity-Class of age of calving (month)					
First lactation	20-24	14.9	1.01	556.1	3.77
	25-26	14.9	0.79	554.8	2.91
	27-28	15.1	0.74	562.6	2.71
	29-30	15.2	0.80	561.8	2.94
	31-34	15.5	0.85	576.9	3.09
	35-45	16.0	1.11	593.7	4.03
Second lactation	31-36	16.1	1.21	595.2	4.43
	37-38	16.3	0.95	604.5	3.48
	39-40	16.2	0.86	601.5	3.14
	41-42	16.5	0.86	613.3	3.13
	43-44	16.6	0.95	615.8	3.46
	45-48	17.0	0.91	631.4	3.30
	49-60	17.2	1.09	634.4	3.93
Third lactation	41-48	17.3	1.40	632.4	5.09
	49-50	17.0	1.23	618.5	4.49
	51-52	17.3	1.10	636.4	4.14
	53-54	17.2	1.13	634.0	4.14
	55-56	17.3	1.17	635.5	4.30
	57-58	17.9	1.31	658.1	4.79
	59-62	17.8	1.20	654.9	4.38
	>63	17.4	1.24	642.3	4.49

Acknowledgements

The author thanks the staff of The Genetic Improvement Service of the Ministry of Agriculture, Rabat, Morocco and Prof. Ismaï l Boujenane, Department of Animal Production, Institut Agronomique et Vétérinaire Hassan II, Rabat, Morocco who made the data available and for manuscript review. Aziz Tijani acknowledges the "Agernce universitaire de la Francophonie" for financial support to participate to the 56th annual meeting of the EAAAP.

References

Jamrozik, J. & L.R. Schaeffer, 1997. Estimates of genetic parameters for a test day model with random regression for yields traits of first lactation Holsteins. J. Dairy Sci. 80: 762-770.

Ptack, E. & L.R. Schaeffer, 1993. Use of test day yields for genetic evaluation of dairy sires and cows. Livest. Prod. Sci. 34:23-34.

Karaca, M. 1997. Determination of the sources of variation to adjust production for three times a day milking. M.Sc. Thesis. Iowa State University, Ames, Iowa.

SAS/STAT® User's Guide. Version 6, Fourth Edition, Vol. 2, 1994. SAS Inst. Inc., Cary, NC.

Strabel, T. & T. Szwaczkowski, 1995. Certain effects on test-day milk yield in dairy cows. Anim. Sci. 13 : 55-63.

Swalve, H.H., 1995. The effect of test models on the estimation of genetic parameters and breeding values for dairy yields traits. J. Dairy Sci. 78: 929-938.

Tijani, A., G.R. Wiggans, C.P. Van Tassell, J.C., Philpot & N. Gengler, 1998. Use of (co)variance functions to describe (co)variances for test day yield. J. Dairy Sci. 82: (Jan). Online.

Veerkamp, R.F. & M.E. Goddard, 1998. Covariance function across herd production levels for test day records on milk, fat, and protein yields. J. Dairy Sci. 81: 1690-1701.