Recording System and Quality of Dairy Cattle Production Data in Tunisia

A. Ben Gara[1], B. Rekik[1], M. Ben Hamouda[1], & M. Guellouz[2]
[1]Ecole Supérieure d'Agriculture de Mateur, 7030, Mateur, Tunisie.
[2]Office de l'Elevage et des Pâturages, 30 rue Alain Savary, 1002 Tunis.
Phone: 00 216 72 465 565. Fax: 00 216 72 468088. E-mail: m.b.hammouda@iresa.agrinet.tn

Abstract

Investigation of data quality was done through fitting the incomplete gamma function to lactation curves on a sample of 18053 lactations with test-day records of 7032 Holstein-Friesian cows. These cows are from four production sectors, the state herds (OTD), the cooperative herds (UCPA), the groups of private investors' herds (SMVDA), and the farmers' herds. After editing 8640 records remained. The effects of production sector, herd, parity, first test-day date, calving year, calving season, and the length of lactation on lactation curve traits were analysed. The factors associated with milk yield at the beginning of lactation and the decreasing phase of the curve, persistency, and peak yield varied significantly ($P<0.01$) with all variables. The state herds had the lowest peak and total yields. The summer season was unfavourable for milk production. Third lactation cows had the highest peak and total yields. Around 25% of the lactation curves were atypical ($a<0$ or $b<0$). Seven factors were significantly associated ($p<0.01$) with the occurrence of atypical lactations.

Key words: Lactation record, incomplete gamma, lactation curve trait, herd type.

Introduction

Breeding programmes are based on AI and on an official A4 national recording system since the early 1960's in Tunisia. In the absence of a national genetic evaluation, the rationale for a within herd breeding decision varies with the herd owner. There are four types of herds, the state herds (OTD), the cooperative herds (UCPA), the groups of private investors' herds (SMVDA), and the farmers' herds. Completed milk yield lactation records, test-day milk yield or cow milk yield index in few herds are tools for culling cows while proofs of foreign bulls are used to select sires.

A cow production during a lactation length of 305 days is subject to variation (Grossman *et al.*, 1986; Tekerli *et al.*, 2000). Various mathematical functions were used to describe lactation curves. The incomplete gamma function (IG) was relatively powerful in fitting observed daily yields (Wood, 1967; Scott *et al.*, 1996; Tekerli *et al.*, 2000; Vargas *et al.*, 2000). Fitted lactation curves are useful in orienting herd management and extending partial records. The objectives of this study are to assess production data quality and to study the factors that affect milk yield production throughout the length of lactation.

Materials and Methods

A sample of 18053 lactation records of 7032 Holstein-Friesian cows was provided by the National Center for Genetic Improvement at Sidi Thabet (OEP), Tunis. The incomplete gamma function (Wood, 1967) was used to fit lactation curves in four types of herds. An atypical lactation has either a negative b or c. Persistency, peak yield, and DIM at peak yield were calculated (Tekerli *et al.*, 2000). The effects of production sector, herd, parity, first test-day date, calving year, and calving season on the curve traits of typical curves were analysed by a general linear model. The logistic regression technique (Agresti, 1990) was used to evaluate the effects of the above factors in addition to times of milking per day on the probability of occurrence of atypical curves.

Results and Discussion

1. Lactation curves

The IG was a good fit for the mean lactation curves across cows in the four types of herds. The coefficient of determination from non linear regression ranged from 92% to 95%. Fitted mean lactation curves of first and later lactations are typical curves. Individual curves, however, revealed atypical curves. The percentage of atypical curves ranged from 15% to 42%. These curves were more frequent in the OTD and UCPA herds than in other herds. The mean absolute error ranged from 1.5 kg to 3.24 kg. Lactation curve traits show that first lactation cows produce lower yield than older cows in the beginning of the lactation and were as expected more persistent. Multiparous cows on the other hand reach their peak of production earlier in the lactation than first parity cows. Lactation curves in the four types of herds were different. Those differences were consistent in first and greater lactations. Cows in the SMVDA herds had the greatest peak yield among all cows in the different production sectors.

2. Factors affecting the shape of lactation curves

The least squares means of level effects and the coefficient of regression on DIM at first test-day are in Table 1. All factor effects were highly significant ($P< 0.01$) on a, c, peak yield, persistency, and total yield through 305 DIM. While b seems not to depend on the lactation number and the calving year. DIM at peak yield varied only with parity. The high level of significance of model effects on most of the lactation curve traits suggests major differences in management between and within production sectors and also important annual climate changes in Tunisia. Total and peak yields were the lowest for the summer season when feeding resources are limited and the heat stress effect is important. First lactation cows have the lowest total and peak yields but the highest DIM at peak and persistency. On the other hand, this data show that third parity cows have the highest total and peak yields but the lowest DIM at peak and persistency .

There were 1634 atypical lactations from a total of 6495 lactations (25.2%). Atypical curves with a negative b were frequent (68.4%). Cows in the SMVDA and farmers' herds were more likely to have typical curves than cows in other herds. In the second lactation, the probability of occurrence of atypical curves was 20% greater than the probability of observing typical curves. Atypical lactations increased with calving year and the DIM at first test-day. Cows in the SMVDA and farmers' herds are more likely to produce milk yield at their potential. Changes in rations are frequent due to the lack of roughage in the second half of the spring season. In the summer season, herd conditions are aggravated by the heat stress and resulting health disorders.

The main factors, calving year, calving season, farm operation, and rank of lactation do affect not only the total milk yield but also the rate of milk production throughout the length of lactation, i.e., the shape of the lactation curve. Frequent changes in ration's quantity and quality as well as physiological and health troubles related to harsh environmental conditions may lead to atypical lactations.

References

1. Agresti, A. 1990. *Categorical data analysis.* John Wiley and sons, Inc. New York.
2. Bar-Anan, R., Weller, J.I., Wiggans, G.R. & Osterkorn, K. 1986. Prediction of annualized lactation yield from partial lactations. *J. Dairy Sci. 69,* 1897-1903.
3. Grossman, M., Kuck, A.L. & Norton, H.W. 1986. Lactation curves of purebred and crossbred dairy cattle. *J. Dairy Sci. 69,* 195-203.
4. Scott, T.A., Yandell, B., Zepeda, L., Shaver, R.D. & Smith, T.T. 1996. Use of lactation curves for analysis of milk production data. *J. Dairy Sci. 79,* 1885-1894.
5. Tekerli, M., Akinci, Z., Dogan, I. & Ackan, A. 2000. Factors affecting the shape of lactation curves of Holstein cows from the Balikesir Province of Turkey. *J. Dairy Sci. 83,* 1381-1386.
6. Vargas, B., Koops, W.J., Herrero, M. & Van Arendonk, J.A.M. 2000. Modeling extended lactations of dairy cows. *J. Dairy Sci. 83,* 1371-1380.
7. Wood, P.D.P. 1967. Algebraic model of the lactation curve in cattle. *Nature, Lond. 216*, 64-165.

Table 1. Least square means for variable levels effects and linear regression coefficient for lactation curve[1] traits of Holstein-Friesian cows in Tunisia.

		Lactation curve[1] trait						
Variable	n	a	b	c (x10^{-3})	Peak[2]	Persistency[3]	DIMP[4]	Y_{305}
Sector:								
SMVDA	2734	19.13[a]	0.24[a]	4.36[a]	34.92[a]	6.83[a]	56.85[a]	8337[a]
OTD	954	15.15[b]	0.23[a]	4.48[a]	26.06[b]	6.75[b]	46.55[ab]	6057[b]
UCPA	400	14.09[c]	0.20[b]	3.98[b]	22.79[c]	6.74[b]	49.06[ab]	5456[c]
Farmer	773	15.40[b]	0.26[c]	4.17[b]	29.26[d]	7.00[c]	63.66[ac]	7071[d]
Parity								
1	1844	12.49[a]	0.24[a]	3.33[a]	23.73[a]	7.16[a]	75.31[a]	6192[a]
2	1346	16.17[b]	0.23[a]	4.31[b]	28.31[b]	6.77[b]	49.05[b]	6715[b]
3	916	18.13[c]	0.23[a]	4.55[c]	30.83[c]	6.68[c]	44.96[b]	7120[c]
4	755	16.93[b]	0.24[a]	4.81[d]	30.17[d]	6.71[c]	46.84[b]	6897[d]
Season								
Fall	1043	16.13[a]	0.22[a]	3.97[a]	28.11[a]	6.88[a]	56.51[a]	6790[a]
Winter	1281	15.25[b]	0.26[b]	4.50[b]	28.68[b]	6.87[a]	60.34[ab]	6771[a]
Spring	1279	16.39[a]	0.23[a]	4.40[b]	28.71[b]	6.76[b]	46.61[ac]	6769[a]
Summer	1258	15.94[a]	0.22[a]	4.12[a]	27.54[c]	6.81[c]	52.70[a]	6593[b]
DIM at first test-day		-0.18**	0.01**	0.04**	-0.04**	0.02**	0.28	3.64*

[a, b, c, d] Means of variable levels with different superscripts for each lactation curve trait are significantly different (p<0.05).

[1] Modeled as : $Y_t = a\, t^b\, e^{-ct}$, where Y_t = milk yield on day t, a= a factor to represent yield at the beginning of lactation, and b and c are factors associated with the ascending and decreasing phases of the lactation curve.

[2] Peak yield calculated as: $a(b/c)^{b} e^{-b}$.

[3] Persistency calculated as: -(b+1)*Ln (c).

[4] DIMP: DIM at peak yield calculated as: (b/c).

5

* P<0.05.

** P<0.01