SOME ENVIRONMENTAL FACTORS AFFECTING 305-DAY FIRST LACTATION MILK YIELD IN FRIESIAN IN EGYPT

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SUMMARY

A total of 816 records of Friesian cows at two farms belonging to Ministry of Agriculture, Egypt, during the period 1968-76 were used. The influence of age at first calving, farm, year and season of calving, and the three possible first order interactions between these factors on 305-day first lactation yield was investigated.

A least-squares analysis of variance of the data showed significant effect of age at first calving, year and season of calving on milk yield. Interaction of age at first calving by season of calving was important.

Although the linear regression coefficient of 305-day milk yield on age at first calving was positive and significant (18.82 $\pm$ 4.16 Kg/mo), it is desirable for economical production to decrease the age at first calving to increase the length of herdlife and to decrease the cost of rearing the heifers.

A set of multiplicative age factors was derived for 305 day milk yield in the first lactation of Friesian cattle.

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INTRODUCTION

Knowledge of the nature and influence of non-genetic factors upon milk yield provides basic information for developing breeding and general managerial programs. Selection for genetically superior sires and dams is practiced for imporvement production and reproduction traits in dairy cattle. Milk yield in the first lactation can be measured early and has a high economic value and a moderate heritability. Therefore, improvement of dairy cattle largely depends on emhasis placed upon increasing milk yield by selection as reported by many investigators, e.g. Hansen et al, (1983). To increase the accuracy of such selection, correction for the environmental factors affecting lacation records must be practiced. Standardizing milk yield for age at calving is a common practice in dairy cattle evaluation (Van Vleck and Henderson, 1961; Lee and Hickman, 1972; Lee, 1976; Norman et al . 1978, Cooper and Hargrove, 1982; and Hansen et al; 1983).

The ideal model for the investigation of age effects would include sire, farm, year and season of calving as well as their possible interactions with each other and with age. However, the unknown bulls and the limited number of observation per each sub-classes make such an analysis impractical. Statistical tests for interactions between these factors are usually not made although reports of some workers (e.g. Miller et al, 1970; and Norman et al, 1978) indicated such interaction exist.

The purpose of this study was 1. to determine the effect of farm, year and season of calving on milk yield in the first lactation, 2. to determine whether the interaction of age with season of calving is important in the first lactation, and 3. to determine the relationship between first lactation milk yield and age at first calving.

MATERIALS AND METHODS

A total of 816 2x, 305-day or less completed first lactation records of Friesian cows caving between 1968 and 1976 were used. The Friesian herd was maintained at two farms, Sakha and El-Karada, which are located in the northern part of the Nile delta.

Animals were mainly grazed on Egyptian clover, berseem, during December-May. They were fed on concentrate mixture along with wheat or rice straw and limited amounts of clover has when available during the rest of the year. Cows producing more than 10 Kg a day and those pregnant in the last two months of pregnancy were supplemented with extra concentrate ration. Heifers were first attempted for breeding at 18 mo of age using artificial insemination. Cows were hand-milked twice a day till 1972 and machine-milked thereafter

The following complete fixed model was used to study the effect of farm (f_i), year (r_j), season of calving (s_k), age at first calving (a_l) and three possible first order interactions between these factors on 305-day milk yield in the first lactation using a least squares analysis. The other interactions were ignored because of the empty cells.

$$y_{ijklm} = \mu + f_i + r_j + s_k + a_l + (fs)_{ik} + (fa)_{il} + (sa)_{kl} + e_{ijklm} \quad (i)$$

where :

Y_{ijklm} is the 305 day-2x record of the th cow in the farm who calved at the l th age in year, during the kth seasons;

u is the overall mean ;
$(fs)_{ik}$ is the interaction between the ith farm and kth season of calving;
$(fa)_{il}$ is the interaction between the ith farm and lth age at first calving class;
$(sa)_{kl}$ is the interaction between the kth season of calving and lth age at first calving class;
e_{ijklm} is a random error term assumed to be normally and independently distributed with zero mean and common variance σ^2_e .

The measurement of farm effect included two farms, Sakha and El-Karada. There were data from nine years, 1968-76. Seasonal divisions were made as follows : December through February (winter), March through May (spring), June through August (summer) and September through November (autumn). The age effect was divided into seven groups. group I included cows that calved at less than or equal 26 mo and group 2 from 27 to 29 mo of age, all other age groups followed similar pattern of 3-month intervals up to 41 mo. Age group 7 consisted of cows record at 42 to 50 mo of age.

The following model was used to calculate the slope of age curve for Friesian first lactation milk yield.

$$Y_{ijkm}=\alpha+f_i+r_j+s_k+(fs)_{ik}+B_1 x_{ijkm}+B_2 x^2_{ijkm}+e_{ijkm} \quad (ii)$$

where :

y_{ijkm} is the 305-day-2x record of ijkm th cow;
α is the intercept;
B_1, B_2 are linear and quadratic regression coefficients, respectively, of milk yield on age at first calving;
X_{ijkm} is the age at first calving of ijkm th cow ranging between 25 and 50 mo;

The other terms are defined as in the previous model.

RESULTS AND DISCUSSION

The overall mean of 305-day milk yield in the first lactation was 2430± 37 kg (Table 1). The present mean was slightly higher than that estimated by Ragab et al, (1973) which was 2304 ± 18 kg using another herd of Friesian cattle at Tahrir province, Egypt. The average age at first calving was 31.6 ± 0.2 mo. The estimate of 33.5 mo was reported by Mohamed et al . (1985).

The least squares analysis of variance(Table 1) revealed that 305-day milk yield was significantly ($P < .01$) influenced by age at first calving.Similar results were reported by many investigators, e.g. Barrada et al . (1969), Miller et al (1970), lee and Hickman (1972), Lee (1974) and Ashmawy and Mokhtar (1984). In heifers calving at age up to 35 mo, a curvilinear relationship was observed between first lactation yield and age at first calving.The youngest first calvers (⩽ 26 month of age) produced the lowest yield, while the oldest ones (> 42 mo) produced the highest yield. A one year increase in age at first calving from 30 to 42 mo of age, resulted in a highly significant increase in milk yield (427-66 = 361 kg, Table 1). However, it is not justified to bring heifers into calving at an unduly late age although their first milk yield will increase because this will result in decreasing the longevity (Ashmawy,1985), and increasing the cost of rearing the heifers (Hoque and Hodges,1980). Gill and Allaire (1976) showed that early first calvers were more economical producers than late calvers as they compensated low initial yield in their longer productive life.

To test the significance of curvilinearity relationship between age at first calving and milk yield in the first lactation, a polynomial ofsecond degree (model 'ii') was used and yielded a non-significant partial quadratic regression coefficient. The linear regression coefficient of 305-day milk on age at first calving was positive and highly significant (18.82 ± 4.16 Kg milk/mo of age). Therefore, the relationship between milk yield in the first lacatation and age at calving could be considered as linear, Hansen et al. (1983) came to the same conclusion. Lee and Hickman (1972) found that the best fitted age curve for canadian Holstein first lactation milk yield would have a slope of about 55 kg of 305-day milk yield per month of age. This high estimate is due to the high mean of milk yield in their study as compared to the low mean in the present work. In contrast, Ashmawy and Mokhtar (1984) found a curvilinear relationship between 305-day milk yield and age at first calving in British Friesian cows.

The present results also revealed that among heifers, nearly 78 % calved at 27-35 mo of age class whereas only 22 % calves below or above this age. Excluding 2.8 % of heifers that calved at age more than 41 mo, the highest milk yield was detected in heifers calving at 30-32 mo of age. This could be considered the desirable range of age at first calving for Friesian under the Egyptian conditions. Improving managerial conditions for friesian heifers in Egypt to accelerate growth rate with more careful heat detection and breeding at a convenient young age is advisable to decrease age at first calving. Calving at younger ages resulted in a significant decrease in first lactation milk. probably because of immaturity of body size and udder. Rao and Nagarcenkar (1980) reported that an increase in age at first calving resulted in increased weight at first calving up to the age of 42 mo, and the first lactation yield increased as the weight at first calving increased generally up to 370-400 kg in Friesian crosses.

Table 1 shows that 305-day milk yield significantly ($P < .01$) influenced by the year of calving. However, there was no apparent trend in this trait (Table 1). The effect of farm on 305-day milk yield was not significant. The expected nonsignificant effect of farm is due to the similarity of climatic conditions and managerial system followed in both farms. Analysis of variance also revealed that 305-day milk yield was significantly influenced by season of calving (Table 1). Seasonal effects are regional in nature and, thus, correction for their effects on lactation milk yield would be specific for that region. Other recent studies showing the effect of season are those reported by Cooper and Hargrove (1982) for Holstein cattle and by Norman et al. (1978) for five dairy breeds. Higher values for yield were found for autumn than those in other seasons (Table 1). Bereskin and Freeman (1965), and Tucker and Legates (1965) reported that yields of lactation initiated in fall and winter months are larger than amounts produced by cows calving in other seasons.

It seems that nutritional causes might be responsible for such difference observed in 305-day milk yield since cows calving in autumn (September-November) get berseem (December-May) throughtout their lactation period and they start and continue their lactation in mild climate conditions. A decrease in milk production observed in the present study during spring and summer may be also due to a decreased feed intake. Bianca (1965) cited that feed consumption in lactation Holstein cows began to decline at 21°C, be depressed by 20 % at 32°C, and virtually stopped at 40°C environmental temperature.

The three first order interactions estimated in the present study except the interaction of age at first calving and season of calving appear to be unimportant as can be noted from Table 1. Maximum milk production is achieved by autumn calving at ages up to the six class of age, 39-41 mo of age (Figure 1). It seems that lactation curves for a specific age differ from season to season. Miller et al. (1970) found a significant interaction between age and month of calving. They also indicated that comparisons of individual records and bull proffs could be badly biased if no adjustments were made for interaction. The same results were obtained by Norman et al . (1978) for Guernsey, Holstein and Jersey cattles but they found that the coefficient of determination, R^2, was raised from only 0.2 to 0.5 % beyond that accounted for by the main effects (Herd, Year, age, and month of calving).

The information about the interactions is needed to eliminate or to account effectively for nongenetic differences between cows in selection (Van Vleck and Henderson, 1961; Miller et al., 1970 and Cooper and Hargrove, 1982). Therefore, it is desirable to adjust 305-day milk yield for age at first calving, season of calving and their interaction Simultaneously.

A set of multiplicative age factors in the first parity was developed utilizing the season of calving, age at calving and their interaction (Table 2). This was calculated by :

Age factor = $\frac{\hat{A}_i}{\hat{A}_{i}'}$ where $\hat{A}_i$ is the highest least-squares subclass mean and $\hat{A}_i'$ is the ith subclass mean. This is essentially the ratio of least-squares subclass means relative to the peak of the production subclass_

However,analysis of a larger data when available should give more reliable factors.

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Table (1): Least squares estimates of effects and standard errors (S.E.) of different factors affecting 305-day milk yield of Friesian cows in their first lactation.[a]

Classification	No.	Estimate, Kg	S.E., Kg
Overall mean	816	2430	37
Farm		NS[b]	
Sakha	677	6	35
El-Karada	139	-6	35
Season of calving		** b	
Winter	286	-10	45
Spring	181	-71	54
Summer	201	-27	52
Autumn	148	109	33
Year of calving		**b	
1968	88	-695	82
1969	107	78	79
1970	93	53	79
1971	123	-290	71
1972	115	-269	74
1973	73	131	86
1974	98	164	79
1975	53	299	101
1976	66	529	53
Age at first calving		**b	
≤ 26 mo	40	-354	115
27-29 mo	232	-118	61
30-32 mo	259	66	58
33-35 mo	145	- 94	68
36-38 mo	77	24	86
39-41 mo	40	48	114
> 42 mo	23	427	86
Residual (σ_e)	--	457	--

a) The interaction of age at first calving was significant.

b) Indicating the statistical significance of the classification as a source of variation, NS: not significant, *P<.05, and ** P<.01.

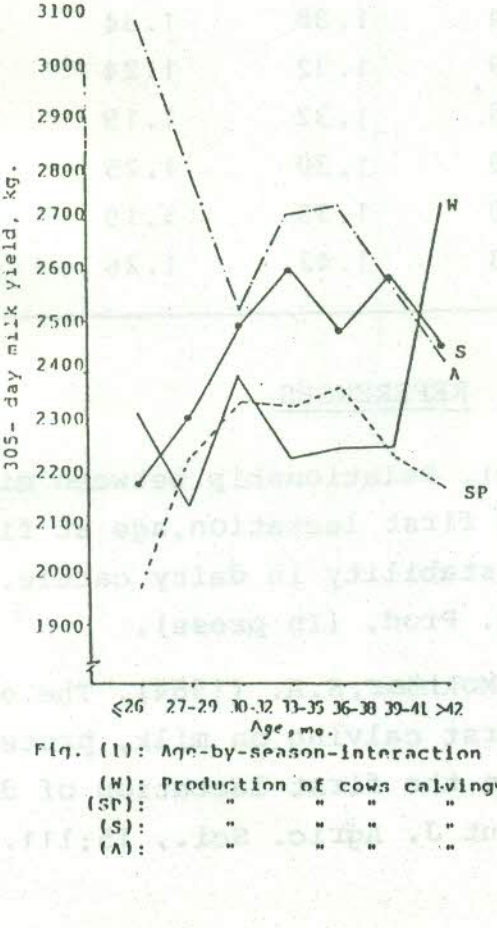

Fig. (1): Age-by-season-interaction

(W): Production of cows calving in winter.
(SP): " " " " " spring
(S): " " " " " summer
(A): " " " " " autumn

Table (2): Multiplicative age correction factors within the first lactation of Friesian cattle

Age at first calving, mo	Season of calving			
	Winter	Spring	Summer	Autumn
≤ 26	1.33	1.56	1.41	1.00
27 - 29	1.44	1.38	1.34	1.40
30 - 32	1.29	1.32	1.24	1.22
33 - 35	1.38	1.32	1.19	1.14
36 - 38	1.19	1.30	1.25	1.14
39 - 41	1.20	1.39	1.19	1.20
> 42	1.13	1.42	1.26	1.28

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" الملخــص العربى "

بعض العوامل البيئية التى تؤثــر على الانتاج فى ٣٠٥ يوما فـى الموسم الاول فى ماشــيه الفريزيان فى مصــر ..

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استخدم فى هذا البحث عدد (٨١٦) سجلا من الابقار الفريزيــان من محطتى سخا والقرضا التابعتين لوزاره الزراعه (مصــر) فــى الفتره من ٦٨ – ١٩٧٦ لدراسه تأثيــر العمر عند أول ولاده ، المزرعه كل من سنه وموســم الوضع ، والتداخل بين هذه العوامل علــى الانتاج فــى ٣٠٥ يومــا .

بينت طريقه المربعات الدنيا ان تأثير كل من العمر عنــد أول ولاده ، وسنه ، وموسم الوضع كان معنوى وكذلك التداخــل بين العمر عند أول ولاده وموسم الوضع كان ذو أهميــه .

على الرغم من أن معامل انحدار الانتاج فى (٣٠٥) يوما علــى العمر عند اول ولاده كان موجب ومعنوى (١٨٫٨٢ – ١٦٫٤ كجم / شهــر) الا انه من المناسب اقتصاديا خفض العمر عند أول ولاده لزياده طو ل فتره الحياه الانتاجيه وكذلك خفض تكاليف الرعايه للعجلات .

كما اشتقت مجموعه من معاملات تعديل الانتاج فى (٣٠٥) يومــا فى الموسم الاول للعمر فى ماشــيه الفريزيان .

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