J. Agric. Sci. Mansoura Univ., 31 (6): 3407- 3414, 2006

DAIRY PERFORMANCE CHARACTERISTICS OF HOLSTEIN AND ITS CROSSES WITH EUROPEAN FRIESIAN IN A LARGE COMMERCIAL HERD IN EGYPT

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ABSTRACT

The present study aimed at testing the effect of using Holstein germ plasm to improve productivity and longevity of European Friesian in Egypt. This was conducted by comparing performance of the crossbreds of Holstein x Friesian (HF) with that of their purebred Holstein (H) mates.

Data used comprised 1852 and 2504 lactation recods of 425 Holstein (H) and 500 Holstein X Friesian (HF) cows. All cows were sired by a common pool of 209 Holstein bulls. Data were collected over the period from 1991 to 2000 and were analysed by General Linear Models (SAS, 1996) and Mixed model (Harvey, 1990).

Least squares means for 305-day milk yield, lactation period, calving interval were 7438 kg, 336 and 429 day for Holsteins and 6119Kg, 303 and 390 day for Holstein Friesian, in respective order . Genetic differences were highly significant for sire (P<0.0001) and nonsignificant between the two genotypes in all traits except for CI (P<0.0336). Parity exerted significant effect on the three traits (P< 0.0001-0.0003). The 305 dMY increased significantly from the 1st to the 2nd lactation and tended to decrease thenafter.

Indicators of longevity (number of completed lactations, herd life and productive life) and productivity (annualized milk yield and milk per day of cow age) showed no significant differences between the two studied genotypes (H and HxF). The results refer to the feasibility of upgrading productivity of cows with European Friesian genetic background by using pure Holstein semen .

Keywords: Holstein, Friesian, milk production, calving interval, longevity, productivity.

INTRODUCTION

Friesian Cattle imported to Egypt from Europe faced different genetic and physiological problems. Lowered production of milk, retarded growth and delayed sexual maturity were detected in the successive generations. Inbreeding depression and stress of adverse environment were considered the main reasons (Nigm, 1990). Using Holstein semen was suggested to upgrade genetic potential and consequently productivity of progeny of the European Friesian herds kept in Egypt for a long time. The hypothesis was that productivity and longevity of Holstein Friesian (the crossbred HF) would be improved with no marked differences from the purebred Holsteins.

The objective of the present study was to compare milk production, calving interval, productivity and longevity traits in pure bred Holstein (H) with corresponding estimates of Holstein Friesian (HF) cows maintained at a large commercial herd in Egypt.

MATERIALS AND METHODS

The present study was carried out at the commercial farm belonging to the International Company for Animal Wealth, located at Abou-Rawash, about 28 Km northern west of Cairo, during the period from September 1991 to March 2000. The data comprised 425 Holstein purebred Holstein (H), and 500 crossbred Holstein X Friesian (HF) mates. All cows of both groups were sired by the frozen semen of a common pool of 209 Holstein bulls. The Holstein frozen semen used was imported from the United States and Canada.

Animals

Animals used were classified according to genotype to: (1) 425 pure bred Holstein (H) which were imported as pregnant heifers in 1991. All were registered in the American Holstein Association; (2) 500 crossbred Holstein Friesian mates, HF (offspring of European Friesian dams and Holstein bulls).

Herd Management

Animals were housed in open sheds. American and Canadian semen was used in A.I. Feed requirements were offered according to N.R.C. (1988). Egyptian clover was available from Nov. to May. Alfa alfa or daraw in addition to whole corn silage were offered from June to October. Rice straw and concentrate mixture (16% protein) were available all the year round. Drinking water was available all the day. Animals were milked three times daily using Herringbone (4x8) parlours.

The herd is a member in the milk recording system operated by Cattle Information System Egypt (CISE) of Cairo University.

Data

A total number of 4356 normal lactation record, classified as follows, were used:

Genotype	Parity					Total
	1	2	3	4	5	
H	797	515	315	159	66	1852
HF	1243	705	334	156	66	2504
Total	2040	1220	649	315	132	4356

Traits

Traits studied were selected to cover aspects of production, reproduction, longevity and productivity. These included milk production in 305 day (305-dMY), lactation period (LP); calving interval (CI); number of completed lactations (NCL); herd life (HL) defined as the period elapsed from birth to drying off date of last lactation (in month); productive life (PL, month) defined as the period elapsed from first calving to the last drying off date . Indicators of productivity used were : annualized milk yield (AMY,Kg) calculated as : (total milk yield divided by CI)x365; and milk produced in day of cow age (M/dCA, Kg/ day) calculated as : cumulative milk produced up to the end of lactation divided by cow age , in days, at the end of lactation .

Statistical analysis

Analyses of variance were performed using the General Linear Models (GLM) procedure of SAS (SAS, 1996) and the mixed model computer software (Harvey, 1990).

The following mixed model was used to analyze milk production traits, including 305-day milk yield (305 dMY), lactation period (LP), and annualized milk yield (AMY).

$$Y_{ijklmno} = \mu + s_i + G_j + C_k + Y_1 + P_m + (GxP)_n + b\,(X_{ijklmno} - \bar{x}) + e_{ijklmno}$$

Where:

$Y_{ijklmno}$ = The observation of production trait,

μ

si = the random effect of the i th sire, I = 1, 2, ..., 209,

Gj = the fixed effect of the j^{th} genotype, j= 1, 2, where 1= pure Holstein (H) and **2** = Holstein x Friesian (HF) ,

C_k = the fixed effect of the k^{th} season of calving k= 1, 2, where, 1 = cold season (December – May) and 2 = Hot season (June – November),

Y_1 = the fixed effect of the 1th year of calving, 1= 1,2, ..., 10,

P_m = the fixed effect of the m^{th} parity, m = 1, 2,....., 5,

$(GxP)_n$ = the interaction between genotype and parity ,

b = the linear regression coefficient of the trait on age at calving in months,

X ijklmno = the age at calving of the 0^{th} observation on the n^{th} animal in the m^{th} parity m 1^{th} year of calving, K^{th} season of calving and j^{th} breed,

$\bar{X}$ = the overall mean of age at calving.

$e_{ijklmno}$ = the error term .

A Second model was used to analize longevity traits (NCL, HL and PL). Parity and interaction of genotype x parity were dropped and traits were regressed on AFC. Milk / day of cow age was analysed using a model with components of sire, genotype, season and year of calving and regression on AFC.

RESULTS AND DISCUSSION

Least squares means and standard errors of 305-day milk yield (305-dMY), lactation period (LP) and calving interval (CI) are presented in table 1. The difference in 305-dMY between pure Holstein (H) and their crosses with European Friesian (HF) did not reach statistical significance (P<0.1682, table 2). The same trend was observed in LP. Pure Holsteins scored longer CI (P<0.0336).

The average 305-dMY of Holstein (7438 kg) lies within estimates found in the literature for the same breed in Egypt (Abdel Salam (2000, 7128 Kg); Fahim (2004, 7336 Kg); Salem *et al.* (2006, 9038 Kg) and Al-Hammad (2005, 10847Kg). Sire proved to be a significant source of variation on the three traits (P< 0.0001). This finding may refer to the importance of this factor in improving the three traits. Season of calving exerted significant effect on 305-dMY (P< 0.0008), LP (P<0.0001) and CI (P<0.0001). Cool season (Dec.-May) scored higher 305 dMY and longer LP. Cool season calvers, however, scored longer CI.

Table (1): Least squares means[1] (X) and standard errors (SE) of 305-day milk yield (305-dMY), lactation period (LP) and calving interval (CI) of Holstein and Holstein X Friesian cows .

		305d MY (Kg)		LP (day)		CI (day)	
	N	X	SE	X	SE	X	SE
Overall mean	4356	6971	21.8	356	1.20	453	1.47
Genotype :							
HF	2504	6119	89.4	303	4.94	390^{b}	6.06
H	1852	7438	91.1	336	5.03	429^{a}	6.17
Season of calving :							
1 (Dec. – May)	2130	6850^{a}	84.7	326^{a}	4.67	420^{a}	5.74
2 (June-Nov.)	2226	6707^{b}	87.3	313^{b}	4.82	399^{b}	5.92
Parity :							
1	2040	7009^{b}	80.1	389^{a}	2.42	480^{a}	5.43
2	1220	7148^{a}	69.6	345^{b}	2.73	440^{b}	3.35
3	649	7063^{b}	98.5	312^{bc}	5.44	403^{bc}	6.68
4	315	6555^{b}	166.1	285^{bc}	9.16	376^{bc}	11.25
5	132	6118^{b}	240.6	268^{c}	13.28	349^{c}	16.31

HF = Holstein X Friesian cows ; H = Holstein cows .
[1]Within each column, means followed by different letters differ significantly from each other at P< 0.05.

Table (2): Analysis of variance of 305-day milk yield (305- d MY), lactation period (LP) and calving interval (CI) of Holstein and Holstein X Friesian cows .

Source of variance	df	Traits					
		305-dMY		LP		CI	
		MS ($x10^6$)	*P*	MS ($x10^3$)	*P*	MS ($X10^3$)	*P*
Sire	208	4.60	0.0001	10.1	0.0001	14.1	0.0001
Genotype(G)	1	3.7	0.1682	9.5	0.2115	41.6	0.0336
Season of calving	1	2.2	0.0008	142.3	0.0001	361.7	0.0001
Year of calving	9	4.4	0.0153	21.9	0.0002	44.6	0.0001
Parity (P)	4	30.4	0.0001	82.1	0.0001	49.7	0.0003
G X P	4	7.2	0.0052	9.2	0.1944	10.5	0.3385
Reg. on A C	1	36.8	0.0001	14.8	0.1185	18.6	0.1551
Residual	2127	1.9		6.1		9.2	

MS = mean squares ; P= level of significance ; A C = Age at calving .

Parity, also, showed significant effect (P< 0.0001-P< 0.0003) on the three traits. The 305-dMY scored the highest estimate in the 2[nd] lactation and tended to decline progressively thenafter. This decline previously reported by

Abdel Salam (2000) draws the attention to the need for further research to clarify the cause (s) of this rapid decline. It is well established that increase in milk production with advance in parity continues till the 3rd or 4th parity in temperate areas.

LP scored the highest estimates in the 1st lactation (389 day) which was higher than LP in the subsequent lactations, the 5th parity class scored significantly the shortest period. To a great extent, the trend of change was almost similar in both 305-dMY and LP.

The observed decline in 305-dMY starting from the 3rd lactation leads one to speculate about longevity of Holstein and its crosses with Friesian. Table 3 presents least squares means of number of complete lactations (NCL), herd life (HL), and productive life (PL) .Genotype (H or HF) showed no significant effect on any of the longevity traits studied while sire ($P < 0.0001$), season and year of calving ($P < 0.0333$-$P < 0.0001$) affected significantly all traits (table 4) .

Table (3): Least squares means[1] (X) and standard errors (SE) for number of complete lactations (NCL) , herd life (HL), and productive life (PL) of Holstein and Holstein X Friesian cows.

		NCL		HL (mo.)		PL (mo.)	
	N	X	SE	X	SE	X	SE
Overall mean	2203	2.12	0.02	56.6	0.31	28.5	0.31
Genotype (G)							
HF	1326	2.33	0.03	59.3	0.45	30.72	0.45
H	877	2.06	0.04	56.6	0.56	29.13	0.56
Season of calving :							
1(Dec.-May)	1263	2.12	0.03	56.9	0.44	29.21	0.44
2(June-Nov.)	940	2.26	0.04	58.9	0.52	30.63	0.52

HF = Holstein – Friesian cows ; H= Holstein cows .
[1]Within each column, means followed by different letters differ significantly from each other at $P < 0.05$.

Table (4): Analysis of varfance for number of complete lactations (NCL), herd life (HL.), and productive life (PL) of Holstein and Holstein X Friesian cows .

Source of variance		NCL		HL		PL	
	df	MS	P	MS	P	MS	P
Sire	207	2	0.0001	375	0.0001	388	0.0001
Genotype	1	1	0.2372	404	0.1473	218	0.2865
Season of calving	1	5	0.0220	1673	0.0032	867	0.0338
Year of calving	8	3	0.0011	1513	0.0001	944	0.0001
Reg. on AFC	1	1	0.9916	400	0.1494	4	0.8872
Residual	1984	1		192		192	

M = mean squares; P= level of significance ; AFC = Age at first calving .

Feasibility of a dairy practice may be based on production intensity in a fixed period of time. Annualized milk yield (AMY) was used together with milk per day of cow age (M/dCA) to compare productivity of pure Holsteins and the mates from their crosses with Europen Friesian (table 5). Analyses of variances of the two traits are presented in (table 6). Again, genotypic differences between pure H and HF were nonsignificant in both AMY and M/dCA. Nigm (1990) explained that breeding of the foundation closed herds of Friesian dams used to produce locally born Friesians depended for a long period on semen from farm produced bulls . This practice may have caused some inbreeding depression. Holstein semen has been successfully used to enhance milk production of the Holstein sired offspring. This enhancement was due to two reason: (1) the direct effect of the straight dairy breeding of Holstein, and (2) : the heterotic effect on dairy performance . These findings were supported by Jasicrowski *et al.*. (1988) in their trial to use ten strains of friesian to improve performance of polish Friesian.

Table (5): Least squares means[1] (X) and standard errors (SE) for annualized milk yield (AMY) and milk per day of cow age (M/dCA) of Holstein and Holstein Friesian cows.

	AMY (Kg)			M/dCA (Kg)		
	N	X	SE	N	X	SE
Overall mean	4356	6289	24.0	2203	8.672	0.575
Genotype :						
HF	2504	5768	98.9	1326	8.147	0.835
H	1852	6846	100.7	877	9.658	0.1048
Season of calving :						
1 (Dec. – May)	2130	6291	93.6	1263	8.932	0.812
2 (June-Nov.)	2226	6323	96.5	940	8.873	0.972
Parity :						
1	2040	6377[b]	88.5			
2	1220	6471[a]	54.6			
3	649	6512[a]	109.0			
4	315	6164[ab]	183.6			
5	132	6011[ab]	266.0			

HF= Holstein – Friesian cows ; H= Holstein cows .
[1]Within each column, means followed by different letters differ significantly from each other at $P< 0.05$.

Table (6) : Analysis of variance for annualized milk yield (AMY) and milk per day of cow age (M/dCA)of Holstein and Holstein Friesian cows .

Source of variance	AMY			M/dCA		
	df	MS($x10^5$)	*P*	d.f.	M.S.	*P*
Sire	208	5.200	0.0001	207	12	0.0001
Genotype (G)	1	0.202	0.7497	1	6	0.3402
Season of calving	1	0.001	0.9807	1	8	0.2709
Year of calving	9	6.977	0.0019	8	28	0.0001
Parity (P)	4	8.076	0.0090	--	--	--
G X P	4	27.900	0.0001	--	--	--
Reg. on A C	1	26.298	0.0009	1*	20*	0.0879*
Residual	2127	2.384		1984	7	

MS = mean squares ; P= level of significance ; AC = Age at calving ; * = for age at 1st calving .

These findings may refer to the feasibility of improving European Friesians kept in Egypt, since the crosses with Holstein (HF) stand on equal footings with pure Holstein.

Conclusion

Use of Holstein germ plasm on Friesian dams from European origin yielded genetically potential dairy cows with performance very comparable to pure Holstein in aspects of productivity and longevity.

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خصائص إنتاج اللبن لأبقار الهولشتين وهجنها مع الفريزيان الأوروبى فى قطيع تجارى كبير فى مصر

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إستهدفت الدراسة بحث تأثير إستخدام الهولشتين فى تحسين إنتاجية وتعمير الفريزيان الأوروبى فى مصر بمقارنة أداء نسل الفريزيان الملقح من هولشتين (HF) مع أداء الهولشتين النقى (H) .

إستخدم فى الدراسة ١٨٥٢ و ٢٥٠٤ سجلا من ٤٢٥ بقرة هولشتين نقية (H) و ٥٠٠ بقرة هولشتين x فريزيان (HF) . نتجت هذه الأبقار جميعا من أباء هولشتين نقية (٢٠٩ طلوقة).

جُمعت البيانات خلال الفترة من ١٩٩١ حتى عام ٢٠٠٠ وحللت ببرامج الحاسب (SAS,1996) والنموذج المختلط (Harvey,1990) .

كانت متوسطات الحد الأدنى للمربعات (LSM) لصفات إنتاج اللبن فى ٣٠٥ يوم ، فترة الحلب ، والفترة بين ولادتين : ٧٤٣٨ كجم ، ٣٣٦ ، ٤٢٩ يوما للهولشتين النقى و ٦١١٩ كجم ، ٣٠٣ ، ٣٩٠ يوما للهولشتين فريزيان (على الترتيب) . كانت تأثيرات الطلوقة عالية المعنوية (P<0.0001)على جميع الصفات بينما كانت غير معنوية بين الهولشتين النقى والهولشتين فريزيان إلا فى طول الفترة بين ولادتين(P< 0.0336) . أثر ترتيب الولادة معنويا على الصفات الثلاث حيث زاد الإنتاج فى الموسم الثانى ثم إنخفض بعد ذلك فى المواسم التالية .

أوضحت مقاييس تعمير الحيوان (عند مواسم الحلب ، طول حياة التقطيع وطول الحياة الإنتاجية ، وكذلك مقاييس الكفاءة الإنتاجية (إنتاج اللبن خلال سنة وكمية اللبن المنتجة فى اليوم الواحد من حياة البقرة) عدم وجود فروق معنوية بين الهولشتين النقى وبين الهولشتين الخليط مع الفريزيان . تشير النتائج إلى جدوى إستخدام السائل المنوى المجمد للهولشتين النقى لتحسين إنتاجية نسل أبقار الفريزيان المنحدرة من أصل أوروبى فى مصر .