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PERFORMANCE OF HOLSTEIN FRIESIAN CATTLE UNDER STRESSFUL CONDITIONS AT GOHT AL-SULTAN FARM, LIBYA

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ABSTRACT

In the present study, the productive and reproductive performance of German Holstein Friesian dairy cows and subsequent generations born in Libya were evaluated. The number of cows that had the first lactation record included in the study was 2094. Data were analyzed using REML to estimate factors affecting milk yield and reproductive traits. The model included: month, year of calving, management, generation, origin of sire as fixed effects and sire as random effect. In addition, age at first calving and lactation period included for milk yield traits as a covariate. Total milk yield was generally high (8409 Liters) and achieved with reproductive efficiency (110 days open) during Dutch management, and at the expense of the reproductive traits (161 days open) during Libyan Management. Management, calving year, calving month, age at first calving and lactation period had a significant effect on both milk yield and reproductive traits. In addition, milk yield and days open were affected by the Temperature Humidity Index (THI). A different trend of milk yield and days open was found during cold and hot seasons. However, Days open were more affected by the increased THI than high milk yield. Management plays important role to maintain high productivity with reproductive efficiency under heat stress conditions. .

Keywords: Holstein Friesian, Milk yield and Reproductive traits, THI.

INTRODUCTION

The biologic nature of lactation makes the total milk production submissive to many environmental effects. And because of genetic differences among cows of the same strain, different responses are expected to occur among these cows in particular environment (Freez, and Richards, 1992). Ultimately, changing environment for imported cows from Germany to Ghot Al-Sultan station in Libya makes them under stress that result from high temperatures during summer season, plus other environmental factors. These stresses are reflected in the productive and reproductive performance of these imported dairy cows. Therefore, conducting detailed studies on the performance levels and studies on environmental effects and their nature on the production of these cows, represent, the basis for future breeding plans, aimed to maintain and improve the genetic makeup. The project at Ghot Al-Sultan station was managed by the Dutch company for five years commencing 1986. It was by then, under the Libyan management.

Several investigators conducted detailed studies on the productive traits of these Friesian dairy cows in Libya (Ahmed *et al.*, 1996, Salhab *et al.*, 1996, Zaied *et al.*, 1995, Zaied *et al.*, 1996. None of these studies investigated the effect of stressful factors on productive and reproductive

traits and relate them to each other. Therefore, the objectives of this study were to evaluate the productive and reproductive traits of imported Holstein Friesian and relate them to each other and to THI.

MATERIALS AND METHODS

Description and source of Data

Data were collected from records of Holsteins Friesian dairy cattle at Ghot-al-Sultan farm. The farm is situated some thirty five kilometers south-east BENGHAZI, and about three hundred meters above the sea level. It is between 32 and 21 longitudinal line. The temperature is between 06°C to 17°C in winter and 18°C to 33°C in summer. The annual rainfall ranges between 200 to 400 mm.

The pregnant heifers were imported from Germany in 1986 and, since then, the replacements were chosen from the same herd. Artificial insemination was carried out by using imported semen from Germany, Holland and sometimes from local selected bulls. The data included two thousands and ninety six records of productive and reproductive traits at first lactation. The number of sires was sixty nine.

The production system in the farm was semi-open. Cows were fed concentrate seven times a day, three at milking parlor on average of 1kg per two liters milk. Dry cows were treated as if 10 liters of milk were produced. Roughage was also provided as 10kg per cow per day in a four times interval. In addition, green pasture was given instead of dry roughages only in spring season at ratio of 2:3 dry matters.

Traits included in the study are:

Actual total milk yield, 305-days M.E. milk yield, 100-day milk yield, dry period, lactation period, age at first calving, days open, calving intervals and Temperature Humidity Index (THI)

Statistical Analysis

Factors studied include: Month of calving, Year of calving, management and generation as fixed effects and the sire effect used as random effect. We use STATISTICA® (2004) software for the analysis of variance component and covariance. The general model to study the traits was:

$$Y_{ijklm} = \mu + S_i + R_j + D_k + O_l + B_m + G_1 + G_2 + e_{ijklm}$$

Where:

Y = the trait studied (milk yield traits or reproductive traits), μ = the overall mean, S = the effect of the i^{th} month of calving (fixed), R = the effect of the j^{th} year of calving (fixed), D = the effect of the k^{th} management (fixed.), O = the effect of the l^{th} generation (fixed), B = the effect of the m^{th} sire (random), G_1 = the regression coefficients of milk yield on lactation period, G_2 = the regression coefficients of milk yield on age at calving and e_{ijklm} = the residual error.

RESULTS

Mean and Variations

Mean , standard deviations and coefficients of variation for milk yield and reproductive traits for Ghot–AL–Sultan herd are presented in Table (1) . The variability in total production 3x was higher than those

adjusted yield traits as indicated by standard deviation and coefficient of variation. Reproductive traits were highly variable as indicated by the standard deviations and coefficient of variations . The higher variability was found in dry period (138.02%), calving interval (27.10%) and days open (81.64%). The variability of age at first calving was the lowest among the reproductive traits . The coefficients of variation for age at first calving were (8.3 %) compared with calving interval (27.10 %) and days open (81.64 %) .

Table 1: Overall means and variation for milk yield and reproductive traits.

Traits	Mean ± SD	C.V
Yield 100 days ADJ	2322 ± 370	15.92
Yield 305 days M.E	9192 ± 1272	13.84
Total production 3x	8409 ± 2627	31.24
Dry period	81 ± 111	138.02
Lactation period	336 ± 96	28.57
Calving interval	417 ± 113	27.10
Days open	138 ± 113	81.64
Age at first calving	28 ± 2.3	8.30

Management

There are significant differences ($p<0.05$) between Dutch management and Libyan management in all productive and reproductive traits Table 2 . During Dutch management , all productive traits were higher than those in Libyan management , except total production 3x where it is higher in Libyan management . It must be mentioned here that higher total production during Libyan management 8724 L was accompanied by longer lactation period (354 day) compared with (314 day) during Dutch management which very close to standard 305 day. Calving interval and days open were significantly different ($p<0.001$) between Dutch management and Libyan management. Calving interval and days open were higher during Libyan management than Dutch management .

Table 2: Means and standard deviation and coefficient of variation for productive and reproductive traits

Traits	Dutch Management			Libyan Management		
	Mean ±	SD	C.V	Mean ±	SD	C.V
No. of cows		811			993	
Yield 100 days ADJ	2375±	375[a]	15.80	2279±	360[b]	15.78
Yield 305 days M.E	9388±	1362[a]	14.51	9031±	1170[b]	12.96
Total production 3x	8024±	2412[a]	30.06	8724±	2751[b]	31.54
Dry period	75±	56[a]	75.53	86±	141[b]	164.79
Lactation period	314±	80[a]	25.48	354±	104[b]	29.38
Calving interval	389±	61[a]	15.62	440±	137[b]	31.22
Days open	110±	61[a]	55.31	161±	137[b]	85.33
Age at calving	30±	2.8[a]	9.86	27±	1.9[b]	6.72

THI and Milk Yield, Days open

Generally, there was an inverse relationship between milk yield and THI. Fig.1. This means that, during the months May to October, Milk yield was decreased along with an increase in the THI.

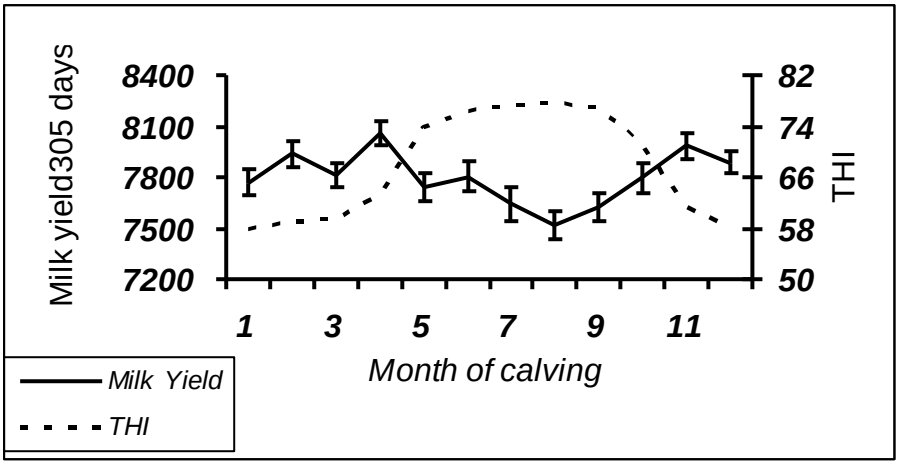

Figure 1: Means and standard error of milk yield with THI through month of calving

Fig 2. shows that there is a direct relationship between the days open and THI, indicating that as THI was increased, the days open were also increased.

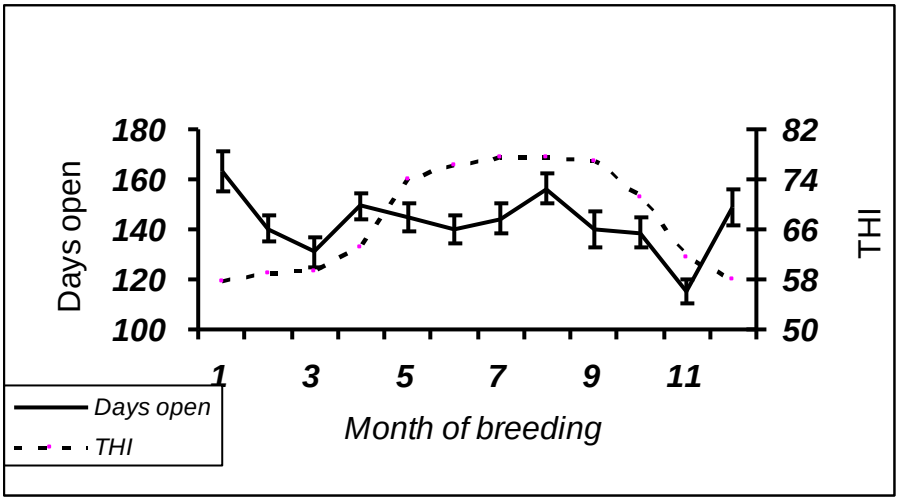

Figure 2. Means and standard error of days open with THI through month of breeding

Fig 3. In this figure, both milk yield and days open were increased during the cold season (November to April). However, during hot season (May to October), milk yield was decreased along with an increase in the days open.

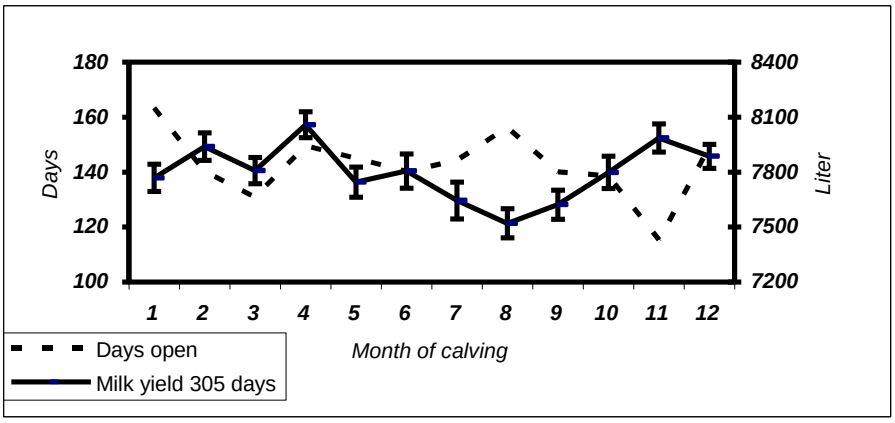

Figure 3. Milk yield and Days Open through month of calving

DISCUSSION

Variability in total milk yield 3x was reduced from 31.24% to 13.84% yield 305 day M.E., as indicated by coefficient of variations Table 1. This, may reflect, the effect of adjustment factors to remove variability, as a result of environmental factors such as, age at calving, month of calving and lactation period.

Despite, the variations in milking interval from 3x in Ghot al sultan herd to 2x in aljalla herd, and the exposure of the two herd to a different region and management, a high total milk yield (9192 L) was obtained. This is in agreement with Boettcher, *et al.*, (2001), and may indicate, a possibility to achieve a high milk yield under Libyan environment, despite stressful enviromental factors i.e., high temperature, shortage of green pasture etc. Means for lactation period, dry period calving interval and days open were generally high: 336 days, 81 days, 417 days, and 138 days respectively. These mean values were higher when compared with the results obtained by Tawfik, *et al.*, (2000), Atil, (1999), and Sanjabi, (2000). But, lower if compared with Ahmed, *et al.*, (1996), Moeini and Sanjabi, (2000), Negash, 2001, and Quintana, *et al.*, (1998), and in agreement with Sultan, (1991), Miller, *et al.*, (2002), and Vaccaro, *et al.*, (1999). Mean for age at first calving (28 month) was high compared with results obtained by Dobos, et al (2001), but in agreement, with Fujita, *et al.*, (2002), and lower compared with results obtained by Meini and sanjabi (2000), and Negash (2001) .

The coefficient of variation for the dry period, CI and days open were highly variable. These were 138.02%, 27.1% and 81.64% respectively, and may all reflect, the effect of environmental factors on these traits, beside, the antagonism between high milk yield and reproductive traits.

Actual milk production was affected by both Dutch and Libyan management Table 2. Despite, the differences occurring in early lactation or when they are at a peak of milk production, a high total milk yield was obtained. During the years 1986 to 1990 of Dutch management, a high total milk yield was attained along with standard reproductive efficiency. During the years 1990 to 1997, the Libyan management, was also able to maintain a

higher production level at the expense of the reproductive traits. This was achieved with longer lactation periods 354 day, when compared to 314 day that was quite close to the standard 305 day during the Dutch management. This finding is in agreement with Tawfik *et al.*, (2000), who showed, the effect of calving year on traits studied in Egypt and Germany was significant, and with none significant effect, on 305 day milk yield in Germany.

Actual milk yield 3x and adj.100 day milk yield were significantly affected by management, calving year, calving month, age at first calving and lactation period. Age at first calving, however, did not show any significant effect on 305 day milk yield M.E. This may indicate the removal of differences due to age at calving, by the use of correction factors at the appropriate age. This result is in agreement with Tawfik, *et al.*, (2000). Significant differences were only found either early in lactation adj.100 day milk, or later on 305 day milk yield M.E. This raises a question on correction factors used, to adjust variability by the lactation period. This means, the lactation curve might be different for Holstein Friesian under Libyan environment. In addition, calving interval and days open scored higher values during Libyan management. Lactation period were significantly affected by management, calving year and calving month (Table.2). However, only, the management and lactation period effects on dry period were significant. On the other hand, lactation and dry periods were increased during the Dutch and Libyan management. This finding is in agreement with Zaied, *et al.*, (1995), and contradicts with Tawfik, *et al.*, (2000), who stated, that, the effect of calving year on lactation period in Germany and Egypt is not significant. During the Dutch management, age at first calving was generally decreased Table 2. This indicates, Holstein Friesian heifer matured earlier under Libyan environment (27 months), compared to 30 months for the imported German heifer. This is in agreement with Atil and Khattab, (2000) for German Holstein Friesian under Egyptian environment. This is also, expected due to differences in management and environment between Germany and Libya.

During summer season, July to September, milk yield was decreased. This finding is in agreement with Mohammed, (1986), in Libya and Atil and Khattab (2000), in Egypt. However, the highest milk yield was found during April and November Fig 1. In April, the increase in milk yields may due to the availability of green pasture during spring season. While, the increase in milk yields, during November, may reflect the start of weather changes. Also, days open were increased from June to August Fig.2, indicating, summer seasonal effect on reproductive traits. These findings are in agreement with Khattab and Atil, (1999) and Tawfik, *et al.*, (2000).

Figures 1 and 2 revealed that, as THI is increased, milk yield decreased and Days Open increased. Indicating that, Holstein Friesian dairy cattle were quite sensitive to climate changes. On the other hand, the relationship between milk yield and Days Open as shown in figure 3 was different during cold and hot seasons. This means that, milk yield and Days Open were both increased during the cold season. This result is in agreement with those obtained in cold region in western Europe and North America (Lee et al, 1997; Windig et al, 2005 and Patton et al, 2007). However, Days Open were increased, while, milk yield was decreased during

the summer season. Indicating, the magnitude of increase in days open was higher due to seasonal changes than to the high milk yield. This result is in agreement with those obtained by Haung *et al,* (2008). Under Libyan environmental conditions, heat stress is considered to be the most effective factor in the deterioration of fertility of Holstein Friesian than high milk yield. Despite the environmental stressful conditions, it is clearly seen that, management played an important role in attaining high milk yield and reproductive efficiency of Holstein Friesian dairy cows

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اداء أبقار الهولستين فريزيان تحت ظروف الاجهاد بمزرعة غوط السلطان ليبيا

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فى هذه الدراسة، تم تقيم الأ داء الانتاجى والتناسلي لأبقار الهولستين فريزيان الألمانية المستوردة وأجيالها المتعاقبة المولودة فى ليبيا. كان عدد الأبقار التى لها أول سجل إدرار بهذه الدراسة ٢٠٩٤ . تم تحليل البيانات بطريقة التقديرات المحددة لأقصى احتمالية(REML) لتقدير العوامل المؤثرة على إنتاجية اللبن والصفات التناسلية وتضمن النموذج شهر وسنة الولادة، الإدارة ، الجيل وأصل الآباء كعامل ثابت والآباء عشوائي. إضافة لذلك تضمن النموذج العمر عند أول وضع وطول موسم الإدرار لصفات إنتاج اللبن كمتغيرات. كان الإنتاج الكلى للبن فى العموم مرتفع (٨٤٠٩ لتر) وبكفاءة تناسلية (١١٠ يوم مفتوح) خلال فترة الإدارة الهولندية وعلى حساب الصفات التناسلية (١٦١ يوم مفتوح) خلال الإدارة الليبية. كان للإدارة، سنة الوضع، شهر الوضع والعمر عند أول وضع تأثيرات معنوية على كل من إنتاجية اللبن والصفات التناسلية. إضافة لذلك فان إنتاجية اللبن والأيام المفتوحة تأثرت بدليل الحرارة والرطوبة ووجد نمط مختلف بإنتاجية اللبن والأيام المفتوحة فى الفصل البارد والحار. ومع ذلك تأثرت والأيام المفتوحة أكثر بزيادة دليل الحرارة والرطوبة من ارتفاع إنتاجية اللبن. تلعب الإدارة دورا مهما فى الحفاظ على إنتاجية عالية بكفاءة تناسلية تحت ظروف الإجهاد الحراري.