SHORT NOTE [NOTA CORTA]

LACTATION PERFORMANCE OF HOLSTEIN AND HOLSTEIN X GYR CATTLE UNDER INTENSIVE CONDITION IN A SUBTROPICAL ENVIRONMENT

[COMPORTAMIENTO DE LA LACTACION EN VACAS HOLSTEIN Y HOLSTEIN X GYR EN CONDICIONES INTENSIVAS SUBTROPICALES]

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SUMMARY

Data from 289 milk yield records of purebred Holstein (H), ¾ Holstein ¼ Gyr (¾H ¼G) and ½ Holstein ½ Gyr (½H ½G) were used to compare milk production traits of these genotypes in an intensive operation in a subtropical region of northwestern Mexico. The performance traits studied were: 305-d milk yield days (P305), total milk yield per lactation (TMY), average daily milk production (DMP); lactation length (LL), peak milk yield (PM) and day of peak milk. Higher (P<0.05) P305 averages were observed for purebred Holsteins (5417 ± 96 kg) than ¾H ¼G (4807 ± 131kg) and ½H ½G (4541 ± 92 kg). The shortest lactations were observed for ½H ½G animals (288 ± 2.0 d) whereas the longest lactations were observed for purebred Holstein (303 ± 2.1d). The highest 305-d milk yield was observed in cows calving in January (5283 ± 1090 kg), whereas the lowest milk yield occurred with calvings in June (3989 ± 896 kg). These results indicate that, under intensive management in a subtropical setting, purebred Holstein performed better than crossbred animals, in terms of milk yield. However, in this subtropical environment reproductive performance of purebred Holstein cows is very poor; thus, this study emphasizes the importance of crossbreeding Holstein x Gyr cattle to produce cows that are more adapted to the hot-humid environmental conditions of the region. These results also showed the drastic impact of heat stress during the summer months on the milk yield of these cows.

Keywords: Lactation performance; subtropical environment; Holstein x Gyr.

RESUMEN

Registros de producción de leche (n= 289) de vacas Holstein (H), ¾ Holstein ¼ Gyr (¾H ¼G) y ½ Holstein ½ Gyr (½H ½G) fueron utilizados para comparar los rasgos de producción de leche de estos genotipos en una explotación intensiva en una región subtropical del noroeste de México. Las variables analizadas fueron la producción de leche a 305 días (P305), producción de leche total por lactancia, duración de la lactancia, producción diaria de leche, pico de lactancia y días al pico de lactancia. Mayores (P<0.05) promedios de P305 se observaron en las vacas Holstein puras (5417 ± 96 kg) que las ¾H ¼G (4807 ± 131kg) y ½H ½G (4541 ± 92 kg). Las lactancias más cortas se presentaron en las vacas ½H ¼G (288 ± 2.0 d), mientras que las más prolongadas se presentaron en las vacas Holstein (303 ± 2.1d). La mayor producción de leche a 305 días se presentó en vacas que parieron en enero (5283 ± 1090 kg), mientras que las producciones de leche más bajas se observaron en las vacas que parieron en junio (3989 ± 896 kg). Estos resultados indican que, en explotaciones de leche intensivas en zonas subtropicales, las vacas Holstein presentan mayores producciones de leche que las vacas cruzadas. Sin embargo, en este ambiente subtropical el desempeño reproductivo de las vacas Holstein es muy pobre; por consiguiente, este estudio enfatiza la importancia de contar con vacas Holstein x Gyr las cuales presentan una mayor adaptación a las condiciones de intenso calor y humedad de esta zona. Estos resultados muestran también el drástico impacto negativo que tiene el intenso calor del verano sobre la producción de leche de las vacas.

Palabras clave: Comportamiento de la lactancia; condiciones subtropicales; Holstein x Gyr.

INTRODUCTION

In Latin America, a great deal of the milk produced comes from extensive dairy operations in tropical and subtropical zones. In these agroecological areas heat load is one of the leading causes behind livestock health problems (Pech-Martinez *et al*., 2007); decreased feed intake (Blackshaw and Blackshaw, 1994), reduced reproductive capacity (Morton *et al*., 2007) and increased mortality (Riley *et al*., 2007), all of which lead to reduction of profits in these dairy operations.

Many extensive dairy operations in these hot and humid zones utilize cattle genetically derive from strains originally bred in the more temperate climates of Europe and North America. These high producing cows of European origin will always be less efficient producers of milk in harsh environments than inherently heat tolerant breeds (Madalena *et al*., 1990), developed through crossbreeding between local and dairy breeds and selection within those populations for high milk yield. Since genotype and its management must be matched to harsh climatic conditions, crossbreeding of European dairy breeds with Zebu or native breeds from tropical areas has been used widely as a method to improve milk production under grazing conditions in the tropical and subtropical areas of Latin America (Junqueira *et al*., 2005).

The majority of published studies on cattle crossbreeding in the American tropics have been obtained in extensive conditions. Thus, scarce information exists on tropical dairy genotypes suitable for intensive dairy operations in the American tropics. Therefore, more information is needed on performance of crossbred animals for intensive dairy operations in zones with intense heat load. This study compares milk yield of crosses of Holstein x Gyr cattle in an intensive dairy operation in a subtropical zone of northwestern Mexico. Additionally, this study determined the effect of month of calving on milk yield and other milk traits of purebred and crossbred Holstein cows.

MATERIALS AND METHODS

This study was carried out on a well-managed herd of purebred Holstein and crossbred cows (Holstein x Gyr), housed in open corrals in a hot humid area of northwestern Mexico (longitude 107° 25' W and latitude 24º 48'N**,** about 60 m above sea level). Long-term mean annual rainfall is 658 mm and average year temperature is 24°C. The study period was between 2006 and 2008. The number of H, ¾H ¼G and ½H ½G cows included in the study were 120, 59 and 110, respectively. Observations for 2006 and 2008 were 135 and 154, respectively.

No lactations for some months of summer and fall are presented because calving rates in these months were practically inexistent. This was so because only Gyr sexed-semen was used from October to February (cooler moths of the year) on all cows, and this reproductive approach resulted in very poor pregnancy rate. Lower numbers of cows in spring and summer reflect lower pregnancy rate due to heat stress of cows inseminated during the hottest part of the year.

Cows were contemporary mostly pluriparous with different grades of Holstein x Gyr. Mean total milk production per lactation in these cows ranged from 2223 to 8191 kg per cow. The cows, grouped according to their milk production, were milked two times daily, and fed rations depending on the production level of a mixture of cottonseed hulls, corn grain and soybean meal. The concentrate to forage ratio (DM basis) was 55:45 for lactating cows. The forage component of the diet consisted of corn silage. Animals had free access to water at all times and rations were in line with NRC (2001) recommendations.

All cows were tested free of tuberculosis and brucellosis. They were also vaccinated against leptospirosis, infectious bovine rhinotracheitis and bovine viral diarrhea. Cows with clinical conditions such as mastitis, lameness and digestive disorders detected during the study were withdrawn from the study. Drying off was routinely performed on a given day of the week corresponding to 210–220 days into pregnancy. Calves were separated from their dams immediately after birth and reared artificially, receiving 4 kg of milk replacer/day. The cows were dried-off at 60 days from next expected calving, or, else, if milk yield dropped below six kg/day.

Milk yields were recorded every 14 days throughout lactation and total milk yield was calculated by multiplying the average between successive milk measurements by the number of day milk recordings, and summing the products. For lactation periods exceeding 305 days, milk production up to 305 days was computed. The duration of each lactation period (days) was computed by the difference between the end date of the lactation period and the start date of the lactation minus the number of days that calves were allowed to suckle the colostrum. Lactations completed before 305 d due to drying off spontaneously were considered as complete lactations (P305). All lactations were adjusted to mature equivalent; adjusting factors to mature age were estimated using polynomial regression analysis using averages for each lactation number. The highest milk yield was in cows in their fifth lactation and this yield was regarded as mature age yield.

Mature equivalent P305, total milk yield per lactation (TMY), average daily milk production (DMP); lactation length (LL), peak milk yield (PM) and day of peak milk were analyzed by ordinary least squares methodology using the GLM procedure in the Statistical Analysis System (SAS Institute, Inc., Cary, NC). The dependent variables were genetic groups and month of calving. The following model was used: Yijk = μ + Gi + Sj + eijk; where: Yijk = analyzed trait of cow k; μ = overall mean; Gi = effect of genotype; S = effect of month of calving; eijk = random error. It was assumed that the errors are independent and distributed according to the normal distribution with 0 mean and Σ^2 variance. All effects in the model were assumed to be fixed, except for the error.

RESULTS AND DISCUSSION

The proportion of Holstein in the breed composition of cows had a marked influence (P<0.05) on both P305 and TMY. Similar to what it has been observed in previous studies in tropical environments with good management and feeding regimes (Madalena *et al.*, 1990; López-Ordaz *et al*., 2009), TMY and P305 increased as the proportion of Holstein genes in the breed composition of the cow changed from 0.5 to 1.0 (Table 1). This response, however, is not observed under grazing conditions in the tropics, where genotypes approaching 100% Holstein genes present lower milk yield than crossbred Holstein cows (Faco *et al*., 2002; Lopez *et al*., 2009; Peroto *et al*., 2010). Under the conditions of the present study (extended periods of high ambient temperature coupled with high relative humidity), it is clear that purebred Holstein cows out-performed crossbred cows in terms of milk yield, with adequate feed supply and good sanitary, health and milking programs.

Despite the high genetic potential of Holstein cows to produce milk in this hot environment, purebred Holstein cows are not heat tolerant relative to local or Zebu breeds, and this inadaptability has lead to a poor reproductive performance of Holstein cows in this zone (Garrido, 1976). Therefore, there is justification for crossbreeding Holstein cows with a breed tolerant to heat, parasites and diseases, such as Gyr, in order to match the genotype to the prevailing climatic conditions.

The average P305 for purebred Hostein cows was far below the values obtained in intensive dairy operations in temperate climates with hot summers (Ray *et al*., 1992), which indicates that Holstein purebreds did not express their full genetic potential. This is explained by the fact that Holstein cows have a poor mechanism to maintain thermo neutrality within very narrow limits. Relatively small increases in body temperature of this breed of cattle result in reduce feed intake (Wheelock *et al*., 2010; O'Brien *et al*., 2010), as a key strategy to achieve thermal balance, as well as altered endocrine status (Igono *et al*., 1988), reduction in rumination and nutrient absorption (O'Brien *et al.*, 2010), increased maintenance requirements (Collier *et al*., 2005) and alteration of the mammary tissue metabolism (Silanikove *et al*., 2009), resulting in a net decrease in nutrient/energy availability for milk production.

Purebred Hoslteins had longer (P<0.05) LL than other groups (Table 1). Short lactations is a common feature of Zebu cattle, which represent a major problem for milk production in the tropics (Facó *et al*., 2002; Peroto *et al*., 2010). The high heat tolerance of zebu cattle relative to Holstein cows is achieved partly through having a lower maintenance requirement, which in turn is correlated with lower metabolic rate, and as a consequence, their genetic potential for prolonged lactations is much lower than that of European dairy breeds.

Table 1. Milk production traits and duration of lactation period for pure and crossbred Holstein cows kept under intensive conditions[1] in a hot-humid environment of northwestern Mexico. Values are least square means ± SE.

Item	½H ½G	¾H ¼G	H
Number of cows	120	59	110
305-d milk yield (kg)	4541 ± 92[a]	4807 ± 131[a]	5417 ± 96[b]
Total milk yield	4970 ± 241[a]	4852 ± 348[a]	5594 ± 252[b]
Days in milk	288 ± 2.0[a]	297 ± 2.8[b]	303 ± 2.1[c]
Daily milk yield (kg)	14.9 ± 0.3[a]	15.8 ± 0.4[a]	17.8 ± 0.3[b]
Peak milk yield (kg)	19.6 ± 0.5[a]	21.2 ± 0.7[b]	23.7 ± 0.5[c]
Day of peak milk	71 ± 0.3[a]	67 ± 1.4[b]	73 ± 1.0[a]

[1]Cows permanently in pens, receiving high concentrate diets, twice machine milking, artificial breeding and artificial rearing of calves.

[a,b,c]Rows with dissimilar superscripts differ (P<0.05).

Cows calving in June had the lowest (P<0.05) values for P305, when maximum ambient temperatures above 40ºC prevail in the study site (Figure 1). On the other hand, the highest milk yield was reached during the coolest period of the year (January). This data closely coincides with different studies in southern United States of America with Holstein cows in environments with hot summers (> 35ºC; Collier *et al*., 1982; Ray *et al*., 1992), or crossbred cows in tropical areas of Mexico (Vite-Cristóbal *et al*., 2007).

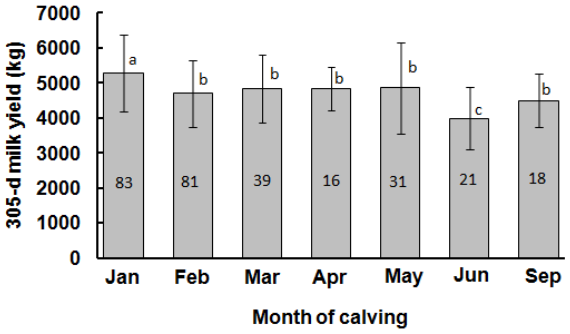

Figure 1. The effect of month of calving on mature equivalent 305-d milk yield of three genetic groups of cows under intensive condition in northwestern Mexico. Values are means ± standard deviations. Numbers in bars are number of observations. Bars with dissimilar letters differ (P<0.05).

CONCLUSIONS

Seasonal high ambient temperature and humidity in northwestern Mexico depress milk production, regardless of the genotype of cows kept under intensive management. Purebred Holstein cows showed greater milk production ability than crossbred cows (Hostein x Gyr). However, caution should be exercised when using purebred Holstein cows in this environment, as reproductive failure of this breed has been solidly documented in this zone.

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Submitted January 12, 2011 – Accepted May 09, 2011
Revised received June 13, 2011