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Full Length Research

Factors affecting lactation performances of Jersey-White Fulani and Holstein-Gudali genetic crossed groups of cows in Western Highlands of Cameroon

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ABSTRACT: The aim of this study was to evaluate factors affecting daily milk yield, lactation peak milk and calving interval lactation peak of Jersey-White Fulani and Holstein-Gudali genetic crossed groups of cows in Western Highlands of Cameroon. Data on 404 genetic crossed cows obtained from the database of the Institute of Agricultural Research for Development (IRAD) of Bambui in the Western Highlands of Cameroon were used. These genetic crossed cows were results of crosses between imported Jersey (J) and Holstein (H) bull semen with local White Fulani (WF) and Gudali (G) cows. Results obtained revealed that only daily milk yield (DMY) varied significantly between the different genetic crossed groups of cows. Daily milk yield, lactation peak milk (LPM) and calving interval lactation peak (CILP) tended to increase with exotic blood level. Cows with 70% of Holstein exotic blood (75%Hx25%G) recorded the highest LPM (14.51 ± 2.97 kg) and the longest CILP (39.86 ± 9.89 days) being the highest DMY (6.74 ± 0.41kg) was in 50%Hx50%G genetic crossed group. Genetic crossed group II (75%Jx25%WF) registered the lowest DMY (5.59 ± 0.43 kg) and the lowest LPM (10.46 ± 1.16 kg) meanwhile the shortest CILP (27.19 ± 3.68 days) was obtained with genetic crossed group I (50%Jx50%WF). Performances obtained for both DMY, LPM and CILP with Holstein-Gudali (50%Hx50%G and 75%Hx25%G) crossed as compared to Jersey-White Fulani crossed revealed their high productive potential through their adaptability capacity to harsh conditions of tropics.

Keywords: Cameroon, crossed cows, Holstein, Jersey, lactation, performances.

INTRODUCTION

Despite the importance of the African cattle herd, which represents 1/3 (17.26%) of the world cattle population, their production and productivity are still very low. Indeed, milk production remains insufficient and constitutes only 4.7% of world production (Hakoueu *et al*., 2021). This level of milk production does not reach the level of efficiency required to meet the needs of a growing population.

Demand for animal products such as milk increases with the years, especially in cities, which according to the predictions will house 60% of the population of African countries by 2050 (FAO, 2019). To offset the dairy deficit, Africa imports 50% of the dairy products it consumes, mainly in form of powdered milk. There is therefore an urgent need to improve cattle productivity in order to boost production performances and thus eradicate poverty.

Low cattle productivity can be improved through intensification of livestock systems and genetic improvement of local livestock. This intensification can be done either through selection during a long period or through a shorter term crossbreeding. Genetic improvement of local breed by crossing with exotic dairy breeds is one of the solutions put in place (Hakoueu *et al.,* 2021).

To improve milk production, high performing exotic dairy cattle breeds like Jersey and Holstein Friesian were introduced in the early seventies (Mbah *et al*.,1987). These cattle were crossed with local breeds in Bambui in the Sudano-guinean altitude zone where important researches in terms of duration and number of animals involved were conducted with the aim of identifying productive and adapted genotypes for the enhancement of dairy production in Cameroon.

The present study aims to evaluate the factors affecting lactation performance of genetically crossed Jersey-White Fulani and Holstein-Gudali groups of cows in the Western Highlands of Cameroon. The results will therefore help public services to guide animal husbandry improvement programs and farmers to optimize dairy production.

MATERIALS AND METHODS

Description of the study area

Information obtained from the available database of Bambui Regional Centre of the Institute of Agricultural Research for Development (IRAD) on a period of 13 years (1985-1998) were used in the present study. Geographically localized in the Western highlands of Cameroon, the geoclimatic characteristics of the Bambui Regional Centre are described by Hakoueu *et al*. (2019).

Experimental animal

In order to carry out this study, 404 genetically crossed cows distributed into six groups as represented in Table 2 were used in this study. These crossed cows were obtained through importation from USA of Jersey and Holstein bull semen, which was used to inseminate local cow breeds (Gudali and White Fulani) as represented in the Table 1.

Technical management of crossbred cows

Crossbred cows involved in this study were all calved and raised in the research farm of IRAD Bambui center. They were all subjected to the same management (feeding, herd health management, mating of cows as well as milk production) conditions established by the center (Hakoueu *et al*., 2021).

Characteristics studied

Daily Milk Yield (DMY): It is the average value of milk produced in a day of milking during the lactation period.

Calving Interval Lactation Peak (CILP): It is the interval (number of days) between the beginning of milking and the highest volume of milk produced in a day of lactation.

Lactation Peak Milk (LPM): It is the highest quantity of milk produced in a day of milking during the lactation period.

The distribution of the different genetic crossed groups of cows is represented in the Table 2.

Statistical analysis

Data for DMY, CILP and LPM were subjected to analysis of variance of fixed effects using the General Linear Model (GLM) procedures of SPSS version 23. Tukey test was used for testing the differences between least squares means. The model used was as followed:

$$Y_{ijkl} = \mu + B_i + S_j + P_k + Y_l + e_{ijkl}$$

Where Y_{ijkl} is the observation on DMY, CILP and LPM, μ is the overall mean, B_i is the fixed effect of dam blood level (i=50%Jx50%WF, 75%Jx25%WF, 85.5%Jx12.5%WF, 50%Hx50%G, 75% Hx25%G and 85.5%Hx12.5%G), S_j is the fixed effect of calving season (j=dry season, rainy season), P_k fixed effect of dam parity (k=1 to 7), Y_l is the fixed effect of the year (n=1987 to 1995), e_{ijkl} is the residual effect assumed to be independent and randomly distributed with a mean of zero and variance σ^2.

RESULTS

Effects of genetic and non-genetic factors on daily milk yield (kg) of Jersey-White Fulani and Holstein-Gudali genetic crossed dairy cows

Least square means and standard errors of effects of genetic and non-genetic factors on daily milk production (kg) of Jersey-White Fulani and Holstein-Gudali crossbred dairy cows are summarized in Table 3. The overall daily milk yield (DMY) for all genetic crossed dairy cows involved in this study was 6.17 ± 0.48 kg.

Analysis of the least square means showed a significant difference ($p<0.05$) among animals with different levels of exotic blood although the significance was not linearly related with the increase of exotic blood level. Results revealed that the genetic crossed group of Jersey crossbred dairy cows have produced low quantity of milk than the Holstein genetic crossed group. Thus, the lowest DMY recorded (5.59 ± 0.43 kg) was produced by genetic

Table 1. Experimental genetic crossed groups.

Groups	Genetic composition	Different genetic crosses
I	50%Jx50%WF	crossing between Jersey (J) semen and White Fulani (WF) cow
II	75%Jx25%WF	backcrossing between Jersey (J) semen and 50% White Fulani (WF) cow
III	87.5%Jx12.5%WF	backcrossing between Jersey (J) semen and 75% White Fulani (WF) cow
IV	50%Hx50%G	crossing between Holstein Friesen (H) semen and Gudali (G)
V	75%Hx25%G	backcrossing between Holstein Friesen (H) semen and 50% Gudali (G)
VI	87.5%Hx12.5%G	backcrossing between Holstein Friesen (H) semen and 75% Gudali (G)

J=Jersey, H=Holstein, G=Gudali, WF=White Fulani.

Table 2. Distribution genetic crossed cows.

Groups	Genetic crossed	N for DMY	N for CILP	N for LPM
I	50%Jx50%WF	135	80	80
II	75%Jx25%WF	117	108	108
III	87.5%Jx12.5%WF	8	7	7
IV	50%Hx50%G	130	83	83
V	75%Hx25%G	9	6	6
VI	87.5%Hx12.5%G	5	5	5
Total		404	289	289

J=Jersey, H=Holstein, G=Gudali, WF=White Fulani, N= Number of observations, DMY=daily milk yield, CILP= calving interval lactation peak, LPM= lactation peak milk.

crossed group II having 75% of Jersey exotic blood (75%J x25%WF) while the highest DMY (6.74 ± 0.41 kg) obtained was with genetic crossed group IV (50%Hx50%G).

Calving season had a significant effect on the DMY. Genetic crossed cows that calved during the dry season had a daily production (5.86 ± 0.52 kg) lower ($p<0.05$) compared to the rainy season production (6.49 ± 0.45 kg).

Year of calving had a significant ($p<0.05$) effect on DMY of the different genetic crossed groups of cows. This DMY fluctuated across years without a specific tendency even though the lowest daily production (5.04 ± 0.67 kg) was registered during the period of 1992 and the highest production (7.26 ± 0.47 kg) was registered in 1991.

Parity was found to have a non-significant effect on DMY ($p>0.05$). Results revealed a nonlinear increase of DMY with the increase of the parity. However, heifers had lower (5.35 ± 0.53 kg) DMY compared with cows in the higher parities with the parity 7 having the highest (7.00 ± 0.67 kg) DMY.

Effects of genetic and non-genetic factors on lactation peak milk (kg) of Jersey-White Fulani and Holstein-Gudali genetic crossed dairy cows

Least square means and standard errors of effects of genetic and non-genetic factors on lactation milk peak (kg) of Jersey-White Fulani and Holstein-Gudali genetic crossed dairy cows from 1987 to 1994 are summarized in Table 4. The overall lactation peak milk (LPM) recorded for all the different genetic crossed dairy cows involved in this study was 12.20 ± 1.35 kg.

Level of exotic blood did not affect ($p>0.05$) the lactation milk peak of the different groups of crossed cows. Though results revealed that, LPM variation among the genetic groups was linear in the genetic group of Jersey crossed (10.46 ± 1.16, 11.42 ± 1.11 and 12.06 ± 2.64 kg for crossed cows having 50%, 75% and 87.5% of Jersey blood respectively), meanwhile in the Holstein genetic group, LPM variation was not related to the degree of exotic blood (12.30 ± 1.14, 14.51 ± 2.97 and 12.47 ± 3.46 kg for crossed cows with 50%, 75% and 87.5% of Holstein blood respectively). Genetic crossed group I (50%Jx50%WF) had the lowest lactation milk peak (10.46 ± 1.16 kg), while the highest LPM (14.51 ± 2.97 kg) was obtained in genetic crossed group IV (75%Hx25%G).

Calving season had no significant ($p>0.05$) effect on the lactation milk peak. Year of calving had significant ($p<0.05$) effect on LPM of Jersey-White Fulani and Holstein-Gudali genetic crossed groups as indicated in the Table 4. LPM fluctuated across years without a clear tendency. LPM decreased from 1987 (12.17 ± 1.34 kg) to 1989 (10.33 ± 1.39 kg) and increased in 1990 (15.22 ± 1.37 kg). It decreased once more from 1991 before increasing again in 1994 (14.21 ± 4.76 kg). The lowest LPM of 8.83 ± 1.89 kg was registered in 1992 while the highest was in 1990 (15.22 ± 1.37 kg).

Parity was found to significantly affect ($p<0.001$) lactation milk peak. Results revealed that LPM increased with parity from the parity 1 with the lowest (9.72 ± 1.39 kg)

Table 3. Least square means (± SE) for daily milk yield (kg) of the different genetic crossed groups.

Source of variation	N	Means ± SE
Overall	404	6.17 ± 0.48
Genetic crossed groups		*
50%Jx50%WF	135	5.60 ± 0.39[a]
75%Jx25%WF	117	5.59 ± 0.43[a]
87.5%Jx12.5%WF	8	6.08 ± 1.08[a]
50%Hx50%G	130	6.74 ± 0.41[b]
75%Hx25%G	9	6.34 ± 1.08[ab]
87.5%Hx12.5%G	5	6.71 ± 1.52[ab]
Season		*
Dry	153	5.86 ± 0.52[a]
Rainy	251	6.49 ± 0.45[b]
Year of calving		*
1987	67	6.34 ± 0.53
1988	81	6.24 ± 0.49
1989	50	5.27 ± 0.55
1990	66	6.76 ± 0.51
1991	62	7.26 ± 0.47
1992	25	5.04 ± 0.67
1993	35	6.14 ± 0.58
1994	8	5.48 ± 1.17
1995	10	6.99 ± 1.03
Parity		NS
1	251	5.35 ± 0.53
2	152	5.98 ± 0.57
3	81	6.46 ± 0.58
4	78	5.97 ± 0.62
5	73	6.70 ± 0.68
6	54	5.77 ± 0.67
7	37	7.00 ± 0.67

a,b,c,d,e:Values carrying different superscripts within the cell are significantly different. **Key:** N=number of observations, J= Jersey, WF=White Fulani, H=Holstein, G= Gudali, * Significant (P < 0.05), NS = Non significant (p >0.05).

Table 4. Least square means (± SE) for lactation peak milk (kg) of the different genetic crossed groups.

Source of variation	N	Means ± SE
Overall	289	12.20 ± 1.25
Genetic group		NS
50%Jx50%WF	80	10.46 ± 1.16
75% Jx25%WF	108	11.42 ± 1.11
87.5%Jx12.5%WF	7	12.06 ± 2.64
50%Hx50%G	83	12.30 ± 1.14
75%Hx25%G	6	14.51 ± 2.97
87.5%Hx12.5%G	5	12.47 ± 3.46
Season		NS
Rainy	179	12.31 ± 1.27
Dry	110	12.10 ± 1.36
Year of calving		*
1987	50	12.17 ± 1.34[ab]
1988	67	11.98 ± 1.18[ab]
1989	37	10.33 ± 1.39[ab]
1990	43	15.22 ± 1.37[c]
1991	49	12.08 ± 1.3[ab]
1992	15	8.83 ± 1.89[a]
1993	22	10.41 ± 1.58[ab]
1994	6	14.21 ± 4.76[bc]
Parity		**
1	56	9.72 ± 1.39[a]
2	49	10.59 ± 1.56[a]
3	48	11.31 ± 1.55[a]
4	37	12.04 ± 1.57[a]
5	26	16.78 ± 1.81[b]
6	34	12.40 ± 1.65[a]
7	39	12.59 ± 1.69[a]

[a,b,c,d,e]:Values carrying different superscripts within the cell are significantly different. **Key:** N=number of observations, J= Jersey, WF=White Fulani, H=Holstein, G= Gudali, **= highly significant (P < 0.001), * Significant (P < 0.05), NS = Non significant (p >0.05).

value to the parity 5 with the highest value (16.78 ± 1.81 kg) recorded. The LPM value decreased thereafter while remaining non-significantly higher than the LPM of heifers with a difference of 7 liters between the parity 1 and parity 5.

Effects of genetic and non-genetic factors on calving intervals to lactation peak (days) of Jersey-White Fulani and Holstein-Gudali genetic crossed dairy cows

Least square means and standard errors of effects of genetic and non-genetic factors on calving intervals to lactation peak (days) of Jersey-White Fulani and Holstein-Gudali genetic crossed groups summarized in Table 5 revealed that the overall calving intervals to lactation peak (CILP) recorded for all the different groups was 32.68 ± 4.06 days.

Level of exotic blood did not affect (p>0.05) the length of calving intervals to lactation peak. Though results revealed that, genetic crossed group IV had the longest CILP (39.86 ± 9.89 days), whereas the genetic group II had the shortest (27.19 ± 3.68 days) period between the calving and the lactation peak, with a non-significant difference of 12.6 days between the shortest and the longest period.

Table 5. Least square means (± SE) for calving intervals to lactation peak (days) of the different genetic crossed groups.

Source of variation	N	Means ± SE
Overall	**289**	32.68 ± 4.06
Genetic group		NS
50%Jx50%WF	80	34.87 ± 3.84
75% Jx25%WF	108	27.19 ± 3.68
87.5%Jx12.5%WF	7	30.54 ± 8.78
50%Hx50%G	83	30.90 ± 3.75
75%Hx25%G	6	39.86 ± 9.89
87.5%Hx12.5%G	5	32.73 ± 11.49
Season		NS
Rainy	179	30.96 ± 4.54
Dry	110	34.40 ± 4.23
Year of calving		*
1987	50	26.86 ± 4.44[ab]
1988	67	28.47 ± 3.94[ab]
1989	37	31.79 ± 4.61[b]
1990	43	24.82 ± 4.54[ab]
1991	49	28.56 ± 3.76[ab]
1992	15	24.59 ± 6.29[ab]
1993	22	34.76 ± 5.27[b]
1994	6	14.77 ± 15.84[a]
Parity		NS
1	56	34.98 ± 4.63
2	49	33.51 ± 5.18
3	48	40.65 ± 5.17
4	37	34.22 ± 5.22
5	26	26.30 ± 6.01
6	34	30.23 ± 5.48
7	39	28.87 ± 5.62

[a,b,c,d,e:]Values carrying different superscripts within the cell are significantly different. **Key:** N=number of observations, J= Jersey, WF=White Fulani, H=Holstein, G= Gudali, * Significant (P < 0.05), NS = Non significant (p >0.05).

Calving season did not significantly (p>0.05) affect the length of the calving intervals to lactation peak in this study. Crossed dairy cows calving during the dry season had CILP of 34.40 ± 4.23 days while in rainy season this CILP was 30.96 ± 4.54 days.

The Table 5 revealed significant effect of year of calving on the CILP of different crossed groups of cows. CILP varied across the years without a clear tendency. This CILP increased in 1988, 1989, 1991 and 1993 with the longest CILP observed in 1993 while the shortest CILP was observed in 1994.

The parity was not found to affect (p>0.05) calving intervals to lactation peak. Results revealed a non-linear decrease of CILP with the increase of the parity except at the Parity 3 where the CILP increased with the highest value (40.65 ± 5.17 days) observed. Hence, heifers had higher value of CILP (34.98 ± 4.63 days) as compared to cows at parity 7 (28.87 ± 5.62 days) with parity 5 recording the lowest CILP value (26.30 ± 6.01 days).

DISCUSSION

Genetic and non-genetic factors affecting daily milk yield (kg) of Jersey-White Fulani and Holstein-Gudali genetic crossed dairy cows

The overall daily milk yield (DMY) for all different genetic crossed dairy cows involved in this study was higher than the results of Sanyang and Diack, (2005) in Gambia who found a DMY of 3.54 ± 0.94 and 4.5 ± 1.19 kg with Jersey and Holstein crossbred respectively. The results were also higher than the findings of Mebrahtom *et al.* (2016) who had 4.60 ± 1.67 kg with crossbred dairy cows managed under smallholder farmers in Ethiopia. Even though, the average DMY found in this study was lower than the result obtained by Keita (2005) in Senegal, who found a daily milk yield of 7.3 kg with Holstein crosses, this result was positive and encouraging. DMY of Jersey-White Fulani and Holstein-Gudali crossed obtained in this study was 2 time higher than DMY of local breeds. In fact, milk production in Cameroon has been characterized by the traditional system using local zebu cows (Gudali, White Fulani, Red Fulani). However, this production has been insufficient reaching only an average of 3 liters per cow per day (Bayemi *et al*., 2005).

Least square means analysis showed a significant difference (p<0.05) amongst cows with different levels of exotic blood although the significance was not linearly related with the increase of exotic blood level. These findings were dissimilar to the results obtained by Kamga *et al.,* (2001) and Djoko *et al*. (2003) with the same crossed and Doko *et al.* (2012) in Benin with Girolando cattle. However, the non-linear relation between DMY increase and the increase of exotic blood level was similar to the results obtained by Tawah *et al*. (1999). Tawah *et al*. (1999) also studied the genotype and environmental factors of crossbreeding the local Gudali zebu cows with either Montbeliard or Holstein bulls. Their study confirmed reports that 50% crossbred cattle were superior to their backcrosses in milk production in harsh tropics. Doko *et al*. (2012) in Benin found similar results with Girolando cattle. In fact, in climatic environment with good sanitary conditions, crossbred cattle having a high blood percentage of exotic dairy cattle could increase considerably their milk production. Nevertheless, in a difficult environment as in the tropics where exotic dairy cattle have a low resistant capacity to harsh conditions

(Nguyen, 2003), their milk production was low as compared with crossbred cattle having low exotic blood. Results also revealed a considerable variability between genetic groups with Jersey crossbred dairy cattle group producing low milk than Holstein crossbred dairy cattle group. Kamga *et al.* (2001) working with Holstein, Jersey and their crossed with Gudali confirmed the suitability of Holstein-Gudali crossed for milk production in Cameroon. This variation in genetic groups involved in the present study could be attributed to zootechnical and climatic factors.

Calving season had a significant effect on the DMY. Crossed cows' dairy cattle that calved during the dry season had a daily production (5.86 ± 0.52 kg) lower ($p<0.05$) compared to the rainy season production (6.49 ± 0.45 kg). These results were dissimilar to the findings of Kamga *et al.* (2001) and Djoko *et al.* (2003) with the same breeds which revealed no significant difference of DMY with the season. However, similar results to the present study found by Melaku *et al.* (2011), Doko *et al*. (2012) and Wondifraw *et al*. (2013) revealed that, cows calving during the rainy season had higher DMY. This could be due to the fact that, rainy season is characterized by an excess succulence forages with high nutrient content, low fiber content, high digestibility and high voluntary intake by animals (Bayou *et al*., 2015). Thus, when nutrition is sufficient, animals become productive for high daily milk yield. Whereas cows calving in dry season had low DMY. Low availability of natural forage coupled to heat stress and diseases during the dry season may have contributed to the observed trend in DMY. Moreover, during the dry period, heat stress results in impaired mammary growth, leading to reduced milk yield in the subsequent lactation. Nevertheless, the effects of heat stress on milk composition and quality are inconclusive (Tao *et al*., 2018). Values obtained with Holstein crossbred dairy cattle confirmed the high potential of those crossbred and their adaptability in tropical milieu.

Year of calving had a significant ($p<0.05$) effect on DMY. Djoko *et al*. (2003) found similar results with the same crossbred and Doko *et al.* (2012) in Benin with Girolando cattle. Indeed, crossbred cattle that calved from 1987 to 1989 had a DMY lower that crossbred cattle calving in 1990, 1991 and 1994. This difference in production could be linked to the evolution of the lactation number (parity) across years. From 1987 to 1989, most of crossbred cattle were at their first parity while in 1990, 1991 and 1994 these cattle were already above the first parity. These yearly variations in DMY according to Kiwuwa *et al*. (1983) could be attributed to climatic differences across years and also to zootechnical differences such as lactation number and pathology problems across years.

Parity was found to have a non-significant effect on DMY ($p>0.05$). This result although in accordance with the findings of Bayou et al. in 2015, was different from the findings of Wondifraw *et al.* (2013). Results revealed a nonlinear increase of DMY with the increase of the parity. However, heifers had lower DMY compared to cows at the higher parities with crossed dairy cows of parity 7 having the highest DMY. This could be due to the fact that young lactation cows have lower energy balance for growth and lactation as they cannot consume adequate energy in the diet (Bayou *et al.* 2015).

Genetic and non-genetic factors affecting lactation peak milk (kg) of Jersey-White Fulani and Holstein-Gudali genetic crossed dairy cows

Results obtained concerning the influence of the level of exotic blood on the lactation peak milk yield (LPM) of different crossed cows used in this study was similar to the finding of Doko *et al*. (2012) who did not find any significant differences for LMP between crossbreds with Girolando cattle in Benin. However, in this study, results revealed a non-significant increase of LPM with an increase in exotic blood amongst the genetic group of Jersey crossed dairy cows. Meanwhile in the genetic group of Holstein crossed dairy cows, there was no clear trend between the degree of exotic blood and LPM. These observations were contrary to the results of Doko *et al.* (2012) who revealed that LPM decreased when the degree of exotic blood increased. The average value of lactation peak milk obtained in the present study was higher than the results obtained by Doko *et al.* (2012) with Girolando cattle in Benin but lower than the results obtained with Holstein in Morocco by Boujenane (2010). Although the level of exotic blood did not affect ($p>0.05$) the lactation peak milk, genetic crossed group V recorded the highest LMP. The value obtained with Holstein crossbred dairy cattle confirmed the high potential of those crossbred and their adaptability in tropical milieu.

Calving season had no significant ($p>0.05$) effect on the lactation peak milk. Doko *et al.* (2012) observed dissimilar significant effects of seasons on LPM with Girolando cattle in Benin. This non-significant influence of seasons on LPM could be attributed to the reduction of feed unavailability during the dry season through regular administration of feed supplementation and silage (Kamga *et al.*, 1989).

Year of calving had significant ($p<0.05$) effect on LPM of Jersey-White Fulani and Holstein-Gudali genetic crossed dairy cows. Doko et al. (2012), observed similar significant effects of years of calving on LPM with Girolando cattle in Benin. LPM fluctuated across years without a clear tendency. The fluctuations observed in lactation peak milk production could also be associated with changes in the quality and availability of concentrate supplements and maize silages offered to lactating cows over the years (Tawah *et al*. 1999). In addition, differential responses to heat stress in exotic genotypes, and their variable susceptibility to various diseases under similar conditions could explain the fluctuations (Mbah, 1984). Heat stress and diseases, coupled with untimely and sporadic interventions in some years may have contributed to the observed trends in LPM. A component of the observed trends may have originated from variations in the genetic quality of imported semen over the years (Mbah *et al.,* 1987).

Parity was found to significantly affect ($p<0.001$) lactation peak milk. This finding was in accordance with the findings of Boujenane (2010) in Morocco with Holstein and Doko *et al.* (2012) with Girolando cattle in Benin. Results revealed that LPM increased with increase of the parity from the parity 1 with the lowest value to the parity 5 with the highest value recorded with a difference of 7 kg between the two parity (1 and 5). According to Boujenane (2010), as observed with LMY, lactation peak milk reached it maximum at the fifth parity. The peaked yield of LPM at the fifth lactation was mainly due to the increase in body weight combined with advancing age at full development of secretory tissues of the udder. The decreased observed after fifth parity might be due to the fact that physiological activities of all body systems which start to decrease with age and the secretory tissues of mammary gland are partially degenerated leading to gradual decrease in milk production with advance in age.

Genetic and non-genetic factors affecting calving intervals lactation peak (days) of Jersey-White Fulani and Holstein-Gudali genetic crossed dairy cows

Least square means and standard errors of effects of genetic and non-genetic factors on calving intervals lactation peak (days) of Jersey-White Fulani and Holstein-Gudali genetic crossed dairy cows revealed that the overall calving intervals lactation peak (CILP) recorded in this study was lower than the value (75.26 ± 1.76 days) obtained by Doko *et al.* (2012) with Girolando cattle in Benin. This difference could be due to the difference expression of the genetic potential of genetic crossed involved (Holstein-Gudali and Jersey-White Fulani in Bambui and Holstein-Gir in Benin) coupled with climatic and zootechnical factors.

Level of exotic blood did not affect ($p>0.05$) calving intervals lactation peak of crossed dairy cows in this study. Doko *et al.* (2012) also found no statistical difference of degree of exotic blood on CILP. Results obtained in the present study showed that CILP varied from 27.19 ± 3.68 days performed by the genetic crossed group II to 39.86 ± 9.89 days performed by crossed cows of group V. Though non-significant, these results were lower than the findings (70.9 ± 3.3, 76.3 ± 2.1 and 78.0 ± 7.3 days respectively for 25% 50% and 62.5% of Gir blood) of Doko *et al.* (2012) with Girolando. Breeding conditions coupled with climatic and zootechnical factors could be mentioned as responsible of these variations. Values obtained with Holstein crossed dairy cows c onfirmed the high potential of those crossbred and their adaptability in tropical milieu.

Calving season did not significantly ($p>0.05$) affect calving intervals lactation peak in this study. Doko *et al.* (2012) found dissimilar results revealing a significant difference in seasons. This non-significant influence of seasons on the calving intervals lactation peak could be attributed to the reduction of feed unavailability during the dry season trough regular administration of feed supplementation and silage during the dry season to compensate the deleterious effect of dry season on feed availability.

Significant effect ($p<0.05$) of year of calving on the CILP of Jersey-White Fulani and Holstein-Gudali crossed dairy cows was observed in this study. Doko *et al*. (2012) also found a significance amongst years. These fluctuations of CILP across years could be attributed to climatic differences as a result of fluctuations in feed (pastures) availability and quality through the seasons and years and could been attributed to the zootechnical differences such as lactation number and pathology problems across years.

Parity was found to not affect ($p>0.05$) calving intervals lactation peak. Results revealed a non-linear decrease of CILP with the increase of the parity though Doko *et al*. (2012) reported significant effects of CILP on parity. This could be attributed to the advance in age of cows. Similar results were found by Boujenane (2012) with Holstein in Morocco and Doko *et al.* (2012) with Girilando in Benin. However, values obtained for CILP were lower than the values obtained by Doko *et al*. (2012) and closer to values obtained by Boujenane (2012).

Conclusion

At the end of this research work, it appeared that daily milk yield, lactation peak milk and calving interval lactation peak varied between the different genetic crossed. These lactation performances increased with exotic blood with the best performances observed in the genetic crossed group V (75%Hx25%G). Values obtained by Holstein-Gudali crossed cattle (75%Hx25%G) show the high potential of these crossed cattle and their adaptability in tropical environment probably due to the complementarity of characters (precocity of Holstein and hardiness of Gudali).

CONFLICT OF INTEREST

The authors declare no conflict of interest in the realization and publication of this piece of work.

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