

Reproductive Performance and Milk Production of Girolando Cows in the Ranch of Kpinnou, South-West of Benin Republic

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Abstract: Reproduction and milk production of Girolando cows raised in the ranch of Kpinnou were studied from 2005-2008. The traits recorded were: age at 1st calving (92 records), calving interval (205 records), daily milk yield, peak milk yield, lactation yield (205 records), lactation length and dry period. The fixed factors tested were rate of blood Gir, season of calving, lactation number, year of birth and year of calving. The overall mean of age at 1st calving, calving interval, daily milk yield, peak milk yield, lactation yield, lactation length and dry period were respectively 35.3±0.4 months, 468±14 days, 7.2±0.2, 12.3±0.2, 1739±43 kg, 239±3 days and 229±8 days. The rate of blood Gir had a significant effect ($p<0.05$) on age at 1st calving, daily milk yield and lactation yield but not significant ($p>0.05$) on peak milk yield, lactation length and dry period. Lactation number, season of calving and year of calving significantly affected ($p<0.05$) all studied traits.

Key words: Calving season, age at 1st calving, milk yield, Girolando, peakmilk, Benin Republic

INTRODUCTION

Republic of Benin is located in Western Africa, bordering the Atlantic ocean. The country covers an area of 114 000 km² and has 8 million inhabitants from which 70% are agricultural workers. Agriculture contributes to 37% of GDP and over 85% of export earnings. Livestock production contributes to about 6% of national GDP. The cattle population is estimated to 1.9 million heads. This herd is made up of cattle breeds' Laguna, Somba and Borgou (31%), zebu M'Bororo, Gudali and White Fulani (8%) and their crossbreeds (61%) (Dossou *et al.*, 2006). Milk production of these breeds is low and varies from 1-2.5 L day⁻¹ for a lactation length of 150-180 days (Dossou *et al.*, 2006). The low productivity of these indigenous breeds cannot meet Beninese' needs in milk and the deficit is met through imports which economic implications are now a burden. The imports of milk and dairy products rose from 1.5 billion in 1993 to 20 billion XOF in 2008. However, average milk consumption in Benin is still low, even alarming not exceeding 20 kg per capita per year compared to the average of 34 kg in most developing countries and 50 kg recommended by FAO (Dossou *et al.*, 2006). To reach this level of consumption, there is a need to increase national milk production threefold and this requires a modernization of Benin milk production. Thus, a breeding program focused on pure breeding, crossbreeding and dissemination of improved

animals on farm has been established by the Project of Livestock Development in Samiondji ranch for Lagune cattle, Betecucu and Okpara ranches for Borgou. In addition, Girolando heifers were introduced from Brazil to Kpinnou ranch in 2004.

The aim of this study was to assess the effects of the rate of blood Gir, calving season, lactation number and year of calving on the reproductive performances and milk production of Girolando cows imported from Brazil-Benin Republic.

MATERIALS AND METHODS

Study area: The ranch of Kpinnou is located in the District of Athieme at latitude 6°33'North and longitude 1°47'East (South-West of Benin). The ranch is 400 km² in area. The climate is of Guinean type with two dry seasons (January-March-S1 and August-September-S3) and two rainy seasons (April-July-S2 and October-December-S4). During the period of 1999-2009, the averages annual rainfall, temperature and relative humidity were respectively 1351±212 mm, 28.2±0.6°C and 73.4±1.9%. March was the hottest month while December was the coolest of the year.

Animal management: Girolando (5/8 Holstein-3/8 Gir) is a breed of dairy cattle created in Brazil by crossing Gir cattle, a *Bos indicus* breed which is resistant to hot

temperatures and tropical diseases with Holstein (*Bos Taurus*). Girolando heifers were imported from Brazil to Kpinnou ranch in December 2004. The management pattern at the ranch of Kpinnou was semi intensive and the average annual herd size was 134 heads. The animals were grouped in four herds: milking cows, dry cows and heifers in gestation period, weaned calves, heifers and bulls. During the rainy season, the animals were put in rotation on artificial pastures of *Panicum maximum* and *Andropogon gayanus*. During the dry season, they were fed with hay of *Brachiaria ruziziensis* and silage made of Guatemala grass (*Trypsacum laxum*) and elephant grass (*Pennisetum purpureum*). In complementation, cows received 4 kg of concentrate per day during the morning milking at 6 am and the afternoon at 4 pm. Milking was done using a machine branded Alfa Laval. Water and salt lick were provided *ad libitum*. After calving, calves received colostrums from their dam at will for 2 or 3 days. Then they were separated from her and placed in individual calf pens where they received 3-5 L of milk per day until weaning at 16 weeks. Concentrates and forages were fed progressively from 10th days until weaning. The natural mode of reproduction was adopted in the ranch of Kpinnou. The animals were regularly vaccinated against pasteurellosis, fever and contagious bovine pleuropneumonia. Each 3 months they were dewormed with albendazole and treated against trypanosomiasis. The animals were sprayed once a week during the dry season and twice a week during the rainy season against ticks. They were also screened for tuberculosis and brucellosis each year. Specific treatments were administered to each disease.

Data collection: Data were collected from the individual cow monitoring database. They covered the period from 2005-2008. For each cow identification number, date of birth, date of mating, date of calving and the identification number of the parent were recorded. Each cow also had a record collection of milk where the quantity of milk produced per day and per lactation was recorded. From the 105 age at 1st calving and the 267 lactations initially collected only 92 age at 1st calving and 205 lactations were included. Data from cows which date of birth or calving and number of calving are unknown and lactation interrupted due to illness were excluded. The lactation length was evaluated from the collection of milk after calving until drying up. The dry period was calculated from the end of lactation until next calving. The calving interval represented the time recorded between two successive calving.

Statistical analysis: The traits analyzed were age at first calving (days), calving interval (days), daily milk yield

(kg), peak milk yield(kg), lactation milk yield (kg), lactation length (days) and dry period (days). The fixed factors tested were rate of blood Gir, calving season, lactation number and year of calving. The year of birth was tested only on the age at 1st calving. Data were analyzed using the General Linear Model (GLM) of SAS (2003), according to the linear fixed model below. Duncan's method was used to compare means when they were significantly different:

$$Y_{ijklm} = \mu + G_i + S_j + P_k + C_l + \epsilon_{ijklm}$$

Where:

- Y_{ijklm} = Alternatively represents one of the traits of the cow ijklm
- μ = Overall mean
- G_i = Fixed effect of the rate of blood Gir i (i = 25, 50 and 62.5%)
- S_j = Fixed effect of calving season j (j = S1, S2, S3, S4)
- P_k = Fixed effect of lactation number k (k = 1, 2, 3)
- C_l = Fixed effect of the year of calving l (l = 2005, 2006, 2007, 2008) or year of birth l (l = 2002, 2003, 2005, 2006 for age at 1st calving)
- ϵ_{ijklm} = Random error effect

RESULTS AND DISCUSSION

The rate of blood Gir had a significant effect ($p < 0.05$) on age at 1st calving and insignificant ($p > 0.05$) on calving interval (Table 1). Age at 1st calving was higher ($p < 0.05$) in cows with 50% blood Gir and lower ($p < 0.05$) in those with 62.5% of blood Gir. Age at 1st calving is closely

Table 1: Least square mean±SE of age at 1st calving (months) and calving interval (days) of Girolando cows in the ranch of Kpinnou, Benin Republic

Sources of variation	Age at 1st calving	Calving interval
Overall mean	35.3±0.4 (92)	468.4±13.6 (205)
Rate of blood Gir (%)		
25	34.9±1.3 ^b (16)	470.2±16.2 ^a (45)
50	36.8±0.4 ^a (62)	464.0±9.0 ^a (146)
62.5	29.2±0.4 ^c (14)	509.5±8.40 ^a (14)
Calving season		
S1	-	482.1±14.5 ^{ab} (68)
S2	-	445.5±10.3 ^b (48)
S3	-	437.4±11.0 ^b (30)
S4	-	487.2±16.0 ^a (59)
Lactation number		
1	-	526.3±13.5 ^a (92)
2	-	432.5±04.7 ^b (81)
3	-	393.3±02.6 ^c (32)
Year of birth or calving		
2002	38.5±0.5 ^a (34)	-
2003	34.7±0.4 ^b (44)	-
2005	30.3±0.3 ^c (8)	543.8±26.3 ^a (31)
2006	27.7±0.4 ^c (6)	507.4±18.1 ^a (54)
2007	-	435.5±05.5 ^b (77)
2008	-	424.3±07.1 ^b (43)

Values in bracket are number of observations; ^{a-c}Least square mean with different superscript letters on the same column differ significantly ($p < 0.05$)

Table 2: Least square mean±SE for daily milk yield (kg), peak milk yield (kg), lactation yield (kg), dry period (days) and lactation length (days) of Girolando cows in the ranch of Kpinnou, Benin Republic

Sources of variation	N	Daily milk yield	Peak milk yield	Lactation yield	Dry period	Lactation length
Overall mean	205	7.2±0.2	12.3±0.2	1739±43	229.0±8.10	239.3±3.00
Rate of blood Gir (%)						
25	45	8.0±0.3 ^a	13.1±0.5 ^a	1928±61 ^a	226.3±18.7 ^a	243.9±6.10 ^a
50	146	7.1±0.2 ^b	12.1±0.3 ^a	1727±55 ^b	224.2±9.60 ^a	239.6±3.60 ^a
62.5	14	5.7±0.4 ^c	11.4±0.6 ^c	1255±95 ^c	287.4±14.6 ^a	222.1±13.1 ^a
Calving season						
S1	68	6.7±0.3 ^a	11.1±0.4 ^a	1548±70 ^a	252.1±15.9 ^a	230.0±5.80 ^a
S2	48	7.6±0.4 ^b	12.9±0.5 ^b	1795±94 ^b	209.5±12.5 ^b	235.9±6.40 ^a
S3	30	7.4±0.2 ^b	13.9±0.5 ^{bc}	1916±82 ^b	180.8±12.6 ^b	256.7±5.20 ^b
S4	59	7.5±0.3 ^b	12.3±0.4 ^b	1822±85 ^b	242.6±16.8 ^{ab}	244.1±5.40 ^{ab}
Lactation number						
1	92	5.9±0.2 ^a	10.3±0.3 ^a	1367±48 ^a	295.6±14.1 ^a	230.4±5.00 ^a
2	81	8.1±0.3 ^b	13.1±0.4 ^b	1967±69 ^b	190.1±6.00 ^b	242.4±4.50 ^a
3	32	8.7±0.2 ^b	15.9±0.3 ^c	2229±47 ^c	135.8±5.30 ^c	257.4±5.20 ^b
Year of calving						
2005	31	5.9±0.3 ^a	10.3±0.5 ^a	1438±74 ^a	298.2±26.8 ^a	244.6±7.70 ^{ab}
2006	54	6.2±0.3 ^a	10.3±0.4 ^a	1412±77 ^a	283.2±19.2 ^a	224.2±6.70 ^a
2007	77	7.7±0.2 ^b	13.3±0.3 ^b	1963±68 ^b	183.5±6.60 ^b	252.0±4.00 ^b
2008	43	8.5±0.3 ^c	14.5±0.5 ^c	1964±84 ^b	192.5±11.5 ^b	231.9±6.70 ^a

^{a-c}Least square mean with different superscript letters on the same column differ significantly (p<0.05)

related to the age at puberty which varies according to breed, season, feeding and rearing conditions (Schillo *et al.*, 1983; Mohamed *et al.*, 2010). Cows with 62.5% of blood Gir were born at Kpinnou ranch and had certainly benefited from improved farming conditions enabling them to have an age at 1st calving shorter. The effect of calving season on calving interval was significant (p<0.05) and animals born during the seasons S2 and S3 had got the shortest (p<0.05) calving interval (Table 1). These seasons would provide cows the best feeding conditions enabling them to return quickly to heat to be fertilized again. In most studies, calving during warm seasons adversely affected reproduction in dairy cattle (Ray *et al.*, 1992; Moore *et al.*, 1992; Farin *et al.*, 1994; Silva, 1998). Lactation number significantly (p<0.05) affected Girolando cows calving interval (Table 1) which declined with increasing lactation number from 1-3 tending toward the threshold of 365 days or one calf per cow per year, optimum lens of temperate dairy cattle (Coleman *et al.*, 1985). In general, first parity cows required longer calving interval than the third or above parity cows (Goshu *et al.*, 2007). This may be due to the additional nutritional requirements of cows in early lactation life for growth. Year of birth had significant effect (p<0.05) on age at 1st calving and year of calving significantly affected (p<0.05) the calving interval (Table 1). The effect of the year on these reproductive parameters can be attributed to variations in rainfall conditioning forage resources, the basis of feeding the Girolando cows at the ranch of Kpinnou.

The rate of blood Gir had a significant effect (p<0.05) on daily milk yield and lactation yield which declined with the increase of blood Gir but not significant (p>0.05) on peak milk yield, lactation length and dry period (Table 2).

This is in agreement with the findings of other researchers in Brazil (Madalena *et al.*, 1990; Freitas *et al.*, 1998; Faco *et al.*, 2002) who reported that increasing the proportion of Holstein-Friesian genes did not have any significant effect on milk yield when herds were raised under poor management conditions. Calving season was a source of significant variation (p<0.05) for daily milk yield, peak milk yield, lactation yield, lactation length and dry period (Table 2). Thus, the season S2, S3 and S4 had fostered a better (p<0.05) milk production. Season S3 which corresponded to the short dry season (August-September) gave the best (p<0.05) peak milk yield (Table 2). Lactation peak coincided to season S4 (small rainy season) during which the harmattan (dry and cool wind), creating a mild climate similar to the ones in Brazil. Similar effect of calving season on milk production of dairy cattle has been observed (Ray *et al.*, 1992; Silva *et al.*, 1992; Moore *et al.*, 1992). Lactation number had a significant effect (p<0.05) on daily milk yield, peak yield, lactation yield, lactation length and the dry period (Table 2). Milk production of Girolando cows increased (p<0.05) while the dry period decreased (p<0.005) with lactation number from 1-3. Year of calving significantly affected (p<0.05) the daily milk yield, peak yield, lactation yield, lactation length and dry period (Table 2). The effect of the year on milk production of Girolando cows can be attributed to changes in climatic conditions (rainfall, temperature) from 1 year to another.

Reproductive performance and milk production of Girolando cows at the ranch of Kpinnou are lower than those of Brazil. Analysis of data (1996-2004) from 3282 lactations of Girolando cows revealed that age at 1st calving, calving interval, 305 days milk yield and lactation length averages were 34 months, 420 days, 3349 kg and

272 days, respectively (Freitas *et al.*, 2006). The overall mean of daily milk yield observed here (7.2 kg day⁻¹) was higher than the ones reported by Freitas *et al.* (1998) on Brazilian crossbred dairy cows (6.9 kg day⁻¹). On the other hand, it was lower than the average of 10.1 kg day⁻¹ obtained by Mackinnon *et al.* (1996) and the 13.1 kg day⁻¹ reported by Facó *et al.* (2002) for five Holstein x Gir genetic groups raised under different feeding system in Brazil. The low performances of Girolando cows in Benin Republic may be related to climate of Kpinnou ranch, characterized by high temperature and relative humidity. These two factors in addition to radiation and wind can influence the degree of heat stress (Jordan, 2003). Heat stress is one of the main causes that decreases dry matter intake and feed digestion (Morand-Fehr and Doreau, 2001), reduces the efficiency of milk yield (West, 2003; Bohmanova *et al.*, 2008; Molee *et al.*, 2011) and reduces the fertility (Jordan, 2003). The results can also be explained by the infectious diseases of reproduction such as retained placenta, endometritis, vulvovaginitis and other pathologies such as lumpy skin disease, foot and mouth disease, mastitis and gastrointestinal parasites. The effect of nutrition on reproduction and milk production of dairy cows could also be considered. There were seasonal and annual variations in the quantity and quality of forage available to feed the cows at the ranch of Kpinnou. Moreover, the availability and quality of concentrates and silage were also varied over time. Heat stress and different diseases, coupled with inappropriate and infrequent interventions have contributed to lower milk production performance of dairy cows at Kpinnou ranch.

CONCLUSION

The study showed that reproductive performance and milk production of Girolando cows at the ranch of Kpinnou are lower than those of Brazil, their mother country. The rate of blood Gir led to lower milk production and reduction of age at first calving especially in Girolando cows born in Benin Republic. A significant improvement in all traits was noted with increasing lactation number from 1-3. Significant variations of studied traits due to year and season of calving were noticed.

Thus, the calving season S3 resulted in the best reproductive performance and milk production. Calving schedules may be adjusted to minimize the adverse effect of heat stress. These results may serve as a basis for selection for increased milk production of the Girolando herd at the ranch of Kpinnou.

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