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Effects of Non Genetic and Crossbreeding Factors on Daily Milk Yield of Jersey x Sahiwal x Ankole Cows in Burundi

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Abstract: The study was conducted at the Rukoko station located at 21 km North-Western of Bujumbura in the Imbo natural region, in the South of Rusizi River. The objective was to assess the effects of year of lactation, genetic group, lactation length, season and parity on the Daily Milk Yield (DMY) of Jersey (J) x Sahiwal (S) x Ankole (A) crossed cows. Milk yields were obtained from cows that have been both Suckled and Milked (SM) or only Milked (M). Data were analyzed using the procedure GLM in SAS on SM and M cows, separately. All factors affected significantly DMY ($p<0.001$). A significant increase was observed from 1989-1991 due to the improvement of management techniques. During this period, the production raised from 10.07±0.22 L-11.50±0.17 L day^{-1} for SM cows. Unfortunately, the 1993 civilian war destabilized the managerial techniques and consequently, the milk production decreased. Highest milk yields were observed in crossed cows with 50% of Jersey and 50% of Sahiwal inheritances. Peak yields occurred at the 43rd (12.67±0.42 L) and 56th (6.42±0.45 L) days in milk for SM and M cows, respectively. Milk production was significantly higher in January (11.04±0.23 L day^{-1}), in the middle of the rainy season, than in July (7.02±0.18 L day^{-1}), in the middle of the dry season. Milk yield in SM cows increased from 8.15±0.17 L-9.46±0.16 L day^{-1} during the 1st and the 2nd lactation, respectively.

Key words: Daily milk yield, crossbreeding, jersey, sahiwal, ankole, Burundi

INTRODUCTION

Local breeds are well adapted to the stressful conditions prevailing in sub-saharan regions. They have a high degree of heat tolerance and resist to many tropical diseases. They are also able to survive to long periods of feed and water shortage (Nouala *et al*., 2003; Tadesse and Dessie, 2003). However, local breeds are characterised by poor dairy potential due to their low genetics and to environmental factors like poor roughage quality, heat and disease, limited know-how of the smallholders and low supplement inputs used in breeding activities (Nouala *et al*., 2003; Meyn and Wilkins, 2006; Mwenya, 2006).

Bos taurus breeds that are predominantly found in temperate countries have a high potential for milk production but they are not well adapted to the tropical conditions because of their little heat tolerance and low disease resistance (Tadesse and Dessie, 2003). Therefore, crossing *Bos indicus* with *Bos taurus* dairy breeds has been widely used to combine the high milk production potential of exotic breeds with the adaptability of the local ones (Kiwuwa *et al*., 1983). The principal exotic dairy breeds used for crossing are Friesian, Holstein, Ayrshire, Jersey, Guenersey and Sahiwal. Adeneye and Adebenjo (1978) and Syrstad (1990) reported that Friesian crosses were superior to the other temperate breed crosses for growth and milk production if they are given improved environmental conditions to express their genetic potential. The Jersey crosses are more adapted to high temperature climate than Friesian crosses (Lemerle and Cobrard, 1986). There are also, recommended for smallholders because of their small mature size which necessitates low input. Moreover, high levels of fat and protein in Jersey milk and the good reproductive traits of this breed justify its use in crossing with local breeds (Syrstad, 1990; Nubi *et al*., 1992, Dhara *et al*., 2006).

In Burundi, the traditional sector is predominantly composed of Ankole cattle, characterised by poor

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production, especially milk traits. The smallholder uses the animal's manure to improve the soil fertility and milk is self-consumed. Farmers sell males to generate income (Berahino, 1990). But this traditional breeding is threatened by a decrease in available pasture owing to the needs of the population for crops. Since 1950, the ISABU (Institute of Agronomic Science in Burundi) has initiated a programme to improve the Ankole potential traits by crossing it with foreign breeds (Banzira, 1990). In the Mahwa and Rukoko stations, Ankole was firstly crossed with Sahiwal. In 1966, a herd of Jersey was introduced in the Kiryama public farm (Banuma, 1988) and some of these cows were transferred in the Rukoko station (in 1982) to be crossed with Sahiwal x Ankole cows (Buhwibiri, 1990).

The objective of this study is to asses the effects of environmental and crossbreeding factors on the Daily Milk Yields (DMY) of cows of the Rukoko station.

MATERIALS AND METHODS

Site: The Rukoko station is located at 21 km north western of Bujumbura, south of the Rusizi River, in the natural region of Imbo plain at 700 m altitude, with 270 ha of area (Berahino, 1990). The weather is characterised by a rainy season from November to April and a dry period from May to October (Berahino, 1999). According to the IGEBU (Institut Geographique du Burundi) (2000), the rainfall ranges from 691 mm in 2000 to 1,111 mm in 1996. The mean temperature oscillates between 22.9 and 26.1°C.

The natural pasture is mainly composed by *Brachiaria ruzisienzis*, *Temeda triandra* and *hyparrhenia* grasses. The hot climate and the important population of tsetse fly are favourable to the occurrence of trypanosomiasis.

Animal and herd management: Cows were allowed to graze extensively on the native pasture early in the morning from 7.00-12.00 am and late in the afternoon from 15.00-18.00 pm. From 12.00-15.00 pm, they were returned to the barn where they received water *ad-libitum* and the available cultivated forage mainly composed of *Pennisetum purpureum*. Before the 1993 civilian war, the herd received adequate supplementary feeding but not after it. For each litre of milk produced, lactating cows were supplemented with 0.25 kg of a concentrate composed with 20% oil cake of palm tree, 35% rice bran, 35% corn maize, 10% soya flour and 4% minerals. During the dry season, lactating cows received silage of *Pennisetum purpureum*. The quantity of silage and concentrate distributed depended on their availability. Lactating cows were hand milked twice daily (6.00 am and 18.00 pm) and the production was recorded every day. During the first part of the parturition, calves were allowed to suckle and the milk they consumed was estimated by weighting them before and after suckling.

Data: Total daily milk yields were collected from 1989-1993 and from 1997-2000 on 40 lactating cows for a total of 17,125 records. Data included the animal's identity, its genetic group, birth and calving dates, lactation number, year and month of lactation, lactation length and quantity of daily milk produced (possibly including the estimated suckled milk). For every DMY, the fact that milk yields were obtained from cows only Milked (M) or Suckled and Milked (SM) was specified. Only lactation lengths of 100-305 days were considered in the analyses because lactations lasting >100 days were associated with diseases (540 records deleted). Data from parity 1-9 have been recorded and parities above the second were considered as a third parity. Animals belonged to one of five different genetic groups defined on the basis of the mating system used to produce them (Table 1).

Data analysis: Data were analyzed using the procedure GLM in SAS with the following linear model:

$$Y_{ijklmn} = \mu + A_i + B_j + C_k + D_l + F_m + e_{ijklmn}$$

where:

Y_{ijklmn} = A single DMY
μ = The overall DMY mean
A_i = The effect of ith year of lactation (i = 1989,... 1993;1997, ...2000)
B_j = The effect of jth genetic group (j = 1, 2... 5)
C_k = The effect of kth day in milk (k = 1, 2... 305)

Table 1: Number of cows and records per genetic group, least-squares means of DMY for Suckled and Milked (SM) and only Suckled (S) cows per genetic group

Codes of genetic groups	Explanations	Number of cows	Number of records	LSM of DMY (l)±SE	
				SM	M
S	Sahiwal purebred	3	1,708	6.69±0.16	2.89±0.08
SJA	Sahiwal x Ankole x Jersey (50-75% Sahiwal, 12.5% Ankole, 12.5-37.5% Jersey)	18	8,084	8.49±0.13	5.14±0.06
JSA	Jersey x Sahiwal x Ankole (62.5% Jersey, 25% Sahiwal, 12.5% Ankole)	10	3,181	8.20±0.16	4.80±0.07
JS	Sahiwal x Jersey (50% Sahiwal, 50% Jersey)	6	2,607	11.00±0.16	6.89±0.07
SJ	Sahiwal x Jersey (75% Sahiwal, 25% Jersey)	3	985,000	9.56±0.40	5.23±0.08
Total		40	16,565		

D_l = The effect of lth month of lactation (l = 1, 2 ... 12),
F_m = The effect of mth parity (m = 1, 2, 3)
e_{ijklmn} = The random error

Daily milk records of SM and M cows were analyzed separately. Results are given as least-squares means±standard errors ($p<0.001$).

RESULTS

The models explained 52.75 and 55.92% of the total variability of DMY for SM and M cows, respectively. Through the decomposition of the model sum of squares into sequential sum of squares, it was observed that year of lactation and genetic groups explained 49.2 and 17.8% of the total variation in DMY of SM cows, respectively. The overall DMY means for SM and M cows were 10.56 L and 4.89 L day^{-1}, respectively.

Differences were observed between years and months of production: DMY for SM cows increased from 10.07±0.22 L in 1989 to 11.50±0.17 L in 1991 and decreased thereafter with a drop to 3.79±0.29 L in 1998 (Fig. 1).

Yields were lowest during the dry season. The minimum was observed in July for SM (7.02±0.18 L) and M (4.35±0.09 L) cows, at the middle of the dry season. Higher DMY were maintained from November until April corresponding to the end of the rainy season. The maximum of DMY was obtained in January for SM cows (11.04±0.22 L) at the middle of the rainy season (Fig. 2).

Differences were observed between crossbred and purebred cows. The JS were the best productive cows with SM producing 11.00±0.16 L day^{-1} and M producing 6.89±0.09 L day^{-1}, followed by SJ group with 9.56±0.40 and 5.23±0.08 L day^{-1} for SM and M cows. The S was the less productive genetic group with 6.69±0.16 and 2.88±0.08 L day^{-1}) for SM and M cows, respectively (Table 1).

Milk yield increased from 8.21±0.42 L day^{-1} on the 1st day in milk to a peak of 12.67±0.42 L day^{-1} on the 43rd day. In SM cows, a drop was observed at the 127th day (7.85±1.53 L day^{-1}) followed by a second and unexpected increase with a maximum at the 143rd day in milk (12.09±1.87 L day^{-1}). Lactation shape for M cows was more regular than that of SM cows with a peak of 6.42±0.45 L day^{-1} on the 56th day in lactation (Fig. 3).

The DMY for the 1st, 2nd and the 3rd parity were, respectively 8.14±0.17, 9.46±0.16 and 9.02±0.17 L for SM cows and 4.58±0.07, 5.22±0.06 and 5.38±0.06 L for M cows.

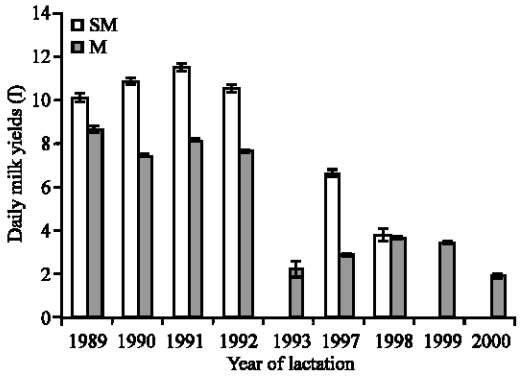

Fig. 1: Least-squares means of daily milk yields for Suckled and Milked (SM) or only Suckled (S) Jersey crossbred cows as a function of years of lactation in the Rukoko station

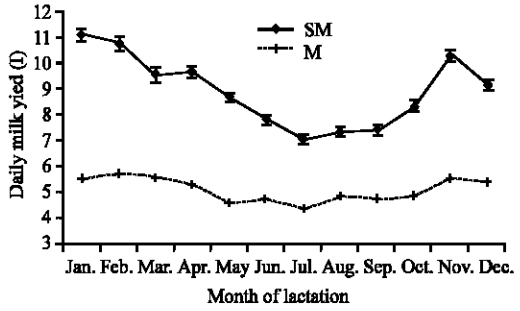

Fig. 2: Least-squares means of daily milk yields for Suckled and Milked (SM) or only Suckled (S) Jersey crossbred cows according to the month of lactation in the Rukoko station

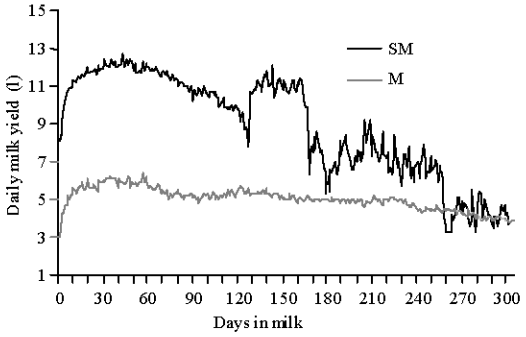

Fig. 3: Evolution of daily milk yields for Suckled and Milked (SM) or only Suckled (S) Jersey crossbred cows during the lactation period in the Rukoko station

DISCUSSION

The overall DMY mean observed for SM (10.56 L day^{-1}) cows was in agreement with DMY

estimated in 1981 on the ISAR (Institut des Sciences Agronomiques du Rwanda) herd of Jersey x Sahiwal which produced 10.50 L day^{-1} (Berahino, 1999). It was higher than the overall DMY mean (5.49 L day^{-1}) for Ayrshire x Sahiwal x Ankole crosses cows obtained in the other station at Mahwa (Hatungumukama *et al*., 2006). Effectively, most of daily milk records in the Rukoko station were gathered before 1993, when animal management was intensive. Moreover, natural grazing (mainly composed by *Brachiaria ruziziensis*) in the Rukoko station is more nutritive than the Mahwa natural grazing (mainly composed bye *Eragrostis Olivacea*). On the other hand, value reported for M cows (4.89 L day^{-1}) was lower than that estimated for the Jersey x Hariana crosses cows (5.20 L day^{-1}) by Dhara *et al*. (2006). Note the DMY obtained for SM cows was twice higher than DMY observed on the M cows. Tesorero *et al*. (2001) found that the presence of a suckling calf improved milk production of Brahman x Holstein crosses. Indeed, suckling stimulates milk ejection and increases milk production (Orihuela, 1990). This phenomenon seems so pronounced on *Bos indicus* breeds and their crosses that milking may become difficult when the calf is absent (Patel and Patel, 1969). The same phenomenon is observed on Ankole cows that may interrupt milk ejection when their calves died or when suckling is stopped (Hatungumukama *et al*., 2006).

The increase in milk production from 1989-1991 may be explained by the improvement of environmental techniques and animal management practices. The important decrease observed at the start of 1993 is undoubtedly related to the civilian war which caused organizational constraints at ISABU. Similar drop was reported on Ayrshire crossed cows in the Mahwa station (Hatungumukama *et al*., 2006).

One of the most important constraints on milk production in the tropics is the little available resources of natural forage during the dry season, as described by Epaphras *et al*. (2004). Moreover, the high temperatures observed during the dry season reduce feed intake with a concomitant decrease in milk production (Breihnholt *et al*., 1981; Morand-Feghr and Doreau, 2001). Such phenomenon explains why milk production was significantly higher in the rainy than the dry season (Fig. 2).

The effect of type of crossbreeding was limited by the small number of DMY records available. The JS (50% Jersey and 50% Sahiwal) cows produce highest DMY than other crossed cows. This result is in agreement with results reported by Syrstad (1990) who confirmed that the maximum milk production can be observed in *Bos indicus* cows crossed with 50-75% of *Bos taurus*.

The lactation shape for SM records was in disagreement with the theoretical curve as described by Wood (1976). On the other hand, the milk production drop observed at 127th day in milk was in agreement with results found out in SM cows in our previous study (Hatungumukama *et al*., 2006). One explication may be that cows lost the stimulus for milk production when their calves were weaned and hence, milk production decreased. Indeed, LSM of DMY for M cows did not show a similar drop. The curve for SM cows may also be explained by little data available.

The increase of DMY from parity 1-3 and more for M cows was consistent with results in the literature (Tadesse and Dessie, 2003; Epaphras *et al*., 2004; Bee *et al*., 2006). The highest production observed in the highest parity may be explained by a greater feed intake in older than younger cows (Johnson *et al*., 2002). Unlike, DMY for SM cows was maximum in parity 2 and not in higher parities. The few data in this group was believed to be the source of the observation.

CONCLUSION

Our study showed that mating local breeds with Jersey improved milk production, although the 1993 war destabilized genetic improvement and diminished managerial techniques. Nowadays, there is a need to restore genetic improvement and ameliorate managerial technique to increase milk production in the Rukoko station. With the reestablishment of the peace in the area, the data gathering will be restored and improved to assess continuously breeding activities.

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