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Dairy Crossbreeding: An Option to Face the Challenges of Climate Change-Productive and Reproductive Features from Two Different Genetic Groups

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Abstract

Crossbred animals are widely used in dairy farming, especially in regions with adverse environmental conditions and poor forage availability. This study was carried out on Girolando dairy cows belonging to two different genetic compositions. These cows were followed from the beginning of pregnancy until the postpartum period, when the cyclic activity was restored. The aim was to analyze milk yield, body condition scoring (BCS), uterine involution, and return to cyclicity and to check if there was a correlation between these parameters. Productivity and reproductive performance in two different climatic periods were also evaluated. We used 49 cows representing two crossbreeding levels, the GS1 group (1/2 Gir × 1/2 Holstein; n = 31) and the GS2 group (3/4 Holstein × 1/4 Gir; n = 18). Cows in the GS1 group had higher milk production, recovered BCS faster and consequently required fewer days to return to cyclicity ($p < 0.05$). No differences were observed in the other parameters evaluated including time for uterine involution, and BCS at calving ($p > 0.05$). The cows in the GS1 group were better than those in the GS2 group in the studied production system. Cows calving in the winter showed earlier uterine involution, return to cyclicity, more milk production, and had better BCS in the postpartum period when compared to those calving in the summer.

Keywords: BCS; Cattle; Crossbreed; Milk; Uterine involution

Abbreviations: BCS: Body Condition Scoring; FAL: Agua Limpa Farm; CL: Corpus Luteum

Introduction

The dairy products will increase in the near term. However, the dairy sector needs to prepare for unequal effects of climate changes [1,2]. Climate change becomes a growing concern that may challenge future feed resources and dairy production in the tropics. Improvement of tropical crossbreds, utilization of agricultural by-products in ration balancing, nutrient requirement correction, and management are measures to dampen the effect of heat stress and improve tropical dairy production [3]. Currently, most of the Brazilian dairy herds consist of Girolando cows, a cross between Gir (Bos indicus) and Holstein (Bos taurus) [4]. The use of crossbred animals in dairy herds in regions that do not offer optimal environmental and nutritional conditions has some advantages in comparison to the use of pure animals, mainly in terms of fertility, longevity, and milk quality [5-7]. These characteristics affect dairy farming in an economically feasible way. The effects of heterosis in crossbred dairy cows are important, especially in economic comparisons throughout their productive life [8-12]. In many cases, F1 crossbreeds perform better than other genotypes [5,13]. But for successful crossbreeding the choice of appropriate breed combinations for the environment and production system management is essential. The aim of this study was to analyze uterine involution, return to cyclicity, milk yield, body condition scoring (BCS), and to check whether there was a correlation between these parameters in crossbreeding dairy cows with two genetic compositions. In addition, were also evaluated the productive and reproductive responses of these animals in two different climatic periods, regardless of genetic composition.

Material and Methods

The study was approved by the Animal Use Ethics Committee, Biological Sciences, University of Brasília, Distrito Federal, Brazil

(Protocol No. 89/2017). The research was carried out at the Água Limpa Farm (FAL), an experimental area of the University of Brasília located at 15°56′ to 15°59′S and 47°55′ to 47°58′W coordinates. The region has a climate with two well-established seasons: dry winter (April to September) and rainy summer with high temperatures (October to March). The animals used in the crossing were the Gir which is a breed of dairy cattle from India and Holstein. The products from this cross are known by the generic name of Girolando. Forty-nine cows representing two crossbreeding levels with different degrees of zebu-taurine blood were used, the GS1 group (1/2 Gir × 1/2 Holstein; n = 31) and the GS2 group (3/4 Holstein × 1/4 Gir; n = 18). The cows were 24 to 60 months old with an average weight of 450kg. The animals were kept on pasture and supplemented with corn silage, concentrate, and mineral salts, with unrestricted access to water. These cows were followed from the beginning of pregnancy until the postpartum period, when the cyclic activity was restored.

Body condition scoring (BCS, from 1 to 5, where 1 is very thin and 5 is obesity), in the prepartum period and changes in the BCS in the postpartum period until the beginning of cyclicity were evaluated. Gynecological examinations started 10 days after calving and were repeated every two weeks (SonoSite M-Turbo®, 5-10 MHz) until the return to cyclicity was confirmed. Over this period, milk yield (kg/day) was also evaluated. Uterine involution was considered complete when the diameter of the uterine horns showed a difference of ≤ 2 mm, and the return to cyclicity was verified by the presence of the corpus luteum (CL). The productive and reproductive performance was also compared in the two different seasons, summer, and winter, irrespective of genetic composition. Data analysis was performed using descriptive statistics followed by the D'Agostino-Pearson Omnibus normality test. Unpaired t-tests and Mann Whitney tests were used for comparisons between the two groups using the GraphPad Prism® 6 program. For correlation analysis, the Spearman test was performed.

Results and Discussion

There was a difference between the GS1 and GS2 groups ($p < 0.05$) when comparing milk production, number of days to return to cyclicity, and BCS at first postpartum ovulation. On the other hand, there was no difference in all other evaluated parameters (days for uterine involution and prepartum BCS) (Figure 1). It was observed that GS1 cows returned to cyclicity 17.14 days earlier than GS2 cows ($p < 0.05$). According to several authors [13-15] this can be explained by the heterosis of the GS1 group, formed by F1 females. Moreover, other factors can affect the return to cyclicity, such as BCS at calving and postpartum, breed, dairy production, postpartum diseases, uterine involution, and thermic stress [16]. The interval between calving and first service in the GS1 group was 70.9 days, and for the GS2 this interval was 88.1 days. The GS1 cows, despite having a slightly lower BCS at calving than GS2 cows (3.4 and 3.5, respectively), stabilized the BCS more quickly, produced more milk, and required less time to return to cyclicity. This was possibly due to the hybrid vigor of these animals. Other studies have also reported that the F1 progeny obtained from crossing breeds showed good characteristics of their parents, showing better performance (more productive), and maximum heterosis or hybrid vigor [15,17].

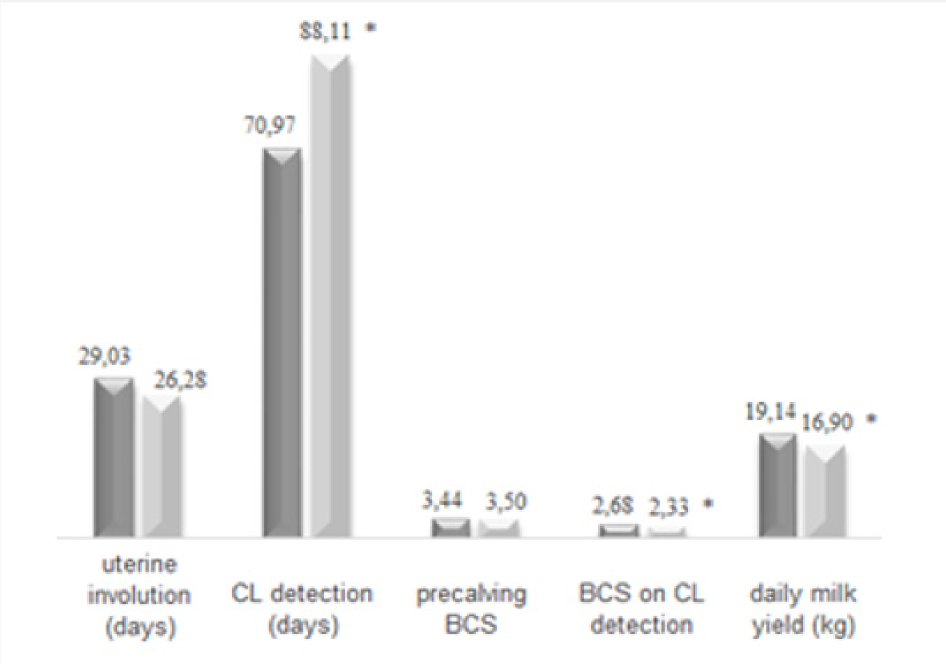

Figure 1: Average days for uterine involution (UI), days for returning to cyclicity (CL), precalving BCS, BCS on CL detection, and milk yield in the GS1 (1/2 Holstein and 1/2 Gir, light bars) and GS2 (3/4 Holstein and 1/4 Gir, dark bars) cows. * p < 0.05.

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The desirable characteristics of these animals give them rusticity, greater resistance to ecto and endoparasites, better productive capacity, adaptation to the tropical environment, and greater tolerance to heat stress [4,14]. However, Perotto [18] reported that in semi-intensive or intensive conditions, Girolando cows with a higher percentage of Holstein blood (3/4 and 7/8) produced more milk than half-blood animals. This observation differs from the results of the present study; however, it is necessary to consider the production system. There was no difference in the prepartum BCS between the groups. However, the GS1 group showed a higher BCS ($p < 0.05$) in the return to cyclicity than the GS2 group. On the other hand, weight loss was significantly different ($p < 0.05$) between the two groups with the GS2 cows showing greater loss (Figure 2).

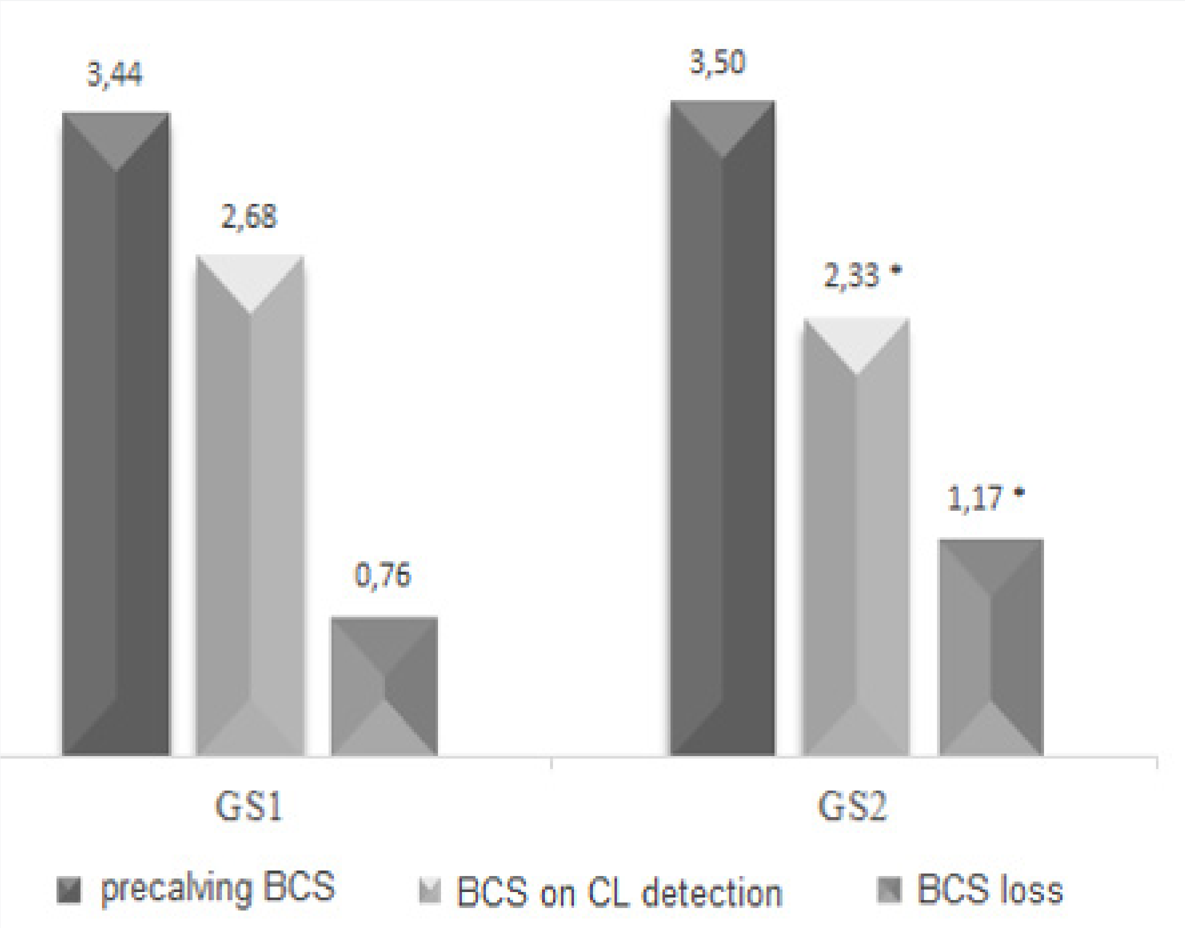

Figure 2: Difference in the precalving BCS between GS1 (1/2 Holstein and 1/2 Gir) and GS2 (3/4 Holstein and 1/4 Gir) cows, BCS on CL detection and BCS loss. * $p < 0.05$.

The loss of BCS between the prepartum period and the return to cyclicity was possibly due to the reduction in the dry matter intake and a concomitant increase in energy demand for the beginning of lactation, leading to a probable negative energy balance [19]. In the GS2 cows, the loss was more accentuated, possibly due to the higher nutritional requirements of these animals, as they have 3/4 of Holstein blood. Loss of BCS in the postpartum period was also described by Busato & Mouffok [20,21], who concluded that the mobilization of body reserves may be related to genetic merit, and more productive lineage cows tend to lose more BCS in the postpartum period.

Santos [19] found that cows returning earlier to cyclic activity lost less BCS compared to animals that took more time. They also found that loss equal to or greater than one BCS unit in the first postpartum week leads to a significant increase in the period for the return to cyclicity. This observation agrees with our results, where the animals with greater loss of BCS (group GS2) required 88.11 days to return to cyclicity, while the animals that lost less (group GS1) needed only 70,9 days. The authors also pointed out that the high loss of BCS reflects the BEN, which affects reproductive performance. In the present study, it was also possible to compare cows that calved in the winter when the temperature was mild (June to September) and in the summer when the highest temperatures were experienced (December to March). For this comparison, the data from the two groups were mixed. It was found that cows calving in the summer needed more time for uterine involution, to return to cyclicity, and produced less milk ($p < 0.05$) compared to animals that calved in the winter (Figure 3).

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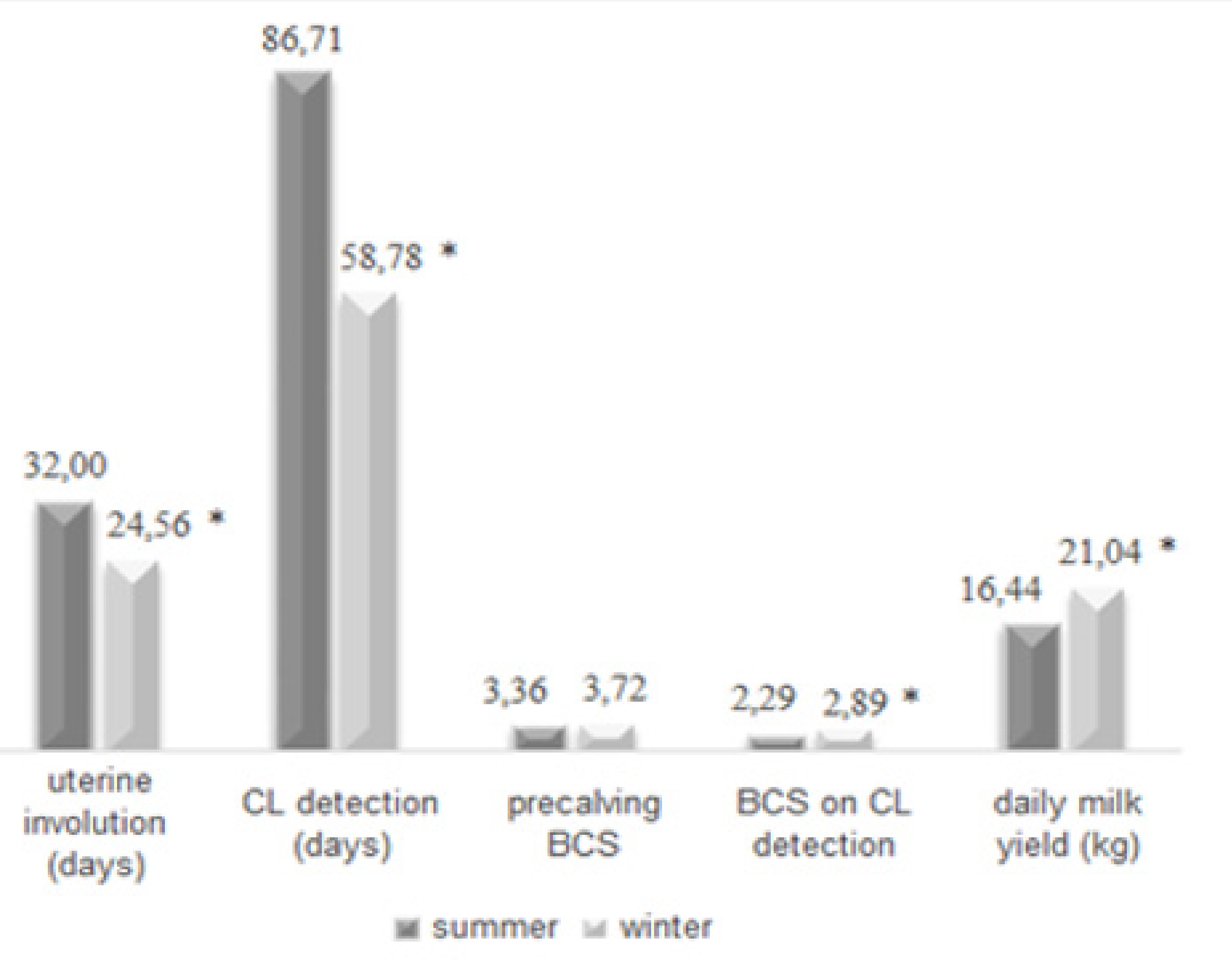

Figure 3: Average days for uterine involution (UI), days for return to cyclicity (CL), precalving BCS, BCS in the return to cyclicity (CL detection), and milk yield of Girolando cows that calved in the summer and winter period. * $p < 0.05$.

Cows calving in the summer spent 32 days for uterine involution and 86.71 days to return to cyclicity. Animals that gave birth in the winter required 24.55 days for uterine involution and 58.77 days for the return to cyclicity. The delays in relation to uterine involution and return to cyclicity in the summer period can be explained by the negative effects of thermal stress and environmental discomfort, challenges that cause a decrease in the consumption of dry matter, generally leading to NEB and hormonal disorders with negative reflex in the uterine involution and the return to cyclic ovarian activity as well as impairment of the immune system [22,23]. Thompson & Dahl [24], following 2613 births in three consecutive years in Florida, showed the effects of the hot months on the occurrence of disorders in the first 60 days postpartum. They observed that the animals showed impaired development of the mammary gland with subsequent reduction in milk production, impaired immune system with a higher incidence of mastitis, respiratory problems, retained placenta, and decreased reproductive performance, resulting in an increase in the number of days for return to cyclicity compared to months with mild temperatures.

Conclusion

In this study, the GS1 group cows were better, as they had superior milk production, fewer days to return to cyclicity, and better BCS from calving to ovulation. Cows calving in the winter required shorter time for uterine involution and to return to cyclicity than cows calving in the summer. They were also better in milk production and had better BCS in the postpartum period when compared to those that had calved in the summer. Although the crossbred animals are more resistant, they also show some degree of difficulty in reestablishing homeostasis in unfavorable environmental conditions. It is important to know the local and adapted breeds and look for the cross that favors the increase in production (meat or milk), without losing the main resistance characteristics.

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