GENETICS AND REPRODUCTION

Seasonal Birth Pattern in Dairy Cattle, in the 1982-2017 Period, in Camagüey, Cuba

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ABSTRACT

Objective: To define the evolution of the seasonal birth pattern in cattle, during the 1982-2017 Period, in Camagüey, Cuba

Materials and Methods: The artificial insemination data used was gathered at Cuenca Lechera (Dairy Country) in Camagüey, between January 1982 and December 2017, and recorded at the Ministry of Agriculture in Camagüey, Cuba. The information was split into four stages for analysis: 1982-1990 (stage I), 1991-1999 (stage II), 2000-2008 (stage III), and 2009-2017 (stage IV), considering the changes that had taken place in Cuban agriculture in terms of land tenure. Seasonal decomposition of births was made using a multiplicative model throughout the period and in all the stages. The criterion for the existence of seasonal variation had a 10% minimum difference.

Results: The seasonal factors reached positive values between February and July, with peaks in April and May along the whole period, with a common seasonal pattern in the four stages characterized by top values in April and May.

Conclusions: These results demonstrate birth seasonality, which corroborates the trend observed in dairy cows in Camagüey to match their biological behavior with the season of greatest pasture availability. In that sense, it is more feasible to handle dairy herds strategically, regardless of the organizational transformations made in Cuban agriculture.

Key words: *seasonality, cattle, reproduction, natality*

INTRODUCTION

The efficiency of systems is in keeping with the procedures implemented in cattle raising processes, and the behavior of their actors, who decide what alternatives should be applied, and the ways productive systems can be run (Vargas *et al.*, 2015). Nevertheless, it is important to consider that, for the most part, the ruling agro-climatic conditions of tropical regions can determine the cost-effectiveness of cattle farms, in most cases (Domínguez, Morales, and Sánchez, 2015).

Leyva-Corona *et al.* (2015) refer to climate as the chief shaper of animal production, and that cattle physiology, performance, and health are influenced by the environment where cows live, which can significantly affect their productive performance. Accordingly, Soto (2010); Guevara *et al.* (2012); Soto, Uña, and Machado (2018), in research done in the mid-eastern region of Cuba (Camagüey and Ciego de Ávila), noted that the feeding limitation is the most striking affectation to the bioproductive response of dairy cattle. It is in relation to the need for reproduction work rearrangement, in order to make all births coincide with the season when pasture is most abundant.

Senra, Soto, and Guevara (2013) said that technological activities and specific strategic actions implemented in cattle raising must be comprehensive and harmonic to face the effects of climate change, and increase the efficiency and sustainability of production systems in agriculture, based on a greater and more efficient use of local resources.

According to Soto *et al.* (2017), the implementation of a seasonally dairy production model adjusted to the conditions of Camagüey may represent a significant response to the need the country has to increase yields on sustainable bases. Despite a reduction of the mean technical efficiency values of artificial insem-

ination in dairy cattle companies, it is important to weigh other factors of technical work, and organizational aspects of reproduction to achieve that purpose, according to Horrach *et al.* (2017).

In Camagüey, seasonal behavior in relation to births has been reported (Bertot *et al.*, 2007), along with the variables linked to artificial insemination efficiency (Horrach *et al.*, 2012), and the concentration of more spontaneous calvings associated to the periods with highest availability of grass (Loyola Oriyés, 2010; Soto, 2010). However, their occurrence due to changes in agricultural policies at different stages has not been reported. Hence, the aim of this paper was to define the evolution of seasonal behavior of births in Camagüey's cattle in the 1982-2017 period.

MATERIALS AND METHODS

This study comprised 36 years (1982-2017). It was based on data gathered from the Dairy Country (municipality of Jimaguayu 77.54° W, 21.23°), and recorded for the Ministry of Agriculture in Camagüey. The artificial insemination data used was collected between January 1982 and December 2017. The information was divided into four stages: 1982-1990 (stage I), 1991-1999 (stage II), 2000-2008 (stage III), and 2009-2017 (stage IV), which included land tenure changes that took place in Cuban agriculture.

These stages comprised changes in Cuban agriculture in recent years, the creation of Basic Production Cooperatives (1993), land transferred to farmers in usufruct (2008) (Decree 259), and further modification in 2012 (Decree 300).

Statistical analysis

Seasonal decomposition of births was made using a multiplicative model throughout the period and in all the stages separately. Two time periods were used: year (non-periodical) and month (secondary period). The following serial multiplicative model was utilized:

Y_{ik} = STC* SAF* Err

Where:

Y_{ik} = Temporary series for births (i = years, k = months).

STC = Birth trend and recurrence.

SAF= Serial factor adjusted by seasonality.

Err = Error.

The seasonal factors achieved in every stage were compared to one another and with the one observed during the whole period, to define the possible existence of a seasonal behavior pattern during the evaluation period.

The criterion used to consider the existence of seasonal variation was a minimum difference of 10% between months. The statistical analyses were made using IBM®SPSS®, version 24.0 (2016).

RESULTS AND DISCUSSION

Among the reproduction indexes, natality and reproduction have a marked influence on production and efficiency of dairy systems, particularly due to an induced calving strategy, or by mere chance, calving occurs more often between April and June (Soto *et al.*, 2017).

The results of the whole series (1982-2017) in terms of birth seasonality were positive in the February-July period, with top values in April-May, and a minimum in December (Fig. 1).

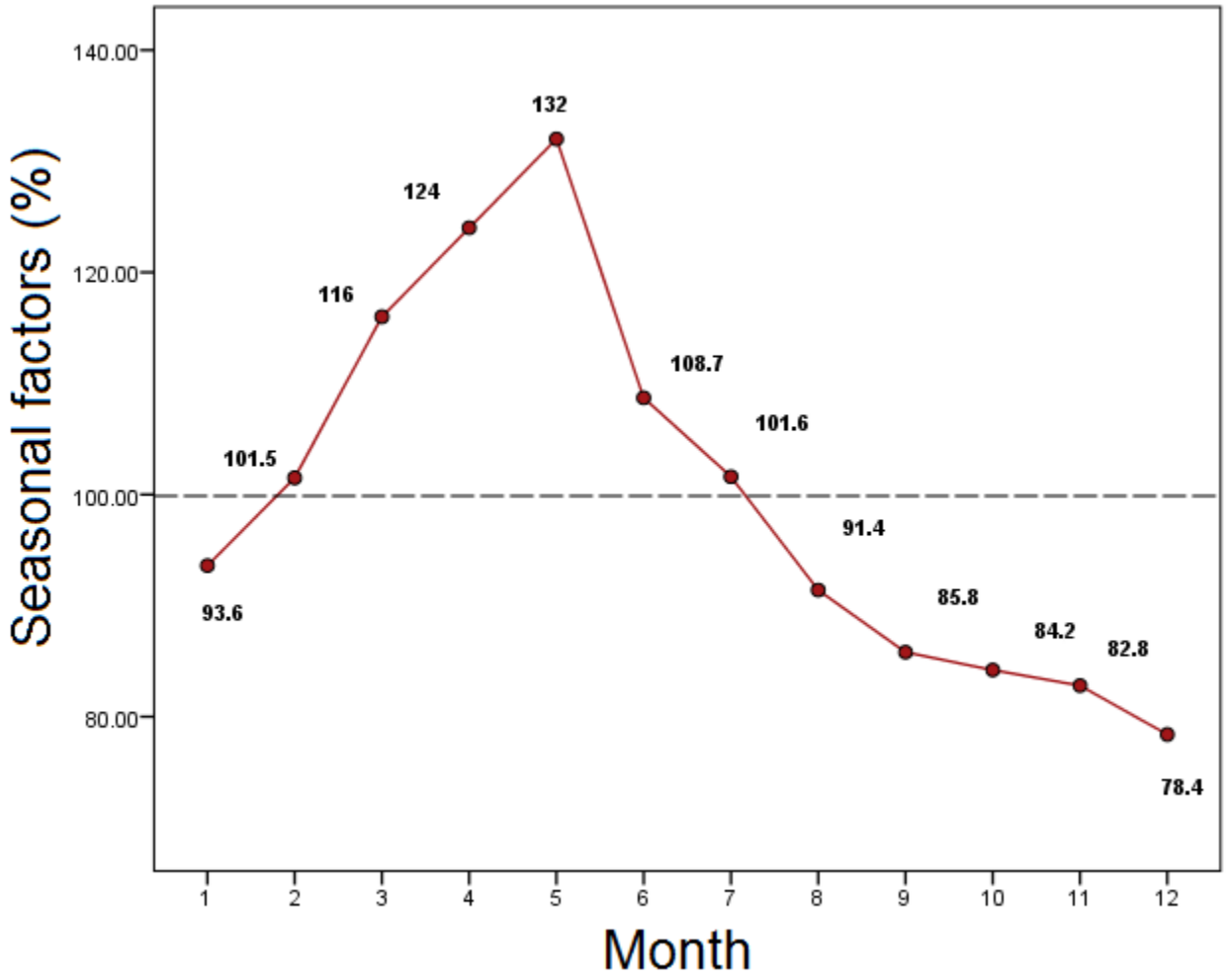

Fig. 1. Seasonal factors of births in the 1982-2017 period

These results coincided with Bertot (2007), who reported that in the 1980s, the Dairy Triangle companies in Camagüey had a birth seasonal pattern, which increased between May and July, and reached a peak in May.

Curbelo *et al.* (2014) found a marked seasonal effect on productive yields on farms in Ciego de Ávila, when births were 76-86% in the April-August period. In that period, Soto, Uña and Machado (2018), who studied private farms in Ciego de Ávila, reported that most births were concentrated in the April-May period, with a positive effect on milk production, even when natality was that high. Precisely, birth seasonality became more relevant under these circumstances, considering the findings of Martínez *et al.* (2015), that reproduction problems are some of the causes that threaten milk production efficiency on those farms, where herds do not reach 85% natality.

Significantly, all the stages include these two months as the ones with the best performances, though there is a significant progressive amplitude of top values toward the last stage (Table 1), in which births were moved to February. It reflected the changes in cattle ownership, with the new cooperatives and private farmer policies implemented in 2008, which led to a decrease in herd size, despite better nutritional base.

Table 1. Seasonal factors of births in four stages

Period (month)	Stages			
	1982-1990	1991-1999	2000-2008	2009-2017

1	91.4	100.5	93.2	86.1
2	89.9	100.7	87.0	132.3
3	101.3	116.6	113.6	131.7
4	115.4	129.1	134.1	108.5
5	118.2	121.0	156.0	140.3
6	105.1	103.5	119.2	120.6
7	103.6	91.0	103.8	106.1
8	103.3	86.3	87.8	87.8
9	102.4	85.4	79.2	79.4
10	92.2	86.3	72.3	71.7
11	90.9	93.5	74.2	69.0
12	86.1	86.2	79.6	66.3

In spite of the main trend of the 2009-2017 stage, these results confirm the existence of a seasonal behavior pattern in births, previously reported (Bertot, 2007), with shorter series (1982-2005) in the same area.

Further studies showed the advantages of using the same behavior in dairy systems for short periods of time; for instance, Guevara *et al.* (2010a) achieved a better response in milk production and it´s components, by concentrating up to 60% of calvings in the first six weeks of the rainy season, which occurs between May and October in Cuba. Various results stress on the advantages of concentrating calving within the April-August period, in order to improve the efficiency of milk production (Loyola Oriyés *et al.*, 2010; Soto *et al.*, 2010), and the overall bioeconomic indicators, by matching the productive peaks with the period with the greatest availability of forage (Guevara *et al.*, 2012; del Risco *et al.*, 2013; Soto *et al.*, 2014), thanks to better grassland use when pasture is most abundant.

It is important to establish calving intervals of herds in the tropics, in order to take full advantage of seasonality in terms of herd reproductive performance, which demands the utilization of those spontaneous patterns, and linked to nutrition as well. The above depends on increased forage availability and the efficiency of feedstuffs (Guevara *et al.*, 2010b), reproduction of estrus females (the variable with the highest impact) (Bertot *et al.*, 2011), and other factors, thanks to the multifactor influences of reproduction (Walsh, Williams, and Evans, 2011).

When nutrition is not coordinated with veterinary-zootechnical management, the results will be affected. A study done on ten private farms in Ciego de Ávila (Soto *et al.*, 2018), showed a marked seasonality of births during the mid-July-early September period, but with insufficient availability of pastures and forages compared to the animal stocking rate. The outcome was a negative forage balance combined with inadequate breeding management, among other factors, which limited the efficiency of the bioproductive and financial indicators.

These results indicate a chance to make a strategic use of seasonal patterns, which are spontaneous, and to arrange calving distribution, in accordance with the greatest availability of grass. In that sense, Loyola Oriyés *et al.* (2015), said that to set up the optimum time for calving intensification, it is important to take into account these determining elements: total milk production and average of milk per cow per day.

Nevertheless, attaining regular reproductive cycles in these systems based on seasonal behavior patterns, requires the inclusion of a group of elements like the cow's transition period, calf care in the preruminating and ruminating stages (Álvarez, Hernández, and Blanco, 2015), the social aspects affecting insemination technicians and cattle people (Horrach *et al.*, 2017), and the negative effects caused by infectious and parasitic diseases during the reproduction stage of herds (Leal Labrada *et al.*, 2018).

CONCLUSIONS

Birth seasonality in the February-July period, with peaks in April and May, corroborates the trend observed in dairy cows in Camagüey, by matching their biological behavior with the season of greatest

availability of pastures. Hence, it is more feasible to handle dairy herds strategically, regardless of the organizational transformations made in Cuban agriculture.

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AUTHOR CONTRIBUTION

Author participation included the following: Conception and design of research: JABV, MNHJ, RVMO, RAB; data analysis and interpretation: JABV, RVMO, MNHJ, IMR; redaction of the manuscript: IMR, MGD, JABV, SSS.

CONFLICTS OF INTEREST

None