Effects of Year and Season on Calving Interval in Romanian Brown Cattle

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Abstract

The aim of the current research was to determine the influence of calving year and season on calving interval (CI) in Romanian Brown breed. A total of 250 data recorded from 150 lactations of 50 Romanian Brown cows raised between 2018 and 2020 were included in the current study. The year proved to exert a significant effect ($p \leq 0.01$) on calving interval, this parameter recording an increased tendency. Comparable values were recorded according to season of calving ($p > 0.05$). Concluding, year of calving was the main influential factors for this particularly reproductive trait. In this respect, additional studies should be performed in order to include other factors, validate their influence and properly manage of its.

Keywords: calving interval, influential factors, Romanian Brown.

1. Introduction

Reproduction is the most important trait, significantly affecting the efficiency of animal husbandry and implicitly the sustainability of the herd. Decreased performance in reproduction represents the most important type of loss in the field. Generally, losses can be attributed to prolonged service periods or calving intervals or to low reproduction indices such as rate of conception and number of services per pregnancy. Reproductive efficiency in cows is decreasing worldwide. The shift towards more productive cows is associated with a decrease in reproductive efficiency. Cows with the greatest milk production also have, the highest incidence of infertility with more services per pregnancy, extended calving intervals and increased culling, all adding significant decreases in farm efficiency. Genetics, poor management and nutrition have all contributed to this decline in fertility. The poor reproductive performance, manifested as prolonged calving intervals, may result in decreased productive performance, increased culling rates and increased costs per cow's lifetime. The main influential factors in reproduction efficiency are considered the calving season, age, parity and milk yield [1, 2] which exert a well-documented negative influence on follicular growth [3], oestrus expression, decreased in oocyte quality and decreased embryo development [4].

Reproductive performance in cattle is dependent on heredity and environmental factors. The effects of heredity are well known based on both parents' performances. The reproductive traits are characterized by a low heritability, as most of the variation in the traits is determined by non-genetic factors and environmental effects [5]. In this respect Dayyani, N. et *al.* (2013), Toledo-Alvarado et *al*. (2017) and others found low values for heritability such as 0.09 for days open and 0.11 for calving interval [6, 7]. Generally, the impact of reproductive traits on productive performance proved to be significant due to the genetic correlation (>0.7).

The effects of the environment are random, also in cases when an attempt is made in order to even the

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conditions. Accidental or unknown environmental differences occur among individuals. In order to maximize the reproductive performances, knowing the environment influential factors and optimizing the environmental conditions is required.
The aim of the current research was to determine the influence of calving year and season of calving on calving interval (CI) in Romanian Brown breed.

2. Materials and methods

The experimental herd consisted in 50 Romanian Brown breed cows.
Use of animals and the procedures performed in this study were approved by the Scientific and Ethics Committee of the Research and Development Station for Bovine Arad of the Academy for Agricultural and Forestry Sciences, Decision no. 51 issued on November 11, 2015. Also, the research activities were performed in accordance with the European Union's Directive for animal experimentation (Directive 2010/63/EU).
Location: The study was carried out at the Research and Development Station for Bovine Arad, Romania (location: 46° 10' 36" N, 21° 18' 4" E, 107 m altitude, 582 mm annual average rainfall 21°C / -1°C average temperature corresponding to summer / winter seasons). Cows that were included in the research herd were managed under a loose system with zero grazing and were between 2nd and 4th lactation, with age and parity balanced within the herd. All cows were included in the Official Performance and Recording Scheme. Furthermore, all cows were fitted with AfiTag pedometers (Afikim, Israel) for production traits, oestrous and specific diseases detection. A data set for 150 lactations, recorded between 2018 and 2020, was analysed for estimation of the effects of the calving year, season of calving, lactation parity and calving ease on calving interval in Romanian Brown breed. Data were cleaned by eliminating human recording errors (outliers), redundant entries and incomplete observations. Cows at first calving or with parity greater than 5 were eliminated from the analysis, as well as cows with no information for studied traits. Grubbs' test [8] was employed in order to detect outliers in a univariate date set that follows an approximately normal distribution.

$$G=\frac{\bar{y}-ymin}{s} \qquad G=\frac{\bar{y}-ymax}{s}$$

where: ȳ=sample mean; s=standard deviation; ymin=minimum value; ymax=maximum value
When suspecting more than one outlier, the Tietjen-Moore test was used to identify and reject them [9].

$$Lk=\frac{\sum_{i-1}^{n-k}(yi-yk)^2}{\sum_{i-1}^{n}(yi-\bar{y})^2}$$

where: k=exactly *k* outliers in the data set; n=number of data points sorted from smallest to largest; yi=the *i*th largest data value; ȳ=mean of the full sample; ȳk=sample mean with largest *k* point deleted.
The effects of studied parameter were assessed using a factorial ANOVA protocol. Differences were tested using Tukey test. The analysed data were expressed as least square means and standard error of mean. All the statistical inferences were carried out using the software package Statistica (StatSoft Inc., Tulsa, OK USA) [10].
Decisions about the acceptance or rejection of statistical hypothesis have been made at the 0.05 level of significance. To determine the effects of non-genetic parameters on calving interval, the trait of interest would be set up as the dependent variable and the reproductive related trait as independent variable in the model. All analyses were performed using statistical software (Statistica – StatSoft) version 13.11.

3. Results and discussion

The least square means, significance, and multiple comparison test results for calving interval of the Romanian Brown cows are presented in Table 1.

Table 1. Least square means, significance, and comparison test results for calving interval in the Romanian Brown cows

Factors	CI (calving interval
Overall Mean	411±38.8
Year of calving	
2018	401±49.12[a]
2019	413.6±38.44[b]
2020	421.9±19.26[c]
Season of calving	
Summer	403.1±26.4[a]
Winter	401.19±33.78[a]

Different superscript per columns differs significantly at $P \leq 0.05$, within the same factor

Cohort

Average CI was 411±38.8 days, for the Romanian Brown cows. The shortest CI length was associated with the year 2018 (401±49.12 days), significantly lower ($p \leq 0.01$) compared to others years. Comparable values ($p > 0.05$) were recorded according to the season of calving.

Year of calving

The current research founded slightly increased intervals between two calving, especially for cows with parity greater than 3rd.

Calving interval has been extensively analysed and reported. It is probably the best index of a cattle herd's reproductive efficiency. The calving year proved to significantly influence the CI. The results obtained in the current study shown an increasing trend in CI during the 3 years analysed. The CI increased from 401 days in year 2018 to 421.9 days in year 2021, by 4.9% (7 days per year) of the initial CI. The results obtained in the current study are consistent with those of others previous studies from different countries. In this sense, studies conducted in USA highlighted a prolongation of CI during the last decade from 12.9 to 13.4 months. Also, average CI length calculated by Neja et *al*. in 2013 or Fedorovych et *al.* (2016) recorded 13.2-13.5 months, comparable with ours (13.7 months) [11, 12]. Similar values reaching 13.4-13.9 months were calculated in a study performed in Canada by Murray et *al*. 2003 [13]. Shorter intervals were recorded in European herds. Thus, a study conducted by Wall et *al.* (2003) in United Kingdom highlighted shorter CI, especially for primiparous (12.9 months) [14]. A depreciative tendency in CI was recorded worldwide. In a study performed in 2004 by Gonzales et *al*. (2004), an over 10% prolongation was recorded associated to last decade, mainly due to prolonged service period and increased number of services per pregnancy, caused by the increased milk yield [15].

Across years, annual increase of CI recorded 1 or more than 1 day/year for all breeds, except Jersey with 0.49 days/year, which are inconsistent with our results (7 days/year) associated to Romanian Brown breed. A comparable increased prolongation of CI was recorded by Hammoud M.H. et *al*. (2010) in a study conducted on Holstein Friesian reared under semiarid conditions, which recorded an annual increasing rate of 4 days/year [2]. Prolonged CI induces important losses in farm efficiency by shortening the productive life. The management of reproductive activity proved to be the most influential factor related to CI length. Also, significantly differences were recorded among inseminator's skills and motivations [16, 17]. Deteriorations of reproductive efficiency were recorded worldwide, significantly affecting the animal husbandry and associated industry. Most often, CI are determined by the time of conception. The voluntary waiting period, service period and the number of services per pregnancy are determinant in this respect. All these parameters vary significantly. The cause still seems to remain mainly the unidirectional breeding programs, which, generally, aimed increasing of milk yield, followed by environmental factors [18].

Not, at least, a significant effect on CI length exerted particular condition associated with the year of study, referring to the aspects regarding the quantity and quality of the available fodder or farm management practices including changes in herd size.

Season of calving

The average calving interval for Romanian Brown, recorded in the current study was 403.1±26.4 days in summer and 401.19±33.78 days in cold season. No significant differences ($p \geq 0.05$) were recorded related to season of calving, even a slightly prolongation of CI was associated to summer. These values are considered within the physiological limits accepted for this particularly breed. The CI values calculated in the current research proved to be similar with those recorded by Hammoud M.H. et *al.* (2010) or Ansari-Lari S., et *al*. (2010) [2, 19]. The differences occurred between seasons were insignificantly and were inconsistent with those obtained by Khodaei Motlagh et *al.* (2013) [1]. Numerous studies conducted over the years on different breeds highlighted higher or lower differences regarding CI according to season of calving. Generally, cows exposed to heat stress in late gestation or early lactation shows prolonged CI due to shorter period of oestrus, reduced intensity of oestrus, anoestrus or lower conception rates, these events depressing fertility. The effects of heat stress in cows are intensively studied and well documented over the time. The effects of environmental temperature on reproduction traits with directly influence on CI are

over studied in the last decades. Relevant is a study conducted by Slama H. et *al*. (1976) which recorded a 14 days prolongation of CI for chancing in number of services required per pregnancy by one unit, both in milk or beef breeds [20].

A prolonged calving interval is also accompanied by the accumulation of fat and consequently led to prolonged service period, increases number of inseminations or even to a higher risk of dystocia in subsequent calving, which could induce a vicious circle in this respect. This theory is not universal accepted. In a previous study conducted by Berry D.B. et *al*. (2007) any significant relationship between body condition score, calving interval and incidence of dystocia was recorded [21]. There are a few studies investigating the effect of pre-calving characteristics on reproduction traits. The preceding calving interval could be introduced as a covariate into the model for genetic evaluation of reproductive efficiency.

4. Conclusions

Reproduction traits, such as calving interval reached, in generally standard values and reproduction management program seemed to be properly performed in the farm. Concluding, year of calving, in this particularly study, was the main influential factor for this reproductive trait.

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