Estimation the Genetic Parameters for Age at the First Calving and Calving Interval in Romanian Spotted, Simmental

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Abstract

The objective of this study was to estimate the genetic parameters for reproductive traits in Romanian Spotted, Simmental type cattle breed using animal model. The data of reproduction traits were from Romanian Breeding Association Romanian Spotted, Simmental type. The age at the first calving was 889.82±2.79 days and first calving interval was 391.55±2.08. The heritability value for age at the first calving was 0.25 and for calving interval was 0.14. The breeding values of cows with records for age at first calving were between -77.52 and 62.60 and for first calving interval between -31.149 and 44.55. Improvement the reproduction traits increase the profitability of farms.

Keywords: animal model, cows, genetic parameters, reproduction traits.

1. Introduction

The reproduction traits are very important for profitability of farms. Romanian Spotted, Simmental type has dual-purpose, milk and meat. Age at first calving and first calving interval were studied by many authors in different breeds. The calving interval is important because it is related with the number of calves born annually. In the breeding program of Romanian Spotted, Simmental type the main objectives are the productions traits and reproduction traits. In the Romanian Spotted, Simmental type the cattle are inseminated at age 16-21 months. Average age at the first calving is between 26-32 months, service period 100-130 days, number of inseminations per pregnancy is 1.7-1.9, the calving interval being between 370-400 days. The service period conditions the calving interval. The profitability of farms increases if the age at the first calving and first calving interval are reduced. The reproduction traits are influenced by genetic factors and environmental factors. The genetic factors are breed, individual and environmental factors and environmental factors are: climate condition and nutrition. For improvement the reproduction traits it is necessary to improve the environmental conditions and supervision of reproduction activity in the farms. The animal model can be adapted to different situations in the genetic evaluation of cows: selection for a single trait with a single measured performance, selection on a single trait with two or more measured performances, selection for two or more traits, selection based on the test-day, genomic selection [1,2].

The aim of this study was to estimate the genetic parameters for age at the first calving and the first calving interval for Romanian Breeding Association Romanian Spotted, Simmental type breed with animal model.

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2. Materials and methods

The data of reproductions traits were obtained from Romanian Breeding Association Romanian Spotted, Simmental type. The pedigree consisted of 1938 animals: 698 cows, 185 bulls and 1064 cows with performance. Data were recorded between the years 2010-2016. The data records are age at the first calving and first calving interval. Age at the first calving is the number of days from the birth of cow and first calving. First calving interval was the number of days between the first and second calving.

The data were analysed with animal model with R software [1,2]:

The model is [1,2]:

$$y=Xb+Za+e$$

X= the incidence matrices for fixed effects

Z= the incidence matrices for additive genetic effects

y= the vector of observations

b= the vector of the fixed effects

a= the vector of the additive genetic effects of cows

e= the vector of error

The mixed model-like equations were:

$$\begin{pmatrix} X'X & X'Z \\ Z'Z & Z'Z + A^{-1}K \end{pmatrix}\begin{pmatrix} \tilde{b} \\ \hat{a} \end{pmatrix} = \begin{pmatrix} X'Y \\ Z'Y \end{pmatrix}$$

$$k = \frac{1-h^2}{h^2}$$

The variance components were estimated:

$$\sigma_e^2 = \frac{P'P - \tilde{b} * X' * P - \hat{a}' * ZP}{n - r(X)}$$

σ^2_e= residual variance

where r(x)= rank of matrix X which is the number of linearly independent columns, known as a degree of freedom for fitting the fixed effects of the model [1]

$$\sigma_a^2 = \frac{\hat{a}' * A^{-1} * \hat{a} + \sigma_e^2 * tr(A^{-1} * C_{22})}{q}$$

σ^2_a= the additive genetic variance

where C_{22}=the sub-matrix corresponding to random effects in the system of equations which was obtained after reversed throughout the system of equations:

$$C = \begin{bmatrix} X'X & X'Z \\ Z'X & Z'Z + A^{-1} * k \end{bmatrix}^{-1} = \begin{bmatrix} C_{11} & C_{12} \\ C_{21} & C_{22} \end{bmatrix}$$

The heritability for reproduction traits was estimated as:

$$h^2 = \frac{\sigma_a^2}{\sigma_a^2 + \sigma_e^2}$$

Where:

σ^2_a= the additive genetic variance

σ^2_e= residual variance

The relative breeding value is:

$$BV\% = 100 + 12 * (\frac{BV_{abs} - Average\ BV_{abs}}{\sigma_{BVabs}})$$

BV% = relative breeding value

BV_{abs}= absolute breeding value

σ_{BVabs}= standard deviation of absolute breeding values

3. Results and discussion

The age at the first calving and first calving interval was shown in Table 1. The age at the first calving for Romanian Spotted, Simmental type breed was higher in our study than the value 847 days but calving interval from our study was lower than calving interval 394.30 in Simmental breed obtained by Bolacali and Ozturk [3]. Cilek and Tekin (2005) [4] reported the calving interval in Simmental cows 379 days. Fedorovych et. al. [5] reported the value of 29 months for age at first calving in Simmental cattle and the calving interval 381.6-396.9 days. In Romania, Băcilă et al. [6] reported the age of first calving in Simmental Fleckvieh breed 835. 49 days and first calving interval 459.89 days. Cziszter et al. [7] reported the values of calving interval in Simmental cows based on their temperament between 389 days (moderate temperament) and 446 days (nervous temperament). Ulutaș and Sezer [8] reported mean for age at first calving 29.4 months and the first calving interval was 373 days in Simmental cattle in Turkey. Means for age at first calving and first calving interval were 1080 days and 464 days in Simmental cattle in Columbia [9].

The components of variance are presented in table 2. The heritability for age at the first calving and first calving interval was shown in Table 3. The heritability obtained in our study ranged in the values reported in literature. Ulutaș and Sezer [8]

obtained the heritability for calving interval 0.02 in Simmental cattle in Turkey. Amaya et al. [9] reported the heritability for age at first calving from 0.20 to 0.22 and for first calving interval 0.04 to 0.08.

Brzakova et al. [10] obtained the heritability for age at first calving and calving interval in Charolais breed 0.234 and 0.077 and in Aberdeen Angus breed 0.175 and 0.082.

Mirita et al. [11] showed that the efficiency of reproduction is expressed by fertility. The reproduction of cows influences both milk and meat production, as it is the basis for the initiation of lactation and ensures cattle for fattening.

The main objectives in the reproduction of cow consist in achieving throughout the year an optimal structure of the herd and obtaining high fertility, the aim being to obtain from each cow, every year a calf with high viability.

The insemination of the cow is established according to the body development, which it must represent 65-70% of the body development characteristic of morphological maturity.

Table 1. The age at first calving and first calving interval in Romanian Spotted, Simmental type breed

Trait	Mean and standard error
Age at first calving	889.82±2.79
First calving interval	391.55±2.08

In Table 1 we can observe an average, in months, of 19 for age at first calving and 12.8 months for between two calvings, values that are in a normal range for Romanian Spotted Simmental Type.

Table 2. The variances for age at first calving and calving interval

Trait	Additive variance (V_a)	Residual variance (V_e)	Phenotypic variance (V_f)
Age at first calving	2072.5	6209.4	8281.9
First calving interval	662.17	3972.23	4634.41

The variances from Table 2 are in a big range and that is because that for the phenotypic data were used days.

In the Table 4 are shown the breeding values for the best cows for age at first calving.

Table 3. The heritability for age at first calving and first calving interval for Romanian Spotted, Simmental type breed

Trait	Heritability
Age at first calving	0.25
First calving interval	0.14

Table 4. The breeding value for the best cows for age at first calving

Number	Breeding value for age at first calving
1	-77.523
2	-71.327
3	-70.315
4	-70.175
5	-69.605
6	-68.896
7	-68.529
8	-67.917
9	-67.107
10	-66.795

The cows with small breeding value are good because the interest is to select the cows with good precocity.

In Table 5 are presented the relative breeding values for cows for age at first calving.

The breeding value provide a measure of the breeding potential of a cow for age at first calving.

Table 5. The relative breeding value for age at first calving

Number	Breeding value for age at first calving
1	136.819
2	133.767
3	133.268
4	133.200
5	132.919
6	132.569
7	132.389
8	132.087
9	131.688
10	131.534

In Table 6 are presented the breeding value for the best cows for first calving interval. The cows with small absolute breeding value are good because the cows must to have a calving interval reduced.

The best cow had a relative breeding value for age at first calving 136.819.

In Table 7 are shown the relative breeding value for cows for first calving interval. The negative absolute breeding value for calving interval were for the best cows.

The best cow had a breeding value 135.297 for first calving interval. It is desired that calving interval to be 12 months.

Table 6. The breeding value for the best cows for first calving interval

Number	Breeding value for age at first calving
1	-31.149
2	-20.193
3	-18.167
4	-17.936
5	-17.734
6	-17.694
7	-17.581
8	-16.954
9	-16.402
10	-16.175

Table 7. The relative breeding value for the best cows for first calving interval

Number	Breeding value for first calving interval
1	135.297
2	122.267
3	119.858
4	119.577
5	119.343
6	119.295
7	119.161
8	118.415
9	117.759
10	117.489

The calving interval depends on the length of service period and the length of gestation. The gestation of cows is on average 283 days. The factors which influence the length of gestation are: the breed, age, the sex of calf, number of calves at calving.[11]

4. Conclusions

The heritability for age at first calving and first calving interval were low in Romanian Spotted, Simmental type breed. For improvement the reproduction traits it is necessary the selection of the best cows and a good management of farms.

Acknowledgements

This work was supported by funds from the National Research Projects 8.1.2 granted by the Romanian Ministry of Agriculture and Rural Development and the Perform project 8 PFE/2021, funds from Ministry of Research, Innovation and Digitalization and Romanian Breeding Association Romanian Spotted, Simmental type.

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