

## Changes in production and reproduction traits in population of the Slovak Spotted Cattle

Jozef Bujko\*, Juraj Candrák, Július Žitný, Radovan Kasarda  
Slovak University of Agriculture in Nitra, Faculty of Agrobiolgy and Food Resources,  
Department of Animal Genetics and Breeding Biology, Nitra, Slovakia

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The study aimed to examine the analyses of the trend in the numbers of dairy cows, production and reproductive traits in the population the Slovak Spotted cattle for period 2010 to 2019. The number of Slovak Spotted dairy cows is maintained on a relatively stable level in recent years. There was a decrease in the number of animals (12 428 in 2010), but not as strong as after 1990 (85 518). From 2017 number of animals is rising from 14,062, to 14,150 (2018) and 14,627 (2019), respectively. As compared to 2010 an increase of 13.15% in 2017, 13.86% and 17.68%, in 2018 and 2019 respectively was observed. Population size raised from 113.15% (2017) to 117.68% in 2019 respectively. The average annual increase in milk production between the years 2010 to 2019 was + 157.5 kg of milk (total 1,575 kg of milk), + 5.8 kg of fat (total 58 kg of fat) and + 6.1 kg of protein (total 61 kg of protein). Positive growth of milk production in recent years is slightly comparable with the trend of breeding improvement.

**Keywords:** Slovak Spotted, dairy cows, traits of milk production, reproduction traits, population size

### 1 Introduction

In general, the cattle are considered to have been one of the first domesticated animals by man for agricultural purposes before 10, 000 years as shown by different authors. It was tamed to provide milk, meat and hides, and for draft purposes (Upadhyay et al., 2017; Pitt et al., 2018). Genetic diversity is manifoldness of occurrence of different genotypes in within-population, and it is necessary for maintenance and further development of the existing breed.

Simmental cattle is the second most important breed in Europe, following the group of Holstein Friesian cattle and holsteinized populations (Perišić et al., 2009; Strapák et al., 2013; Doublet et al., 2019). These cattle are originated from Switzerland, but it has spread around the world. Simmental name is derived from the place of origin-the valley Simme. Nowadays, it is enhanced in all continents, and its population is represented by 41 million animals. It is one of the biggest world's cattle populations (Strapák et al., 2013; Csiszter et al., 2017;

Zólkiewski et al., 2018). The Slovak Spotted cattle is an important dual-purpose breed with a long farming tradition in Slovakia. It is mainly due to its excellent dairy as well as beef production (Strapák, 2004; Bujko et al., 2011; Strapák et al., 2013; Kasarda et al., 2015; Kadlečík et al., 2017), and belongs to the Simmental type of cattle.

The Slovak Spotted breed was officially accepted as an autochthonous breed in 1958. In 1975 a maximum population size reached Slovak Spotted breed. After 1990 size of the breed has decreased significantly due to transformation processes in agriculture and exploitation of Holstein sires for crossbreeding (Kadlečík et al., 2013; Strapák et al., 2013; Kasarda et al., 2015).

Slovak Spotted is open population. Very strong interacted with other important bulls of Simmental populations in Germany, Austria, Switzerland, France and other countries with breeding Simmental (Strapák et al., 2013).

The evaluation of genetic diversity, production and reproductive traits in Simmental cattle show authors

\***Corresponding Author:** Jozef Bujko, Slovak University of Agriculture in Nitra, Faculty of Agrobiolgy and Food Resources, Department of Animal Genetics and Breeding Biology, Tr. Andreja Hlinku 2, 949 76 Nitra, Slovakia.  
E-mail: [Jozef.Bujko@uniag.sk](mailto:Jozef.Bujko@uniag.sk)

in Slovakia (Strapák et al., 2013; Kadlečík et al., 2017; Bujko et al. 2018a,b, 2019; Kasarda et al., 2019), Austria (Ledinek et al., 2019), Serbia (Perišić et al., 2009), Bulgaria (Karamfilov and Nikolov, 2019), Turkish (Bolacali and Öztürk, 2017; Öner et al., 2019), Romanian (Grădinaru et al., 2014; Ciszter et al., 2017), Poland (Zółkiewski et al., 2018), France (Doublet et al., 2019), Mexican (Utrera et al., 2018) and other countries (Strapák et al., 2013).

The aim of this study was to analyse of the trend in the numbers of dairy cows, production and reproduction traits in a population of dairy cows of the Slovak Spotted cattle from 2010 to 2019.

## 2 Material and methods

### 2.1 Data

The data for solving of established aim were obtained from breeding evidence of Breeding Services of the Slovak Republic for the period from 2010 to 2019 (B.S. SR, 2010–2020). Following traits were analysed – milk production (M) in kg, fat production (F) in kg, %, protein production (P) in kg, % for all lactations and selected reproduction traits – age of first calving (AFC) in days and calving interval (CI) in days.

### 2.2 Coding of breeding type

Cows were divided according to the Herd Book classification to subsequent breed-type groups:  $S_0$  – purebred Slovak Spotted with the proportion of foreign breeds less than 12.5%;  $S_1$  – cows with the genetic proportion of Slovak Spotted from 75% to 87.4%;  $S_2$  – cows with the genetic proportion of Slovak Spotted

from 50% to 74.9% (Bujko et al., 2019; Slovak Simmental Breeders Association, 2020).

### 2.3 Statistical analyses

Basic statistical parameters of milk production and reproduction were analysed by using the Statistical Analysis System (SAS) version 9.3.1. Enterprise Guide 3.0 proc means, proc glm, proc reg (SAS, 2011), and MS Excel was used for calculations.

## 3 Results and discussion

The number of dairy cows decreased by 13.46% between the years 2010 to 2019 in the Slovak Republic. A similar tendency was presented by Bujko et al. (2011, 2013), Strapák et al. (2013) by evaluation of the cows' population development in Slovakia in the period from 1990 to 2010. Size of Slovak Spotted dairy cow's population during the period of years 2010–2019 increases by 11.01%. As shown in Table 1, we can conclude a rise in the breeding types  $S_0$  by 17.69%,  $S_1$  by 35.43% in the observed period. In contrast, there was a decrease in  $S_2$  of 11.31%. A similar tendency can also be seen in Slovak Pinzgau breed during the compared as introduced by Kasarda et al. (2008).

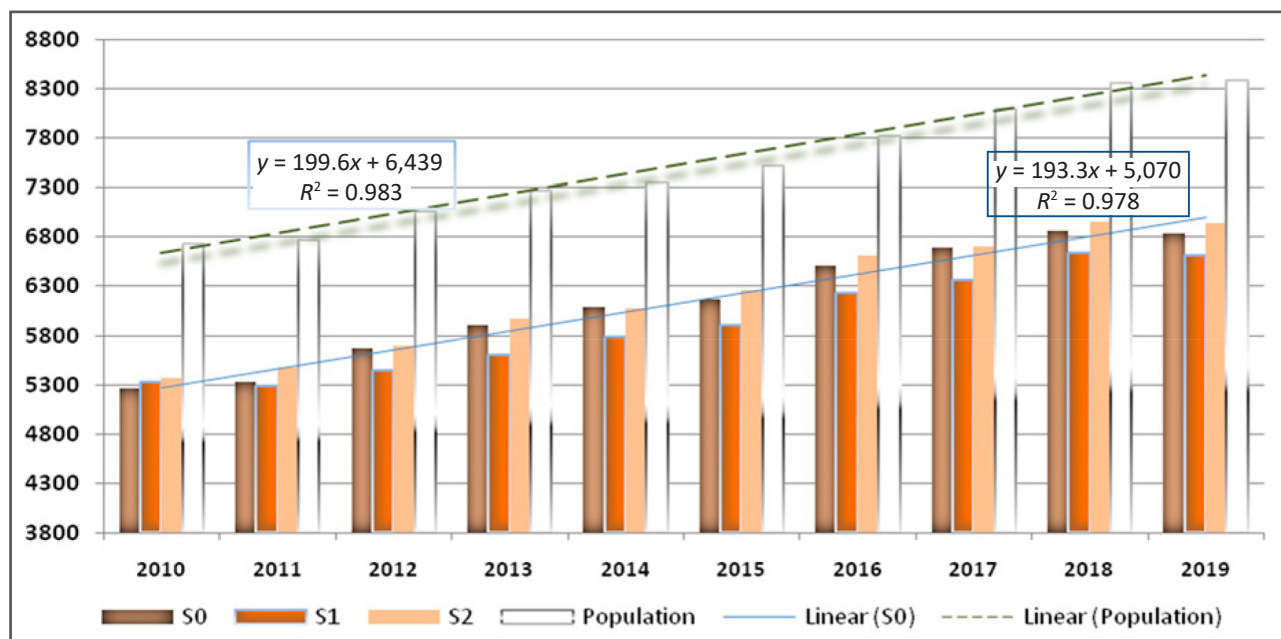
The proportion of Slovak Spotted breed in the total population of dairy cows in Slovakia increased by 7.71%, from 26.24% (2010) to 33.66% in 2016. From 2017 (32.56%) to the end of the reporting period of ear 2019, there was a rising trend (33.66%), an increase of 1.1% (Table 1).

Figure 1 shows differences in milk production (kg) between breeding types in dairy cows of Slovak Spotted cattle by calving years. Milk production of dairy cows in population  $S_0$  increased during years 2010–2019 over by

**Table 1** Number of dairy cows of Slovak Spotted under milk recording in years 2010–2019

| Period    | $S_0$  | $S_1$ | $S_2$ | Total  | Slovakia | Total 6 |
|-----------|--------|-------|-------|--------|----------|---------|
| 2009–2010 | 12,428 | 4,206 | 8,322 | 24,956 | 95,111   | 26.24   |
| 2010–2011 | 12,307 | 4,443 | 8,909 | 25,659 | 89,127   | 28.79   |
| 2011–2012 | 12,573 | 4,830 | 9,254 | 26,657 | 89,592   | 29.75   |
| 2012–2013 | 13,305 | 5,195 | 9,160 | 27,660 | 89 220   | 31.00   |
| 2013–2014 | 13,486 | 5,334 | 9,006 | 27,826 | 86,175   | 32.29   |
| 2014–2015 | 14,165 | 5,707 | 8,983 | 28,855 | 87,014   | 33.16   |
| 2016      | 12,526 | 5,181 | 8,101 | 25,808 | 76,019   | 33.95   |
| 2017      | 14,062 | 5,767 | 8,188 | 27,485 | 84,409   | 32.56   |
| 2018      | 14,150 | 5,677 | 7,862 | 27,689 | 82,443   | 33.59   |
| 2019      | 14,627 | 5,696 | 7,381 | 27,704 | 82,309   | 33.66   |

$S_0$  – purebred Slovak Spotted with the proportion of foreign breeds less than 12.5%;  $S_1$  – cows with the genetic proportion of Slovak Spotted from 75% to 87.4%,  $S_2$  – cows with the genetic proportion of Slovak Spotted from 50% to 74.9%, Total – number of dairy cows of Slovak Spotted cattle together in milk yield control, Slovakia – number of dairy cows together in milk yield control for Slovakia, % Total – percentage share of dairy cows of Slovak Spotted cattle from the total number of dairy cows in the milk yield control for Slovakia



**Figure 1** Differences in milk production between breeding types Slovak Spotted I and population under milk recording in Slovakia

129.89% ( $S_1$  over by 124.13% and  $S_2$  over by 129.16%). In the figure is presented a comparison of the average production by breeding type ( $S_0$ ,  $S_1$  and  $S_2$ ) and dairy population of Slovakia. Both follow the linear trend of increasing milk production in kg, reflecting the regression equation ( $R^2 = 0.978$ ) for  $S_0$ , and  $R^2 = 0.983$  for whole dairy cows' population in Slovakia, respectively.

The proportion of Slovak Spotted dairy cows  $S_0$  (S-Total) under milk recording in the analysed period was rising from 13.07% (26.24%) to actual 17.77% (33.66%). The highest annual increase was found out in the year 2017, where the number of cows  $S_0$  and S-Total increased by 12.26% and 11.04%, respectively.

In 2016, the methodology for evaluating cows was changed from the original interval of the breeding year (from 1 November to 31 October of the following year) to the traditional evaluation system for the calendar year (from 1 January to 31 December of the current year). This could also be one of the factors that made the difference as shown in Table 2. This difference also caused a decrease between the evaluated periods, namely 2014–2015 and 2016 by 1,639 pieces for breeding type  $S_0$  (i.e. 11.57%) and by 3,047 pieces (i.e. 10.56%) in the whole population of the Slovak Spotted cattle (S-Total). The similar trend also in other breeds in population dairy cows in Slovakia as shown results at control years 2010 to 2019 (B.S.SR, 2020).

**Table 2** Comparison of Slovak Spotted cows with a population of all cows in Slovakia in 2010–2019

| Period    | $S_0$  | S-Total | Population | % share of $S_0$ | % share of S-T | % CHS $_0$ | % CHS-T |
|-----------|--------|---------|------------|------------------|----------------|------------|---------|
| 2009–2010 | 12,428 | 24,956  | 95,111     | 13.07            | 26.24          | ± 0        | ± 0     |
| 2010–2011 | 12,307 | 25,659  | 89,127     | 13.81            | 28.79          | -0.97      | 2.82    |
| 2011–2012 | 12,573 | 26,657  | 89,592     | 14.03            | 29.75          | 2.16       | 3.89    |
| 2012–2013 | 13,305 | 27,660  | 89,220     | 14.91            | 31.00          | 5.82       | 3.76    |
| 2013–2014 | 13,486 | 27,826  | 86,175     | 15.65            | 32.29          | 1.36       | 0.60    |
| 2014–2015 | 14,165 | 28,855  | 87,014     | 16.28            | 33.16          | 5.03       | 3.70    |
| 2016      | 12,526 | 25,808  | 76,019     | 16.48            | 33.95          | -11.57     | -10.56  |
| 2017      | 14,062 | 27,485  | 84,409     | 16.66            | 32.56          | 12.26      | 11.04   |
| 2018      | 14,150 | 27,689  | 82,443     | 17.16            | 33.59          | 0.63       | 0.74    |
| 2019      | 14,627 | 27,704  | 82,309     | 17.77            | 33.66          | 3.37       | 0.05    |

% share of  $S_0$  – proportion of  $S_0$  (purebred Slovak Spotted dairy cows with the proportion of foreign breeds less than 12.5%) in the Slovak Republic; % share of S-T proportion of dairy cows S-Total (population of Slovak Spotted dairy cows); % change of  $S_0$  and % change of S-Total population size compared between years (comparison based on population size in years 2009–2010)

**Table 3** Results of milk recording of Slovak Spotted ( $S_0$ ) cows and reproduction traits in 2010 to 2019

| Period    | n      | Milk (kg) | Fat (%) | Fat (kg) | Protein (%) | Protein (kg) | AFC                      |       | CI (days) |
|-----------|--------|-----------|---------|----------|-------------|--------------|--------------------------|-------|-----------|
|           |        |           |         |          |             |              | month days <sup>-1</sup> | day   |           |
| 2009–2010 | 12,428 | 5,269     | 4.03    | 213      | 3.35        | 177          | 30/24                    | 939   | 411       |
| 2010–2011 | 12,307 | 5,326     | 4.04    | 215      | 3.40        | 181          | 30/29                    | 944   | 408       |
| 2011–2012 | 12,573 | 5,676     | 4.02    | 228      | 3.43        | 194          | 31/1                     | 946.5 | 410       |
| 2012–2013 | 13,305 | 5,905     | 4.03    | 238      | 3.44        | 203          | 31/9                     | 954.5 | 409       |
| 2013–2014 | 13,486 | 6,084     | 4.02    | 244      | 3.45        | 210          | 30/30                    | 945   | 408       |
| 2014–2015 | 14,165 | 6,173     | 3.94    | 243      | 3.43        | 212          | 30/10                    | 925   | 407       |
| 2016      | 12,526 | 6,510     | 3.97    | 258      | 3.42        | 223          | 30/9                     | 924   | 403       |
| 2017      | 14,062 | 6,689     | 3.94    | 264      | 3.40        | 228          | 30/24                    | 939   | 402       |
| 2018      | 14,150 | 6,863     | 3.93    | 270      | 3.42        | 235          | 30/26                    | 941   | 404       |
| 2019      | 14,627 | 6,844     | 3.95    | 271      | 3.48        | 238          | 29/25                    | 909.5 | 404       |

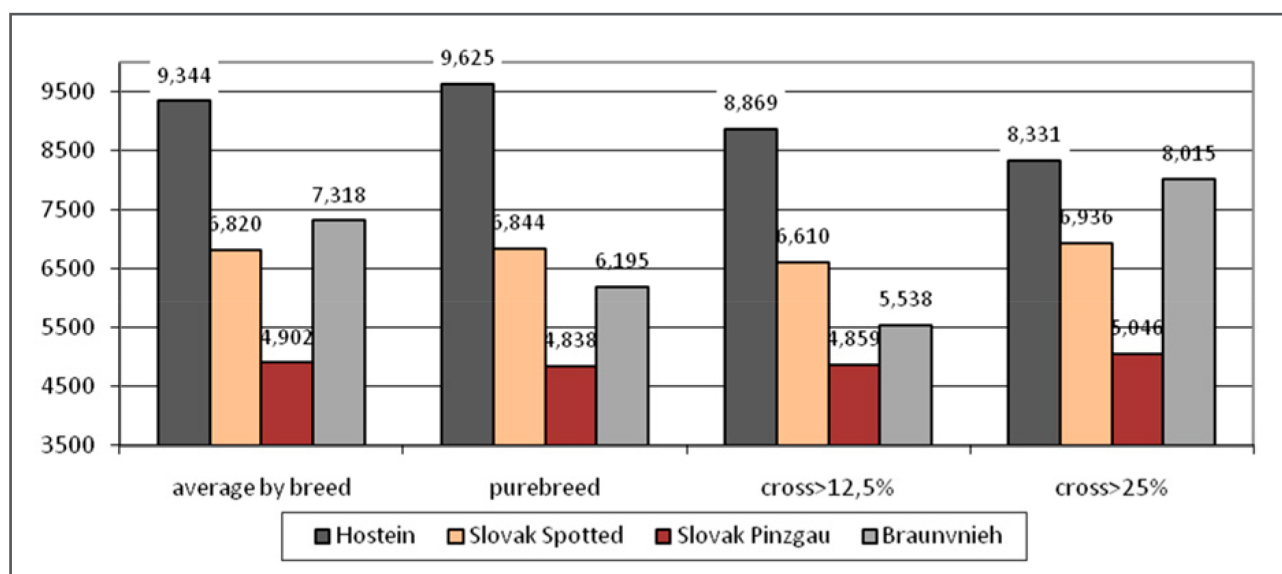
AFC – the age at 1<sup>st</sup> calving (month/day and days); CI – calving interval (days)

Milk production of cows in the breeding type  $S_0$  has an increasing trend from the 2010 (5,269 kg) to the year 2019 (6,844 kg) with an increase of 129.89% for milk, 127.23% for fat and 134.46% for proteins. The average annual increase of milk production between 2010 and 2019 (absolute increase) was + 157.5 kg (1,575 kg) of milk + 5.8 kg (58 kg) of fat and + 6.1 kg (61 kg) of protein (Table 1). This is in comparison to the results of Simmental dairy populations in Germany (7,872 kg milk, 4.15% of fat, 3.53% of protein), as shown by BRS (2019) or Austria (7,661 kg milk, 4.13% of fat, 3.43% of protein), as shown by ZAR (2019).

When comparing the content components in the evaluated period, the fat content decreased from 4.03% (2010) to 3.95% (2019), while the protein content

increased from 3.35% (2010) to 3.48% (2019). The similar tendency was found in the results of dairy populations Simmental cattle reared in Germany, Austria, Switzerland and countries other, as shown by ICAR (2020).

The content components of milk in kg had an increasing tendency, which was directly related to the increase in milk production, where a high positive correlation dependence as stated Bujko, 2011; Ciszter et al., 2017; Bujko et al., 2018a; Karamfilov and Nikolov, 2019. The decrease in the average value of fat content for the evaluated period is also due to the optimization of the feed ration, which is related to the reduction of fibre content and thus the increase of easily digestible carbohydrates. This fact corresponds to the conclusions Koch and Lascano, 2018; Juráček et al., 2020. On the other



**Figure 2** Differences in milk production between breed under milk recording in Slovakia in control period 2019

hand, the protein content in milk increases the average values, which is related to the supplementation of nitrogenous substances in feed rations, which increases the protein content in milk, as shown by Korhonen et al. (2002) and Garamu (2019).

The average AFC in 2010 was over 30 months (939 days) and in 2019 was below 30 months (909.5 days). The similar tendency was observed for the average CI; over 400 days (404 to 411 days). These reproduction traits had a fluctuating trend during the reporting period. When comparing the average values of reproductive traits in the whole population of dairy cows in Slovakia for the evaluated period, namely the AFC was 876 days (2010) and 840 days (2019), on the other hand, for the CI was 429 days (2010) and 409 days (2019), as shown by (B.S.SR, 2020). These results are in contrary to the recommendations of Pšenica et al. (1987), Havrila et al. (2003), Tomko (2018) and Bujko et al. (2019).

The differences in the average of milk production between the main four breeds farmed in Slovakia (including crossbreeds), for the control year 2019 are shown in Figure 2. Highest average production in Slovakia was observed in Holstein breed. Average production milk in population cow Slovak Spotted cattle is slightly under 7,000 kg of milk, which is due to the response to the introduced advancing breeding aim (Slovak Simmental Breeders Association, 2020).

#### 4 Conclusions

In conclusion, we can state, that proportion of Slovak Spotted cattle in the population of dairy cows in the Slovak gradually increased. The proportion of Slovak Spotted cows' population under milk from 2010 to 2019 had an increasing tendency. Individually, in the breeding types  $S_0$  and  $S_1$  we recoded growing trend, however, the proportion of  $S_2$  type decreased. We can state that the average annual increase in milk, fat the production of a protein. The positive tendency in an increased number of cows under milk recording in population, as well as the increase of production ability, are slightly following the trend of breeding values and genetic progress of population.

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