

THE EFFECT OF BULL SIRE PROVENANCE ON PRODUCTION TRAITS OF SIMMENTAL COWS

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Abstract: The aim of the present study was to obtain relevant results related to the basic indicators of fertility and milk yield of Simmental cows, in production conditions on farms of agricultural producers, using appropriate mathematical and statistical procedures, i.e. to determine the influence of bull sires originating from Serbia, Austria and Germany on the implementation of the main breeding program and improvement of production traits of Simmental cows on the territory of Šumadija district. The study of the effect of bull sires who are originally from Serbia, Austria and Germany on performance traits of Simmental cows included a total of 303 cows in first three lactations. Milk production of cows descendents of bulls from the German population was higher compared with the production of cows originating from Austria in the first lactation by 58.29 kg and in the third by 67.72 kg, but in the second it was lower by 12.31 kg. The variability of age at first calving ranged from 766.93 (cows progeny of domestic bulls) to 813.06 days (cows progeny Austrian bulls). Average duration of service period had the interval of variation of 86.80 in cows from domestic bulls in the third lactation to 109.88 days in cows originating from Austrian bulls in the first lactation.

Key words: milk yield, fertility, Simmental breed, bull sires.

Introduction

Genetic improvement of Simmental cattle in our country is realized through selection, i.e. rearing in pure breed. The breeding selection work included attempts to introduce genes of Red Holstein Friesian breed, to improve milk production traits and milking traits. Improvement of the genetic base population of Simmental cattle in our conditions is mainly done through the implementation of

high quality bull sires originating from Austria and Germany, and imports of high-quality heifers.

Romčević et al. (1990) have studied the milk performance traits of the progeny of the same Simmental bulls used, and in Germany and in Serbia. In the rearing conditions that exist in Germany, based on the absolute difference of 417 kg milk, 0.15% of milk fat content and 21.98 kg of milk fat quantity, the highly significant difference in relation to the production of the Serbian population is established.

In regard to Simmental cattle imported from Germany and Austria to Slovakia, *Strapak and Strapáková (1997)* have come to the result that in the first lactation, average yield was 3636 kg of milk with 4.76% milk fat, i.e. 171 kg. Imported cows, in terms of average milk yield, have exceeded the population of the Slovak spotted breed by 626 kg of milk and 48 kg of milk fat. In 1995, the average milk production in Slovakia amounted to 3010 kg with 4.19% fat.

Perišić (1998) has examined the production and reproduction traits of different genotypes of Simmental cows (cows of Domestic Spotted breed and Simmental cows imported from Germany and Slovenia) in the region of upper course of the river Kolubara. The average milk production throughout lactation of all examined cattle amounted to 4311.1 kg. The lowest value is recorded for the cows of Domestic Spotted breed with production in the first three lactations of 3738.8 kg, 4033.4 kg and 4384.3 kg, respectively, and the highest value for German Simmental cows, 4,120.4 kg, 4669.2 kg and 5153.2 kg, respectively. The average milk fat content throughout lactation for all investigated animals is 3.83% with an average quantity of milk fat of 165.06 kg. The production of 4% FCM for all investigated animals is 4191.17 kg.

Perkovic et al. (2003) have examined the impact of Montbeliard bulls on the improvement of the properties of milk and meat performance in Domestic Spotted cattle. Daughters of Montbeliard bulls, compared with the daughters of Domestic Spotted bulls, have had by 299 kg more milk and 0.54% less milk fat.

Comparative examination of the results obtained in 2 groups of F1 generation daughters, *Kučević et al. (2005)* have concluded that the first calvers tested in Germany have achieved a significantly higher yield of milk, milk fat and milk fat content (1057 kg, 41 kg, 0.22%, respectively). Based on the results of RBV (relative breeding value), German bulls show superiority to the average of our population, but also the daughters of bulls in Germany have much better results.

The results of comparative study of first calving heifers of Simmental breed, of domestic and Austrian provenance, in the same rearing conditions (*Medić et al. 2006*) show that in the imported animals realize higher production of milk by significant 1171 kg and 0.49% milk fat.

Examining the impact of genetic and non-genetic factors on performance traits of Simmental cows, *Pantelić et al. (2014)* have established the production of

3701.67 kg of milk, i.e. corrected to 4% FCM, of 3644.58 kg. The average production of milk fat was 144.26 kg and milk fat content 3.88%. The interval from calving to first insemination lasted an average of 124.19 days, and animals calved for the first time at the age of 789.95 days.

Material and Methods

In the last two decades there has been a reduction in the number of cattle of Simmental breed in Serbia and the trend is still present. In order to increase the number of cattle and of high-quality breeding animals, and to improve the genetic composition and increase milk production in the Šumadija district, 150 Simmental heifers were imported from Germany. Import of Simmental heifers had a significant impact on the implementation of the main breeding program in the Šumadija region.

Imported animals are under control and included in the implementation of the basic breeding program carried out by the Association of Simmental cattle breeders "Šumadija" Kragujevac. Simmental cattle in Šumadija region are grown mainly in semi-intensive rearing conditions, i.e. on the small private farms with only several cows. However, there are a small number of milk producers who rear on their farms over 10 quality breeding Simmental cows.

The study of the effect of bulls sires who are originally from Serbia, Austria and Germany, on performance traits of Simmental cows, were analyzed on a total of 303 cows in first three lactations. Heifers and cows are grown on a variety of individual farms, but we can say mainly in very similar housing and feeding conditions. Cows are mostly kept tied in stalls with, with long and medium bedss with straw bedding. Nutrition was based on hay and alfalfa haylage, rarely grass silage, whole maize silage and mainly concentrate finished mixtures. Control of productivity was conducted by breeding organizations according to the AT4 milk recording principles. The following milk production traits in the first three standard lactation were studied:

- Milk yield, kg;
- Milk fat content, %;
- Milk fat yield, kg
- Yield of 4% FCM, kg.

In addition to milk performance traits, the following was determined for each cow:

- age at first calving
- service period after first thre parities.

Average values and variability of all studied traits was determined using standard mathematical and statistical methods, and the significance of the impact of

lactation, heifers origin and provenance of their bull sires by applying the t and F test. For all investigated traits the basic variational-statistical parameters were first calculated:

- arithmetic mean (\bar{X})
- standard deviation (SD)
- coefficient of variation (CV)
- variation interval (Min.-Max.)

Results and Discussion

The use of bulls, i.e. of their frozen semen, is one of the oldest and most accessible methods for genetic improvement in dairy farming. Today, due to the development of information resources and possibilities of using large quantities of information about every individual animal and its siblings and half-siblings, as well as development of methods for molecular genetic analysis, the intensity of selection of bulls was raised to a higher level. By applying genomic testing of bulls, extremely reliable results are obtained on the ability of bulls to improve milk performance traits in their offspring, immediately after the birth of male calf - future bull. The results of the impact of the country of origin (provenance) of bull sires on the tested milk performance traits of their daughters are shown in Tables 1-3.

Table 1. Average values and variability of tested milk performance traits of cows in the first standard lactation observed relevant to the origin of bulls-sires

Indicator	\bar{X}	SD	CV	Min,	Max,
<i>Daughters of domestic bull sires (n=109)</i>					
Milk yield, kg	4386,19	339,18	7,73	3497	5468
Milk fat content, %	3,91	0,08	1,95	3,71	4,18
Milk fat yield, kg	171,65	14,24	8,30	132,59	228,56
Yield of 4%FCM, kg	4329,27	346,95	8,01	3395	5615
<i>Daughters of German bull sires (n=178)</i>					
Milk yield, kg	4524,92	479,13	10,59	3166	5844
Milk fat content, %	3,93	0,08	1,93	3,37	4,11
Milk fat yield, kg	177,65	19,60	11,03	116,83	233,60
Yield of 4%FCM, kg	4474,68	483,74	10,81	3019	5831
<i>Daughters of Austrian bull sires (n=16)</i>					
Milk yield, kg	4466,63	361,10	8,08	3780	4994
Milk fat content, %	3,96	0,04	0,97	3,90	4,02
Milk fat yield, kg	176,88	14,03	7,93	151,20	197,26
Yield of 4%FCM, kg	4439,84	354,32	7,98	3780	4957

Table 2. Average values and variability of tested milk performance traits of cows in the second standard lactation observed relevant to the origin of bulls-sires

Indicator	\bar{x}	SD	CV	Min,	Max,
<i>Daughters of domestic bull sires (n=109)</i>					
Milk yield, kg	4968,17	301,64	6,07	4241	5659
Milk fat content, %	3,93	0,07	1,69	3,71	4,08
Milk fat yield, kg	195,33	12,34	6,32	165,79	225,23
Yield of 4%FCM, kg	4917,24	303,06	6,16	4187	5642
<i>Daughters of German bull sires (n=178)</i>					
Milk yield, kg	5141,38	541,55	10,53	3836	7430
Milk fat content, %	3,94	0,06	1,55	3,75	4,13
Milk fat yield, kg	202,39	21,69	10,72	148,07	294,97
Yield of 4%FCM, kg	5092,44	540,66	10,62	3755	7397
<i>Daughters of Austrian bull sires (n=16)</i>					
Milk yield, kg	5153,69	378,87	7,35	4416	5818
Milk fat content, %	3,93	0,11	2,69	3,72	4,10
Milk fat yield, kg	202,32	16,67	8,24	177,08	238,54
Yield of 4%FCM, kg	5096,33	396,29	7,78	4423	5905

Table 3. Average values and variability of tested milk performance traits of cows in the third standard lactation observed relevant to the origin of bulls-sires

Indicator	\bar{x}	SD	CV	Min.	Max.
<i>Daughters of domestic bull sires (n=109)</i>					
Milk yield, kg	5336.88	332.48	6.23	4247	6174
Milk fat content, %	3.95	0.07	1.72	3.53	4.14
Milk fat yield, kg	210.97	13.48	6.39	169.88	245.11
Yield of 4%FCM, kg	5299.32	332.32	6.27	4247	6146
<i>Daughters of German bull sires (n=178)</i>					
Milk yield, kg	5512.16	553.16	10.04	4129	8480
Milk fat content, %	3.94	0.08	1.95	3.35	4.20
Milk fat yield, kg	217.20	21.87	10.07	165.16	336.66
Yield of 4%FCM, kg	5462.80	546.80	10.01	4129	8442
<i>Daughters of Austrian bull sires (n=16)</i>					
Milk yield, kg	5444.44	415.78	7.64	4942	6441
Milk fat content, %	3.97	0.06	1.59	3.84	4.13
Milk fat yield, kg	216.15	16.89	7.82	195.70	257.64
Yield of 4%FCM, kg	5419.98	417.72	7.71	4912	6441

In regard to milk performance traits in the first three standard lactations, it can be concluded that cows imported from Germany and Austria had much better

results compared to domestic animals. A similar conclusion can be made in the comparison of daughters which originate from domestic and foreign bull sires. The results fully correspond to those published by *Perišić (1998)*, *Medić et al. (2006)*.

In all three lactations, daughters sired by bulls of foreign provenance achieved higher yields of milk, milk fat and 4% fat corrected milk. Milk yield of cows originating from domestic bulls increased gradually from the first (4386.19 kg), to the second (4968.17 kg) lactation, reaching its peak in the third lactation (5336.88 kg). Milk yield of cows originating from bulls from the German population was higher compared with the production of cows, originating from Austrian bulls, in the first lactation – by 58.29 kg, in the third by 67.72 kg, but in the second it was lower by 12.31 kg. Daughters of domestic bulls had lower milk fat content in the first standard lactation (3.91%) compared to first calvers whose sires originate from Germany (3.93%) and Austria (3.96%), but this rule was not observed in the second and third lactation in which the differences were minor. Approximately the same results in their studies are reported by *Romčević et al. (1990)*, *Strapak and Strapakova (1997)*, *Perković et al. (2003)*, *Kučević et al. (2005)*, and lower by *Pantelić et al. (2014)*.

Table 4. Average values and variability of tested fertility traits of cows in the first parity observed relevant to the origin of bulls-sires

Indicator	\bar{X}	SD	CV	Min.	Max.
<i>Daughters of domestic bull sires (n=109)</i>					
Age at calving, days	766,93	87,93	11,46	652	1129
Duration of service period, days	94,82	46,38	48,91	35	308
<i>Daughters of German bull sires (n=178)</i>					
Age at calving, days	785,33	85,39	10,87	656	1311
Duration of service period, days	103,52	54,79	52,92	27	320
<i>Daughters of Austrian bull sires (n=16)</i>					
Age at calving, days	813,06	124,40	15,30	684	1175
Duration of service period, days	109,88	61,80	56,24	41	240

Table 5. Average values and variability of tested fertility traits of cows in the second parity observed relevant to the origin of bulls-sires

Indicator	\bar{x}	SD	CV	Min,	Max,
<i>Daughters of domestic bull sires (n=109)</i>					
Age at calving, days	1151,73	105,14	9,13	979	1478
Duration of service period, days	91,11	52,33	57,44	31	341
<i>Daughters of German bull sires (n=178)</i>					
Age at calving, days	1181,83	107,36	9,08	1017	1701
Duration of service period, days	97,89	52,19	53,31	30	317
<i>Daughters of Austrian bull sires (n=16)</i>					
Age at calving, days	1198,13	147,62	12,32	1023	1571
Duration of service period, days	97,50	38,68	39,67	58	198

Table 6. Average values and variability of tested fertility traits of cows in the third parity observed relevant to the origin of bulls-sires

Indicator	\bar{x}	SD	CV	Min.	Max.
<i>Daughters of domestic bull sires (n=109)</i>					
Age at calving, days	1529,46	115,17	7,53	1333	1871
Duration of service period, days	86,80	31,62	36,42	39	198
<i>Daughters of German bull sires (n=178)</i>					
Age at calving, days	1564,92	126,41	8,08	1230	2062
Duration of service period, days	92,25	35,23	38,19	39	244
<i>Daughters of Austrian bull sires (n=16)</i>					
Age at calving, days	1567,69	185,33	11,82	1194	1973
Duration of service period, days	108,13	38,06	35,20	41	170

The analysis of fertility indicators of cows according to the origin of bull sires (tables 4-6) shows differences in age at first calving of 766.93 (cows of domestic bulls) to 813.06 days (cows of Austrian bulls). Also, the average duration of service period ranged from 86.80 in cows progeny of domestic bulls in the third lactation to 109.88 days in cows originating from Austrian bulls in the first lactation. Significant deviation in the duration of service period was observed in the third lactation, where the difference between cows originating from domestic bulls and cows sired by Austrian bulls was an entire oestrus cycle (21.33 days).

Croatian Livestock Selection Center (2003), in its annual report, cites certain reproduction indicators for the population of Simmental cows. The average age of registered cows in the first lactation was 28 months, in the second lactation 39, and the third - 53 months. The average duration of service period was 120 days. By analyzing the production and reproductive performance of Simmental bull dams

in our country, *Pantelić et al. (2005)* have found the average age at first conception of 517.61 days, as well as the service period of 108.98 days.

Reproductive traits gain increasing importance in the implementation of the breeding program of the Republic of Serbia, since they have significant impact on the economic efficiency of milk production. Poor reproductive performance influences the economic losses that result from extended service period, increased insemination index, higher coefficient of culling of cows and increased production costs due to the use of veterinary services.

The results also indicate that although there are significant differences in age at calving and duration of service period between cows sired by domestic bulls and imported cows originating from Austrian and German bulls in the first lactation, these differences were not significantly increased during the second and third lactation. This indicates that the imported heifers were fertilized somewhat later, and it took them some time to adapt and prepare for fertilization for the second calving.

Conclusion

Improving of phenotypes of dairy animals requires continuous work, which includes systematic improvement of quantitative genetic traits and permanent work on their improved expression. The high yields of milk, milk fat and protein, in addition to the selection, require optimal provision and ensuring of non-genetic factors such as diet, housing, health care, etc.

The milk yield of cows sired by bulls from the German population was higher compared with the production of cows sired by Austrian bulls in the first lactation by 58.29 kg, in the third by 67.72 kg, but in the second it was lower by 12.31 kg. Daughters of domestic bulls had lower milk fat content in the first standard lactation (3.91%) compared to first calvers whose ancestors originated from Germany (3.93%) and Austria (3.96%), but this rule was not observed in the second and third lactation, in which the differences were minor.

Based on the obtained results of fertility traits of cows according to the provenance of bull sires, the differences were established in age at first calving of 766.93 (cows from domestic bulls) to 813.06 days (cows from Austrian bulls). Also, the average duration of service period ranged from 86.80 in cows from domestic bulls after the third calving, to 109.88 days in cows originating from Austrian bulls after the first calving.

Based on these findings it can be concluded that the import of high-quality heifers of Simmental breed sired by bulls from Germany and Austria significantly influenced the improvement of milk and fertility traits of cows in the Šumadija district.

Uticaj provenijence bikova očeva na proizvodne osobine krava simentalске rase

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Rezime

Unapređenje fenotipova mlečnosti krava zahteva kontinuiran rad koji obuhvata sistematsko poboljšanje kvantitavnih genetskih osobina i permanentni rad na njihovom poboljšanom ispoljavanju. Visok prinos mleka, mlečne masti i proteina, pored selekcije zahteva i optimalno obezbeđenje paragenetskih faktora kao što su ishrana, držanje, odgoj, nega i dr.

Proizvodnja mleka kod krava poreklom od bikova iz Nemačke populacije, bila je veća u poređenju sa proizvodnjom krava poreklom od bikova iz Austrije u prvoj laktaciji za 58, 29 kg, u trećoj za 67,72 kg, ali je u drugoj bila manja za 12,31 kg. Kćeri domaćih bikova su imale niži sadržaj mlečne masti u I standardnoj laktaciji (3,91%) u odnosu na prvotelke čiji očevi potiču iz Nemačke (3,93%) i Austrije (3,96%), ali to pravilo nije uočeno u II i III laktaciji u kojima su razlike bile neznatne.

Na osnovu dobijenih rezultata osobina plodnosti krava prema poreklu bikova-očeva ustanovljene su razlike u uzrastu pri prvom telenju od 766,93 (krave od domaćih bikova) do 813,06 dana (krave od austrijskih bikova). Takođe, prosečno trajanje servis perioda kretalo se od 86,80 kod krava od domaćih bikova posle trećeg teljenja, do 109,88 dana kod krava poreklom od austrijskih bikova posle prvog teljenja.

Na osnovu iznetog u zaključku može se konstatovati da je uvoz kvalitetnih priplodnih junica simentalске rase koje vode poreklo od bikova iz Nemačke i Austrije značajno uticao na poboljšanje osobina mlečnosti i plodnosti populacije krava u Šumadijskom okrugu.

Ključne reči: prinos mleka, plodnost, simentalска rasa, bikovi očevi

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