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RESULTS OF THE APPLICATION OF THE TECHNOLOGY OF GENETIC IMPROVEMENT OF SIMMENTAL CATTLE POPULATION IN SERBIA[1]

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Content: Results of production traits obtained from first calving cows and evaluation of the breeding value of bull sires of Simmental breed in Serbia. Data was analyzed using the method of least squares and for evaluation of bulls' breeding value mixed model of random sire effect (BLUP method).

Based on obtained results it was established in statistical analysis that breeding region had highly significantly affected ($P<0.01$) the deviation of production traits from the general average. Considerable deviation from the general average was caused by the year and season of calving ($P<0.05$), and interaction of breeding region and calving season contributed to high variation in yield of milk and milk fat ($P<0.01$).

Key words: cow, milk, milk fat, bull - sire, LS, BLUP

Introduction

Cattle of Simmental breed, as the most present in Serbia, are mainly raised in semi intensive conditions of housing, care and nutrition, i.e. on small private farms with only few female heads of cattle. However, recently, more farmers – milk producers oriented towards the market have over 20 high quality Simmental cows. In order to be able to compete in milk production on the market it is important to continuously work on new

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technological solutions in selection and genetic improvement of milk traits of this cattle breed in Serbia.

Genetic improvement of Simmental breed in our country is realized through selection or breeding in pure breed. Genes of Red Holstein and Montbeliard breed are introduced in smaller percentage in order to improve the milk traits and milkability. Improvement of genetic basis of Simmental cattle populations in our conditions is mainly carried out through Simmental bull sires originating from Germany and Austria, and Montbeliard bull sires from France. Evaluation of additive value of genotype, i.e. accuracy of its evaluation (bull's breeding value) is in direct relation to the selection effect/success in cattle population. The more accurate and objective evaluation of breeding value is objective and in Serbia this is realized through comparison of female animals of same age (CC method) and application of BLUP method.

Production traits of Simmental cows, the effect of systematic factors on them and evaluation of bull breeding value were studied by *Ufford et al. (1979), Dempfle (1981), Ferčej et al. (1989), Erjavec et al. (1989), Lazarević et al. (1991), Vasović (1991), Miščević (1995), Petrović et al. (1997) and (1999), Perišić et al., (2002), Kučević et al. (2004) and (2005), Pantelić et al. (2005) and Petrović Milun et al. (2005).*

Material and methods

Data used in this research was collected from 8 regions – cattle breeding areas in Serbia. Research included approximately 4000 first calving cows which had calved over period of 5 years (2001-2005), and evaluation of the breeding value of 28 bulls with 2134 daughters.

Cattle breeding regions were: Šumadija (1), vicinity of Belgrade (2), Kolubara (3), Pomoravlje (4), Rasina (5), Timok-Niš region (6), Braničevo (7) and region of city of Užice (8).

I season of calving included months of February, March and April, II season May, June and July, III season months of August, September and October and IV season November, December and January.

Bull sires were of Simmental breed and located and exploited in Livestock and Veterinary Centres in Velika Plana and Krnjača.

All investigated heads of cattle were kept tied or free on owned by private farmers, fed in the usual way, differences were in the quantity, ratio and quality of roughage and concentrated feeds (depending on the cattle breeding region).

Mathematical-statistical analysis of data was carried out using mixed model of least Squares with fixed and random effects (LS - Least Squa-

res and BLUP - Best Linear Unbiased Prediction) using the least Square programme (LSMLMW), *Harvey, 1991*. The following models were used in analysis of the effect of cattle breeding region, year and season of calving and bull sires on productivity of cows in the first lactation:

1. $Y_{ijkl} = + P_i + G_j + S_k + GS_1 + b_1 (x_1 - x_1) + e_{ijklm}$
2. $Y_{ijkl} = + P_i + G_j + S_k + O_1 + e_{ijklm}$

where:

Y_{ijklm} – individual animal (*m*) raised in *i* region, calved in *j* year and *ik* season and originating from *l* bull sire

μ - general average of population
P_i - fixed influence of the breeding region (1-8)
G_j - fixed influence of the year of calving (1-5)
S_k - fixed influence of the season of calving (1-4)
GS_1 - fixed influence of the year/season interaction
O_1 - random bull sire effect (1-28)
b_1 - linear regression effect of age at calving
e_{ijklm} - other undetermined effects.

Values of the coefficient of intraclass correlation of R = 0,30 were used for obtaining of BLUP solutions.

Results and discussion

First calving cows raised in breeding region 5 produced by 514.2 kg and 4% FCM more compared to the general average, and even by 655.0 kg more milk compared to heifers which had calved in breeding region 8 (table 1).

Table 1. Effect of systematic factors as LSM deviation (c_i) on productive traits
Tabela 1. Uticaj sistematskih činilaca kao LSM odstupanja (c_i) na osobine proizvodnosti

μ S.E. Odgajivačko područje Breeding area	Mleko, kg Milk, kg 4413 151.2		Mlečna mast, kg Milk fat, kg 170.0 6.3		Mlačna mast, % Milk fat, % 3.88 .03		4% MKM 4% FCM 4213 148.1	
	e_i	LSM	e_i	LSM	e_i	LSM	e_i	LSM
1	-362.5	4050	-1.2	159.9	.09	3.97	-153.7	4016
2	231.4	4644	6.9	177.3	-.03	3.85	195.9	4517
3	-11.5	4402	-.34	169.2	.03	3.91	-9.81	4297
4	243.3	4656	-12.9	177.9	-.05	3.83	-290.1	4529
5	396.7	4809	23.8	184.1	-.06	3.82	514.2	4684
6	123.5	4536	1.3	175.9	-.01	3,87	50.5	4452
7	-122.4	4291	1.2	165.9	-.01	3.87	68.0	4201
8	-427.3	3985	-49.3	162.8	.12	4.13	-484.1	4029
Godina telenja Year of calving								
2001	-207.2	4206	-2.1	162.9	.01	3.88	-130.8	4127
2002	-301.7	4111	-9.1	159.9	.03	3.91	-256.4	4041
2003	179.4	4592	1.9	178.9	.01	3.89	98.8	4519
2004	278.5	4691	5.6	180.7	-.02	3.86	195.1	4587
2005	332.4	4745	3.2	183.9	-.01	3.87	184.1	4655
Sezona telenja Season of calving								
1	173.1	4586	10.1	174.9	.06	3.82	223.9	4458
2	-20.4	4393	-.4	170.8	-.02	3.90	-14.4	4319
3	-179.5	4233	-16.4	168.8	-.09	3.97	-143.9	4224
4	91.2	4504	1.0	174.5	.01	3.87	52.3	4418

Statistical analysis showed effect of breeding region (P<0.01) causing highly significant deviation from the general average of the yield of milk and milk fat (table 2).

Table 2. Least - Squares analysis of variance (F exp.)
Tabela 2. Analiza varijanse najmanjih kvadrata (exp. F)

Uticaji Influences	Mleko, kg Milk, kg	Mlečna mast Milk fat		4% MKM, kg 4% FCM, kg
		kg	%	
Odgajivačko područje / Breeding area	9.121**	9.941**	17.321**	9.431**
Godina telenja / Year of calving	3.321*	3.011*	.213^{NS}	3.011*
Sezona telenja / Season of calving	3.003*	2.999*	2.153*	2.975*
Odgajivačko područje/sezona telenja (interakcija) Breeding area/season of calving (interaction)	2.974**	2.063**	1.1.599^{NS}	3.011**

NS - P>0.05* - P<0.05** - P<0.01

Results referring to deviations of the production traits under the influence of calving year indicate positive tendencies in increase of milk yield. Heifers which had calved in the last three years showed positive deviations which also indicated the presence of positive genetic trend (table 1). Considerable deviations in regard to yield of milk and milk fat ($P<0.05$) were caused by year of calving (table 3).

Data regarding the season of the year when lactation of cows included in our research had started shows highly significant deviations in yield of milk and milk fat from the general average ($P<0.01$). Heifers which had calved in February, March and April produced in lactation by 223.9 kg of 4% FCM more than general average and by 366.9 kg more compared to the heifers which had calved in August, September and October (table 1).

Random effect of breeding males on milk traits of 28 groups of half sisters is presented in table 3.

Table 3. Breeding Value Evaluation (PV) and Rank (RG) of Bulls-Sires
Tabela 3. Ocena priplodne vrednosti bikova - očeva (PV) i rang bikova (RG)

Slučajan efekat - Random effect (BLUP)						
R.br.bika Bull No.	Broj kćeri No.of daughters	mleko milk	mlečna mast milk fat	4%MKM/ FCM, %	4%MKM/ FCM,kg	Rang bikova Rank of bulls
		kg		%		
		PV/BV	PV/BV	PV/BV	PV/BV	
9	79	608.20	23.98	0.01	593.70	1
7	81	585.87	19.23	0.02	571.37	2
11	69	296.56	9.98	0.01	281.53	3
-	-	-	-	-	-	-
10	77	-474.80	-20.23	-0.07	-509.76	26
27	59	-564.22	-23.98	-0.04	-549.62	27
23	62	-701.63	-28.11	0.01	-607.13	28

In analysis of negative and positive BLUP solutions (breeding values) for yield of 4% FCM, bull rank was formed according to which bull no. 6 was evaluated as the best and bull sire no. 21 was at the bottom of the rank.

First calving cows included in our research had produced 4413 kg of milk with 170.0 kg of milk fat, i.e. 3.88% of milk fat and 4213 kg of 4% FCM. Results obtained in our research are similar to those stated by *Ferčej et al. (1989), Erjavec et al. (1989), Pantelić et al., 2005, Kučević, 2004, Kučević et al.2005, Perović M.D (2005),* to some extent these results are higher/better compared to values obtained for milk traits of the same breed (*Petrović et al., 1997, 1999, 1986*), and considerably higher compared to results established by Vasović *(1991) and Miščević (1995*).

Conclusion

Based on research results the following can be concluded: the systematic factors of the environment, breeding region, year and season of calving caused highly significant (P<0,01) and significant (P<0,05) deviation of the yield of milk and milk fat in first calving cows, and obtained results justify the use of linear methods and correction of systematic factors of the environment. Use of mixed model, random effect of bull sire on milk yield in his daughters and forming of bull rank based on their breeding value, results were obtained which demonstrate that bull no. 9 was superior to the others. Bull sire no. 23 had the lowest breeding value for traits of milk yield and yield of milk fat. Based on obtained results it can be concluded that BLUP method gives objective evaluation of the breeding value. This method considers numerous systematic factors of the environment, effect of the different genetic level of bulls and genetic trend, therefore it contributes to objective evaluation of the bulls' breeding value.

REZULTATI PRIMENE TEHNOLOGIJE GENETSKOG UNAPREĐENJA POPULACIJE SIMENTALSKIH GOVEDA U SRBIJI

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Summary

U radu su prikazani rezultati koji se odnose na proizvodne osobine krava-prvotelki i ocena priplodne vrednosti bikova - očeva simentalske rase goveda u Srbiji. Podaci su analizirani metodom najmanjih kvadrata, a za ocenu priplodne vrednosti bikova korišćen je mešoviti model slučajnog uticaja oca (BLUP metod).

Na osnovu rezultata dobijenih u statističkoj analizi ustanovljeno je da je odgajivačko područje visoko značajno (P<0.01) prouzrokovalo odstupanja proizvodnih osobina od opšteg proseka.

Sistematski faktori okoline, odgajivačko područja, godina i sezona telenja su prouzrokovali visoko značajno (P<0,01) i značajno (P<0,05) odstupanje prinosa mleka i mlečne masti krava - prvotelki, a tako dobijeni rezultati ukazuju na opravdanost korišćenja linearnih metoda odnosno korekcije sistematskih faktora okoline. Korišćenjem mešovitog modela, slučajnog uticaja bika - oca na prinos mleka kćeri, kao i formiranjem ranga bikova na osnovu priplodne vrednosti, dobijeni su rezultati koji pokazuju da

je bik pod rednim brojem 9 superioran u odnosu na ostale. Bik - otac broj 23 ima najnižu priplodnu vrednost za osobine prinosa mleka i mlečne masti. Na osnovu dobijenih rezultata može se ustanoviti da BLUP metod daje objektivnu ocenu priplodne vrednosti. Ovaj metod uvažava veliki broj sistematskih faktora okoline, uticaj različitog genetskog nivoa bikova i genetski trend, te stoga doprinosi objektivnoj oceni priplodne vrednosti bikova.

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