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## EFFECT OF FIXED AND CONTINUOUS NON-GENETIC FACTORS ON CALF BIRTH WEIGHT\*

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**SUMMARY:** Cattle reproduction is a highly important field and complex stage of production with large reserves of milk, meat, breeding cattle and by-products.

In scientific literature, fertility is generally assessed through age at first conception, gestation length, length of service period, calving interval, and calf birth weight.

Determination of the effect of particular non-genetic factors on the above traits is a vital step in cattle breeding and reproduction.

Calf weight is governed by both genetic and non-genetic factors. Among non-genetic factors, the fixed effects commonly evaluated are effects of breeding region, season of birth, calving season, year of birth, calf sex and their interactions, and continuous or regression effects include age at first conception or calving.

The effect of fixed and continuous non-genetic factors on calf birth weight was analysed in 1151 Simmental calves in three breeding regions, with the effect of breeding region, parity group, calf sex, and breeding region x calving season interaction being statistically very significant ( $P < 0.01$ ). Birth weight was significantly ( $P < 0.05$ ) affected by year of birth and calving season, whereas the fixed effect of birth season and the continuous effect of age at first conception were non-significant ( $P > 0.05$ ).

The coefficient of determination ( $R^2$ ) showing the level of variation in calf birth weight as explained by the effect of fixed and continuous non-genetic factors fitted in the model was 0.325.

**Key words:** Simmental breed, calf weight, fixed non-genetic effects, continuous non-genetic effects, coefficient of determination.

### Introduction

Cattle reproduction is a very important research field and a highly complex stage of cattle production securing reserves of milk, meat, breeding herds and by-products. At the current level of development of agricultural production and animal science, the issue of milk and meat production is considered less serious than that of cattle reproduction management. Cattle reproduction physiology is a complex field affected by a range of endogenic and exogenic factors more intensely than any other stage of cattle production. Aenhelt et al. (1968) note that there is a cow productivity limit beyond which normal fertility cannot be maintained.

The effect of fixed and continuous non-genetic factors on reproductive traits and calf birth weight was studied by many national and foreign authors [6, 7, 8, 9, 3, 5, 12, 2, 10, 11, 4].

The objective of this study was to analyse data on the fertility of Simmental cows to determine and assess factors that affect variability of calf birth weight.

### Material and Method

The effect of fixed (breeding region, calving season and birth, year of birth, calf sex and interaction breeding region x calving season) and continuous or regression environmental factors (age at first conception) on calf birth weight was evaluated in 1151 Simmental calves using the general linear model that ensured simultaneous analysis of differing effects, regardless of whether they were categorical or continuous in character. The general linear model involved the use of the least squares method for the evaluation of the effects and testing of the hypotheses, according to the following model:

$$y_{ijklmn} = \mu + R_i + P_j + S_{ck} + S_{bl} + Y_{bm} + S_n + R_{Scik} + b_l(x_l - 1) + e_{ijklmn}$$

where

$y_{ijklmn}$  - individual cow of the  $i$ -th rearing area,  $j$ -th parity group,  $k$ -th season of calving,  $l$ -th season of birth,  $m$ -th year of birth and  $n$ -th sex of calf),

$\mu$  - overall population mean under identical distribution of all classes of effects ( $R, P, S_c, S_b, Y_b, S, Y_b S_b$ ),

$i$  - fixed effect of the  $i$ -th rearing area (1-3),

$j$  - fixed effect of the  $j$ -th parity group (1-5),

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Sck - fixed effect of the k-th season of calving (1-4),

Sbl - fixed effect of l-th season of birth, (1-4),

Ybm - fixed effect of m-th year of birth (1-10),

Sn - fixed effect of the n-th sex of calf (1-2),

RScik - fixed effect of the i-th rearing area x l-th season of calving (1-12),

b1 - linear regression coefficient of the effect of age at first conception and

eijklmn - other non-determined effects

Further analysis of service period shows results of the analysis of variance using the above model, i.e. significance of factors, as well as the coefficient of determination (R<sup>2</sup>), denoting the remainder and the model variance divided by 100, respectively.

### Results and Discussion

The effect of systematic environmental factors on calf birth weight was analysed by calculating the least squares means (LSM) and standard errors of the means (SE<sub>LSM</sub>). The results of the analysis are given in Table 1.

Table 1. Least squares means, standard errors of the means and significance of the effect of systematic factors and age at first conception on calf birth weight (CBW)

Systematic effects	Calf birth weight - CBW (kg)		
	N	LSM	SE <sub>LSM</sub>
Total	1151	40.72	0.155
Breeding region			
I	366	39.12842	0.271386
II	563	40.21492	0.190488
III	222	44.64414	0.347099
F <sub>exp</sub>			112.14**
Parity groups			
I (1)	242	39.25620	0.187488
II (2)	249	40.24096	0.327902
III (3)	249	41.24096	0.346441
IV (4)	248	41.35081	0.410425
V (5 i ostali)	163	41.89571	0.405093
F <sub>exp</sub>			13.06**
Season of calving			
I	319	41.28527	0.272144
II	280	40.14643	0.365201
III	248	40.01210	0.307522
IV	304	41.24671	0.287101
F <sub>exp</sub>			3.57*
Season of birth			
0I	322	40.64596	0.314039
II	325	40.45231	0.275366
III	200	39.65500	0.406702
IV	304	41.79934	0.262617
F <sub>exp</sub>			2.59**
Calf sex			
I	571	42.31524	0.214215
II	580	39.15690	0.203556
F <sub>exp</sub>			165.22**
Year of birth			
F <sub>exp</sub>		0.020*	
Breeding region x season of calving			
F <sub>exp</sub>		6.218**	
Age at first conception			
F <sub>exp</sub>		0.016**	
Coefficient of determination - R <sup>2</sup>			0.325**

N.S. - P > 0.05; \* - P < 0.05; \*\* - P < 0.01;

Breeding region had a very significant effect on calf birth weight. Calf weight on individual farms in the Rudno region (I) was highly significantly higher ( $P < 0.01$ ) compared to farms in Zlatibor (II) and Čačak (III) regions.

Calf birth weight increased with cow age. Calf weight at the fifth and succeeding parturitions was highly significantly higher ( $P < 0.01$ ) compared to birth weight at the first four parturitions.

Calf birth weight was also affected by calving season through climate and type of feeds used. Namely, calf weight during the spring (I) and winter (IV) calving seasons was significantly higher ( $P < 0.05$ ) than during the summer (II) and autumn (III) seasons.

Calf birth season did not have a significant effect ( $P > 0.05$ ) on calf birth weight.

Calf sex highly significantly ( $P < 0.01$ ) affected calf birth weight, which was about 3 kg higher in male calves than in females.

The effect of year of birth on calf birth weight was assessed over a period of ten years (1998-2007), and was found to be significant ( $P < 0.01$ ), depending primarily on feeding conditions.

The breeding region x calving season interaction as a fixed factor had a very significant effect on ( $P < 0.01$ ) on calf birth weight, whereas the continuous or regression effect of age at first conception was found to be non-significant ( $P > 0.05$ ).

In their study on the effect of non-genetic factors on reproductive traits in Simmental cows, Petrović D.M. et al (2007) reported a very significant effect of group of parturition, calf sex, birth type and their interaction on calf birth weight, whereas the effect of calving season was significant.

Given the fact that the fixed non-genetic effects fitted into the model had very significant and significant effects on calf birth weight, the coefficient of determination ( $R^2$ ), indicating the level of variation in calf birth weight as explained through the effect of non-genetic factors included in the model, was rather high - 0.325 or 32.5%. The coefficient of determination for calf birth weight was reported to be even higher (0.522 or 52.2%) by Petrović D.M., (2008).

#### Conclusion

The effect of fixed and continuous non-genetic factors on calf birth weight was analysed in 1151 Simmental calves in three breeding regions, with the effect of breeding region, parity group, calf sex, and breeding region x calving season interaction being statistically very significant ( $P < 0.01$ ).

Birth weight was significantly ( $P < 0.05$ ) affected by year of birth and calving season, whereas the fixed effect of birth season and the continuous effect of age at first conception were non-significant ( $P > 0.05$ ).

The coefficient of determination ( $R^2$ ) showing the level of variation in calf birth weight as explained by the effect of fixed and continuous non-genetic factors fitted in the model was 0.325.

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