UDC 575:636
DOI: 10.2298/GENSR1202317S
Original scientific paper

COMPARATION OF HEREDITY COEFFICIENTS OF PRODUCTIVE TRAITS IN THE POPULATION OF BLACK WHITE COWS

Zvonko SPASIĆ, Božidar MILOŠEVIĆ, Nebojša LALIĆ,
Sonja SAMARDŽIĆ, Zoran ILIĆ, Bojana RISTANOVIĆ

Faculty of Agriculture, Lešak, Republic of Serbia

Spasić Z., B. Milošević, N. Lalić, S. Samardžićć, Z. Ilić, and B. Ristanović (2012): *Comparation of heredity coefficients of productive traits in the population of black white cows* . - Genetika, Vol 44, No. 2, 317 - 324.

On the basis of genetic variability of economically important traits we orientate ourselves toward specific methods development and use in genetic improvement of a population. However, the heritability (h^2) is important for giving the answer, which traits can be included in the breeding value evaluation of a population. For determining the heritability 1502 black white breed cows were used: 751 mothers and 751 daughters (together 6393 lactations). The heritability coefficient of investigated traits in cows was calculated using three methods: regression of daughters to mothers, intraclass correlation according to bulls-sires and, for those features for which recurrence exists during the life we used method of repeatability (R).

Corresponding author: Spasić Zvonko,Faculty of Agriculture, Lešak, Republic of Serbia, email spasic.zvonko@gmail.com

For average milk yield, milk fat and fat edited milk during standard lactations by the method of regression and repeatability intermediate coefficients of heredity were determined (from 0,291 to 0,323), while by the interclass correlation were determined high coefficients (from 0,461 to 0,543).The heritability coefficients for average content of milk fat were low (from 0,029 to 0,192), thus further improvement of this quantitative trait in the population would be possible mainly via bulls sires with the higher genetic potential.

Key words: black white breed: heritability, repeatability

INTRODUCTION

Accomplishment of the genetic improvement of milk production and its quality, are basic preconditions of the contemporary dairy farming. Progress in terms of cattle production traits improvement, can be attained, before all, by introduction of new technologies and domestic animals breeding methods, to what has to be given great attention.

By cattle genetic improvement are created, or has been creating, preconditions for high milk and milk fat production. Nowadays, more and more attractive, is milk protein content, as well as cattle fertility traits improvement. However, selection of heads taht will be used as potential parents, still stay opened question.

On the basis of genetic variability of economically most important traits, we orientate ourselves toward use of appropriate methods in genetic improvement. However, heritability (h^2) is important also for an answer on question which traits could be included in estimation of an animal breeding value.

The objective of this study was to evaluate the traits of some new NS maize hybrids from FAO Maturity Group 600 relative to the standard and to determine the effects of the growing environment on their grain yields.

MATERIALS AND METHODS

In heredity coefficients determination of productive traits in two generations of black and white cows breed, 1502 animals were included: 751 mothers and 751 daughters (that were daughters of 5 bull sires). The results of implemented productivity controls, systematized and registered in appropriate farm registry in Gornje Dobrevo, has served as a main source of data for the analysis in this work, whereby 6393 lactations were examined.

Heritability coefficients in cows investigated, were calculated by application of the following three methods:

a) by parent offspring regression (*mother–daughter regression*)

$h^2 = 2\,b_{yx}$; $b_{yx} = \dfrac{Cov(xy)}{s^2(x)}$ where is: b_{yx} = regression coefficient,

$Cov_{(xy)}$ = covariance of the same traits in mothers and daughters

$s^2_{(x)}$ = mothers' trait variance.

Standard error of heritability (S.E. h^2) was calculated using formula:

$$S.E.\ h^2 = \sqrt{2s_b^2} \quad ; \quad s_b^2 = \frac{1}{n-2}\left(\frac{s_y^2}{s_x^2} - b^2_{yx}\right)$$

s_b^2 = regression standard error S_x^2 = mothers' trait variance

S_y^2 = daughters' trait variance n = number of pairs daughter-mother

b) by intraclass correlation of half-sisters within sires

$h^2 = 4\dfrac{Var_{BS}}{Var_{BS} + Var_{WS}}$ where is: Var_{BS} = variance between sires

Var_{WS} = variance within sires

Standard error of heritability (S.E. h^2) was calculated using formula that was derived ROBERTSON (1959), and cited by SPASIĆ (2006):

$$SE.h^2 = \left(h^2 + \frac{4}{K}\right)\sqrt{\frac{2}{s}}$$ where is: K = average number of daughters per sire

s = number of sires

c) by using coefficient of repeatability (repeatability)

Coefficient of repeatability was calculated by using formula presented by SPASIĆ (2006):

$$R = \frac{Var_{BI}}{Var_{BI} + Var_{WI}}$$ where is: Var_{BI} = variance between animals

Var_{WI} = variance within animals

Standard error of repeatability was calculated by SWIEGER (1964) whom is citing SPASIĆ *et al.,* (2006):

$$\mathbf{S.E.}_{(R)} = \sqrt{\frac{2\left(\sum n_{r/i} - 1\right)(1-R)^2\left[1+(K-1)R\right]^2}{K^2\left(\sum n_{r/i} - n\right)(n-1)}}$$ where is:

R = repeatability $n_{r/i}$ = number of results per animal
n = number of cows K = average number of results per animal

RESULTS AND DISCUSSION

Heritability coefficients for milking traits in complete lactations of investigated cows are presented in Table 1.

Tabela 1. Coefficients (h^2) and standard errors of heritability ($S.E.h^2$) and repeatability (R) of milking traits in complete lactations of black and white cows

Metod / Traits	Parent offspring regression	Intraclass correlation	Repeatability
	$h^2 \pm S.E.h^2$	$h^2 \pm S.E.h^2$	$R \pm S.E._R$
Average lactation duration	0,101 0,09	0,338 0,23	0,286 0,03
Average milk yield	0,333 0,03	0,519 0,34	0,394 0,02
Average milk fat content	0,029 0,05	0,192 0,14	0,105 0,02
Average milk fat yield	0,289 0,03	0,549 0,37	0,369 0,02

Heritability coefficients, calculated by parent-offspring regression range from 0,029, for average milk fat content, to 0,333 for average milk yield in complete lactations. By using method of infraclass correlation, the lowest value of heritability was determined for milk fat content (0,192), and the highest was determined for average milk fat yield (0,549). By repeatability, similarly to regression, the lowest heritability was determined for milk fat content (0,105), and the highest for average milk yield (0,394).

It is obvious that, regardless of methods for heritability calculation, the lowest obtained values, although it wasn't expected, are those for average milk fat content during complete lactations. Identical results were obtained by PANTELIĆ *et al.* (2011), PETROVIĆ *et al*., (1998), LOGAR *et al*. (2005), SPASIĆ (1997) and BIFFANI *et al.* (2005) in their research.

Generally speaking, by introduced methodology of heritability coefficients determination, its values range from very low, for average milk fat content (determined by regression), toward high ones, for the traits of milk and milk fat yield (determined by intraclass correlation).

Heritability coefficients for milking traits in standard lactations of investigated cows are presented in Table 2.

Heritability coefficients (h^2) for milking traits in standard lactations of investigated cows population, are very uniform, regardless of calculation method. For milking traits in standard lactations the lowest coefficients were determined by regression method, while the highest value was obtained using intraclass correlation. Coefficients determined using regression and repeatability method are medial, while coefficients determined by the method of intraclass correlation are high, where it is necessary to mention that standard error of this method, as expected, is ordinary high.

Tabela 2. Coefficients (h^2) and standard errors of heritability ($S.E.h^2$) and repeatability (R) of milking traits in standard lactations of black and white cows

Method / Traits	Parent offspring regression	Intraclass correlation	Repeatability
	$h^2 \pm S.E.h^2$	$h^2 \pm S.E.h^2$	$R \pm S.E._R$
Average milk yield	0,297 0,03	0,446 0,30	0,323 0,02
Average milk fat yield	0,291 0,03	0,543 0,36	0,310 0,01
Average 4% FCM milk yield	0,312 0,11	0,461 0,31	0,301 0,01

The results, similar to ours, in regard to investigated traits, were presented by VOS and GROEN (1998), FIRAT *et al*. (1997), DEMATAWEWA and BERGER (1998). However, in the literature, it could be found different data about the heritability coefficients levels for productive milking traits during standard lactations. These values range from 0,114 to 0,424 (LOGAR *et al*., 2005) for the milk yield. For the yield of milk fat they range from 0,141 (SPASIĆ *et al*., 2009) to 0,59 (KADARMIDEEN, 2003), while for 4% FCM milk yield these values range from 0,11 (M'HAMDI *et al*., 2010) to 0,439 (PETROVIĆ *et al.,* 2007).

CONCLUSION

On the basis of the comparison results of determined heritability coefficients for productive traits in black and white cows, the following conclusions can be drawn:

For average milk, milk fat and 4% FCM yield, during standard lactation using regression method and repeatability, medial heritability coefficients have been calculated (from 0,291 to 0,323), while by using intraclass correlation, high coefficients have been calculated (od 0,461 do 0,543).

Heritability coefficients for average milk fat are low (from 0,029 to 0,192), so that further improvement of this quantitative trait will be possible, mostly trough bulls-sires with higher genetic potential.

Substantially higher heritability coefficients determined by intraclass correlation are, at first place, result of small number of sires (5) included in the research.

The most unbiased coefficients of heritability have been determined by the use of repeatability as the upper border of heritability.

ACKNOWLEDGEMENTS

We thank the Serbian Ministry of Education and Science for support. Project TR-31001

Received November 10th, 2011
Accepted June 11th, 2012

REFERENCES

BIFFANI, S., R. CANAVESI., A.B. SAMORE (2005): Estimates of genetic parameters for fertility traits of Italian Holstein-Friesian cattle. Stočarstvo *59*, 2, 145-153.

DEMATAWEWA, C.M.B., P.J. BERGER (1998): Genetic and Phenotypic Parameters for 305-Day Yield, Fertility, and Survival in Holsteins. Journal of Dairy Science Vol. *81*, No.10, pp. 2700-2709.

FIRAT, M.Z., C.M.THEOBALD, R. THOMPSON. (1997): Univariate analysis of test day milk yields of british holstein-friesian heifers using GIBBS sampling. Acta Agriculturae Scandinavica Section A-Animal Science. No. *47*(4), pp. 213-220.

KADARMIDEEN, H.N., R.THOMPSON, M.P.COFFEY, M.A.KOSSAIBATI (2003): Genetic parameters and evaluations from single- and multiple- trait analysis of dairy cow fertility and milk production. Livest. Prod. Sci., 81, 183-195.

LOGAR, B., Š.MALOVRH, M.KOVAČ (2005): Miltiple Trait Analysis of Genotype by Environment Ineraction for Milk Yield Traits in Slovenian Cattle. Poljoprivreda (Zagreb), vol. *11*, No 2, pp. 112-118.

M'HAMDI, N., R. ALOULOU, S.K.BRAR, M.BOUALLEGUE, M. BEN HAMOUDA (2010): Phenotypic and Genetic Parameters of Reproductive Traits in Tunisian Holstein Cows. Biotehnology in Animal Husbrandry *26* (5-6), p 297-307.

PETROVIĆ, M.M., S.ALEKSIĆ, T. SMILJAKOVIĆ, V. PANTELIĆ, D.OSTOJIĆ-ANDRIĆ (2007): Phenotypic and Genetic Parameters of Reproductive Traits of black and White Cows with different Share of HF Genes. Biotechnology in Animal Husbandry vol. *23* (5-6), p 193 - 199.

PETROVIĆ, M., R.LAZAREVIĆ, LJ.LAZAREVIĆ, S.ALEKSIĆ, B.MIŠČEVIĆ, N. NIKITOVIĆ (1998): Heritability and correlation of reproductive traits and milk-white cow. Biotehnology in Animal Husbrandry, *1-2*, pp. 15-20.

SPASIĆ, Z. (1997*)*: Milking and Fertility Traits' – Variability and Relations in tree Generations of Domestic Spotted Cattle. Review of research work at the faculty of agriculture Belgrade 1997, vol. 42, No 1, pp. 183-197.

VOS, H., A.GROEN (1998): Altering milk protein fat ratio – results of a selection experiment in dairy cattle. Livestock production Science. No. 53(1), pp. 49-55.

PANTELIĆ, V., D. NIKŠIĆ, S. TRIVUNOVIĆ (2011): Variability and heritability of type traits of Holstein-Friesian bull dams. 3rd International Congress "New Perspectives and Challenges of

Sustainable Livestock Production", Belgrade, October 5th to 7th, 2011, Biotechnology in Animal Husbandry, Vol. 27 (3), p. 305-315.

SPASIĆ, Z., B. MILOŠEVIĆ, M. MILENKOVIĆ, N. STOLIĆ, Z. ILIĆ (2009): Phenotipic Correlation of production and Reproduction Traits of Cows in the Population of Domestic Spotted Cattle. Research people and actual task on multidisciplinary sciences. Second International Conference, 10 – 12 june 2009, Lozenec, Bulgaria. Volume *1*, pp 104-108.

KOMPARACIJA KOEFICIJENATA NASLEDNOSTI PROIZVODNIH OSOBINA U POPULACIJI KRAVA CRNO BELE RASE

Zvonko SPASIĆ [1], Božidar MILOŠEVIĆ, Nebojša LALIĆ,
Sonja SAMARDŽIĆ, Zoran ILIĆ, Bojana RISTANOVIĆ

Poljoprivredni fakultet, Lešak, Republika Srbija

Na osnovu genetske varijabilnosti ekonomski značajnih osobina opredeljujemo se za određene metode u genetskom unapređenju zapata. Međutim, heritabilitet (h^2) je značajan i za odgovor na pitanje koje se osobine mogu uključiti u ocenu priplodne vrednosti grla.Za utvrđivanje heritabiliteta je posmatrano 1.502 grla crno bele rase: 751 majka i 751 kćer (ukupno 6.393 laktacije).Koeficijenti naslednosti ispitivanih osobina krava izračunati su primenom tri metode: regresijom kćeri na majke, intraklasnom korelacijom po bikovima-očevima i za one osobine kod kojih postoji ponavljanje u toku života metodom repitabiliteta (R).Za prosečan prinos mleka, mlečne masti i mast korigovanog mleka tokom standardnih laktacija metodom regresije i repitabilitetom, ustanovljeni su srednji koeficijenti naslednosti (od 0,291 do 0,323), dok su intraklasnom korelacijom ustanovljeni visoki koeficijenti (od 0,461 do 0,543).Koeficijenti heritabiliteta za prosečan sadržaj mlečne masti su niski (od 0,029 do 0,192) pa je, prema tome, dalje poboljšanje ove kvantitativne osobine u populaciji moguće preko očeva-bikova sa većim genetskim potencijalom.

Primljeno 10. XI. 2011.
Odobreno 11. VI. 2012.