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TESTS OF HOLSTEIN FRIESIAN BULLS[1]

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Abstract: In additon to the assessment of additive, genetic varijability, successful selection work requires investigations of phenotipic, and especially genetic correlation between traits to be improved by selection. Genetic parameters for fertility traits were established on two farms with black and white and Holstein Friesian breeds. Investigations encompassed a total of 2,664 calves, the offspring of 24 bulls. Coeffcients of heritability were evaluated using a mixed least square model.

Coefficients of heritability for investigated fertility traits were relatively low. Evaluated heritabilies and their errors for type of calving, number of stillborn calves, body weight at birth, and duration of pregnancy, were: 0.190 ± 0.062; 0.018 ± 0.006; 0.149 ± 0.051 and 0.288 ± 0.086, respectively. Coefficients of genetic correlation ranged between 0.187 (correlation between the number of stillborn calves and duration of pregnancy), and 0.340 (correlation between the number of stillborn calves and body weight at birth).

Key words: heritability, genetic correlations, fertility traits, progeny test, bulls.

Introduction

The effect of direct and indirect selection for parameters of fertility in the dairy cattle population depends to the highest degree on the value for heritability and genetic correlation of traits. Knowledge pertaining to genetic correlations is especially important when selecting individuals based on several traits, and even more important for indirect selection under conditions when it is not possible to directly improve certain traits, such as type of calving and number od stillborn calves. Thus, application of indirect selection opens the possibility to increase intensity of selection, due to the possibility to reach conclusions more quickly. Knowledge pertaining to values of coefficients of heritability, as well as to nature of genetic correlations of interesting traits, influences the choice of method of selection, and also contributes to a higher level of success.

Due to the significant influence of nongenetic factors on the variability of parameters of reproduction, coefficients of heritability for fertility are low, which complicates breeding, i.e. genetic improvement of these traits, and therefore improvement of cattle production as a whole. Values for heritability can differ, depending on breeding conditions, models used and methods for their evaluation, sample size, breeding methods, as well as the structure of data used for calculations. Values from literature for evaluated coefficients of heritability for type of calving regardless of the model used for evaluation fall in the range from h^2 = 0.028 *(Sofia Alday and Eva Ugarte, 1997)* and h^2 = 0.170 *(Sneinbock et al., 2003).* Several invstigations *(Philipsson et al., 1979, Erf et al., 1990, McGuirk, 1998, Luo et al., 1999, Meyer et al., 2001, Hansen et al., 2003, Steinbock et al., 2003, Radica Đedović, 2004),* indicate that the assessed heritability for number of stilllborn calves varies between h^2 = 0.008 *(Erf et al., 1990)* and h^2 = 0.120 *(Sneinbock et al., 2003).* As expected, as per reported values of heritability of body weight at birth and duration of pregnancy *(Koots et al., 1994, Gregory et. al., 1995, Gregory et al., 1995, McGuirk et al., 1998),* these traits have a medium level of heritability. Values of coefficienats of genetic correlations and their direction are very important during selection for more than one fertility trait *(Martinez et al., 1983, Gregory et al. , 1995, Luo et al. , 1999, McGuirk et al. , 1999).*

The goal of this investigation was to assess values of genetic parameters for fertility traits monitored during the progeny test, which will be used to establish breeding values for Holstein Friesian bulls - sires.

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Materials and Methods

Genetic parameters, heritability, and correlation of traits were investigated on a sample of 2.664 calves, the offspring of 24 bulls, born on two farms of PIK Bečej, during a 5-year period.

Following reproductive traits were included: CT – calving type, NSC – number of stillborn calves, BWB– body weight at birth, and PD – pregnancy duration.

1. CT – based on observations and on the level of assistence offered during calving, calving type for heifers and cows was registered and classified into 5 classes: 1 = normal calving; 2 = additional force used to extract the calf; 3 = correction of irregular position of the calf; 4 = fetothomy; 5 = caesarean section.
2. Due to low frequency in relation to the other two categories, Classes 3, 4, and 5 were grouped to form a joint class.

Table 1. Distribution of calving type by classes

Calving type	n
1	2159
2	470
3+4+5	35

Evaluation of genetic parameters investigated traits was established using the following mixed Least Square model (LSMLMW).

$$Y_{ijklmno} = \mu + O_i + F_j + S_k + P_l + V_m + R_n + e_{ijklmno}$$

where:

$Y_{ijklmno}$ – traits of individual o, from sire i, on farm j, in season k, of sex l, with vitality score m, and calving type n

μ – overall population mean for given trait,
O_i – random effect of sire i (i = 1,...,24),
F_j – fixed effect of farm j (j = 1,2),
P_l – fixed effect of sex l (l = 1,2),
V_m – fixed effect of vitality score m (m = 1,….5)
R_n – fixed effect of calving type n (n = 1,..3)
$e_{ijklmno}$ – random error with characteristics N (0, σ^2)

Results and Discussion

As expected, results obtained for assessed values of heritability for fertility traits are low (Table 2).

Table 2. Heritability (h^2) and heritability errors (Sh^2) of fertility traits

Traits	h^2	Sh^2
	n = 2664	
CT	0,190	0,062
NSC	0,018	0,006
BWB	0,149	0,051
DP	0,288	0,086

*- CT – calving type, NSC – number of stillborn calves, BWB– body weight at birth, PD – pregnancy duration

Results of our investigations are in agreement with certain researchers who found low heritabilities for calving type and number of stillborn calves *(Sofia Alday and Eva Ugarte, 1997, Vassilev, 1998, Meyer et al., 2001, Sneinbock et al., 2003)*. Lower values for coefficients of heritability for calving type and number of stillborn calves than those presented in Table 2 were established by following authors: *Martinez et al. (1983), Meijering (1984), Thomson and Rege (1984), Dadati et al. (1985), Dwyer et al. (1986), Erf et al. (1990), Manfredi et al. (1991), Pogačar et al. (1996), McGuirk (1998), Luo et al. (1999), and Canavesi et al. (2003).*

Following authors: *Lazarević et al. (1982), Cundiff et al. (1986), Koots et al. (1994), Gregory et al. (1995)* reported that calf body weight at birth and duration of pregnancy are characterized by low to medium heritability, but that assessed values vary.

Table 3 presents coefficients of genetic correlation for fertility traits and their errors, as well as statistical significance of investigated coefficients.

Table 3. Coefficients genetic correlation (r_g) and errors (Sr_g) of fertility traits

Traits		r_g	Sr_g
x	y		
CT	NSC	-0,251**	0,018
CT	BWB	0,232**	0,018
CT	DP	0,224**	0,019
NSC	BWB	0,340**	0,018
NSC	DP	0,187**	0,019
BWB	DP	0,382**	0,018

*** - P<0,001 ** - P<0,01 * - P< 0,05 NS - P>0,05

Coefficients of genetic correlation ranged from 0.187 (correlation between the number of stillborn calves and duration of pregnancy) to 0.382 (correlation between body weight at birth and duration of pregnancy). The table shows that the genetic correlation between "easy" calving and number of stillborn calves, was low and negative by direction of action (r_p = -0.251). Results for strength of genetic correlations between fertility traits obtained in this research were lower than values established by *Luo et al. (1999).*

Values obtained for genetic correlations, regardless of their strength, indicate potentials and routes for genetic improvement of fertility traits. The negative genetic correlation established between "easy" calving and the number of stillborn calves indicates the posibility of indirect selection. Therefore, the number of stillborn calves could be reduced by using selected bulls highly ranked for "easy" calving.

Conclusion

Results obtained during the investigations confirmed the hypothesis that fertility traits monitored during progeny testing of dairy bulls have low heritability. Assessed values for heritability and genetic correlations can be used to calculate breeding values for bulls for monitored traits. The use of bulls with known breeding values will contribute to faster genetic progress.

GENETSKA VARIJABILNOST I POVEZANOST OSOBINA PLODNOSTI PRAĆENIH U PROGENOM TESTU BIKOVA HOLŠTAJN-FRIZIJSKE RASE

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Rezime

Pored ocene aditivne, genetske varijabilnosti, za uspešan selekcijski rad neophodno je ispitati fenotipsku, a posebno genetsku povezanost osobina koje se žele unaprediti selekcijom. Utvrđivanje genetskih parametara osobina plodnosti obavljeno je na dve farme goveda crno-bele i holštajn-frizijske rase. Ispitano je ukupno 2 664 teladi, potomaka 24 bika-oca. Koeficijenti heritabiliteta ocenjeni su primenom mešovitog modela najmanjih kvadrata.

Koeficijenti naslednosti ispitivanih osobina plodnosti bili su relativno niski. Ocenjeni heritabiliteti i njihove greške za tip teljenja, broj mrtvorođene teladi, telesnu masu pri rođenju i trajanje bremenitosti iznosili su: 0,190 ± 0,062; 0,018 ± 0,006; 0,149 ± 0,051 i 0,288 ± 0,086, odgovarajuće. Koeficijenti genetskih korelacija nalazili su se u intervalu od 0,187 (povezanost broja mrtvorođene teladi i trajanja bremenitosti) do 0,340 (povezanost broja mrtvorođene teladi i telesne mase pri rođenju).

Ključne reči: heritabilitet, genetske korelacije, osobine plodnosti, progeni test, bikovi.

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