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Estimates of Genetic Parameters of Milk Yield in Brown Swiss and Holstein Friesian Cattle

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Abstract: The purpose of this study is to estimate genetic parameters of milk yield traits in Holstein and Brown Swiss cattle raised at two different State Farms. The heritability estimates of 305 days milk yield and lactation length were 0.21±0.06 and 0.06±0.04 for Holstein Friesian; 0.37±0.03 and 0.27±0.03 for Brown Swiss, respectively. The repeatability estimates of 305-days milk yield and lactation length were 0.36±0.03 and 0.22±0.03 for Holstein Friesian; 0.54±0.16 and 0.65±0.12 for Brown Swiss, respectively. It has been estimated that heritability of milk yield traits were moderate, repeatability of lactation length was high. Thus, high repeatability estimates are promising for opportunities for early selection practices.

Key words: Brown Swiss, Holstein, milk yield, heritability, repeatability

INTRODUCTION

As happens in other branches of the agriculture the main objective of animal farming is to increase economical profitability of the farms. This could be achieved by increasing the yields of animals. The early studies related to this topic in Turkey aimed to utilize the selection strategies to improve the native breeds of country. For this purpose, several herds were established in various state farms and selection programs were applied. Nevertheless, since the improvement rate was found not to be satisfactory by this method, the import of exotic breeds was considered[1] .

Genetic changes in populations depend, largely, on heritability of intended traits and degree of genetic variance. Heritability, repeatability and genetic correlations are important parameters in animal breeding. In any breeding program it is necessary to know the heritability of the selected parameters to determine the most effective selection program[2,3]. Heritability and estimation of genetic correlations are important population parameters required in planning and applying animal breeding[4,5].

The productivity of herd could be improved by selecting superior individuals in order to establish a new population. Before applying the selection decisions, it is necessary to know some parameters of the herd. Heritability is required in order to estimate the successes of the selection for a trait. Repeatability is required to estimate selection age and expected yield of animal. Genetic correlations are required to estimate the effects of degree and type of this trait on other traits[6].

This study, aimed at studying the heritability and repeatability of milk yield characteristics of Holstein Friesian and Brown Swiss cattle raised in two different state farms (Ceylanpınar and Alparslan) in order to determine the better yield estimation to be used for genetic evaluation.

MATERIALS AND METHODS

In the present studys 1931 milk yield records obtained from 328 Holstein cattle in Ceylanpınar State Farm between 1983 and 1997 and 1193 milk yield records of 174 Brown Swiss cattle in Alparslan State Farm between 1987 and 1997 were utilized.

Calculation of milk yield: Lactation milk yield and 305 day milk yield determined from control day milk yield using Holland method was estimated from coefficients of lactation milk yield established previously for both breeds by Gönül[7]. Paired comparison coefficients were utilized to calculate mature age milk yield[8]. Mature equivalent 305 days milk production values were used for heritability and repeatability.

Estimates of genetic parameters: In the estimation of genetic parameters, the mixed model included the

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environmental factor affecting productive traits was utilized. The equation is $Y_{ijkmn}=\mu+a_i+b_j+c_k+s_m+e_{ijkmn}$. Where, Y_{ijkmn} is any milk yield trait; μ is population's expected mean; a_i is the effect of year; b_j is the effect of lactation; c_k is the effect of season; s_m is the effect of sire or cow; e_{ijkmn} is error.

The heritability estimates were obtained from similarities of half sibs on the same sire groups. The similarities of milk yield of cows whose at least two lactation records were known were utilized in the estimation of repeatability. The bulls have at least two daughters with milk records were utilized in the estimation of heritability. For the estimation of heritability and repeatability the following equation was utilized[4].

$$h^2 = 4 \times \frac{\sigma^2_s}{\sigma^2_s + \sigma^2_e}, \qquad r = \frac{\sigma^2_{cow}}{\sigma^2_{cow} + \sigma^2_e}$$

where, σ^2_s is variant among the bulls for heritability, σ^2_{cow} is variant among the cows for repeatability, σ^2_e is variant of error. LSMLMM Least-Square and Maximum Likelihood General Purpose Program was utilized for the analysis of variance and the estimation of heritability and repeatability[9].

RESULTS

Heritability estimates: Heritability of some milk yield characteristics was estimated from adjusted milk records according to some important environmental factors. Half-sib correlation was used in estimation. Heritability estimates for 305 days milk were 0.37±0.03 for Brown Swiss and 0.21±0.06 for Holstein Friesian. Heritability estimates for lactation length was 0.27±0.03 for Brown Swiss and 0.06±0.04 for Holstein Friesian (Table 1).

Repeatability estimates: Adjusted yield records according to environmental factors were used in milk yield traits repeatability estimates. Repeatability estimates for 305 days milk were 0.36±0.03 for Brown Swiss and 0.54±0.16 for Holstein Friesian. Repeatability estimates for lactation length were 0.65±0.12 for Brown Swiss and 0.22±0.03 for Holstein Friesian (Table 2).

Table 1: Heritability estimates of milk yield traits and standard error for Brown Swiss and Holstein Friesian cattle

Breed	Yield trait	Heritability
Holstein Friesian	305 days milk yield	0.21±0.06
	Lactation length	0.06±0.04
Brown Swiss	305 days milk yield	0.37±0.03
	Lactation length	0.27±0.03

Table 2: Repeatability estimates of milk yield traits and standard error for Brown Swiss and Holstein Friesian cattle

Breed	Yield trait	Repeatability
Holstein Friesian	305 days milk yield	0.36±0.03
	Lactation length	0.22±0.03
Brown Swiss	305 days milk yield	0.54±0.16
	Lactation length	0.65±0.12

DISCUSSION

305 days milk yield: Heritability estimates for 305 days milk was 0.37±0.03 for Brown Swiss. This estimate is similar to previously reported results for the same breed[10-12], however, it was lower than the values obtained by Mehta and Bhatnagar[13], Lak[14], Gürdoğan and Alpan[15], but higher than Hagger and Hofer's[16] values.

The heritability of 305 days milk yield estimate was 0.21±0.06 for Holstein Friesian. There are various researches reporting higher 305 days milk yield heritability estimates for this breed than obtained in this study[13,17-21], nevertheless, there are some reports showing similar or lower estimates than this research results[22-24].

Different 305 days milk yield heritability estimates for Brown Swiss raised at various State Farms in Turkey were reported[10,14].

Lactation length: Heritability estimate for lactation length was 0.27±0.03 for Brown Swiss. This value is higher than estimates obtained in India[25,26], Iraq[27] and Turkey[28] nevertheless, there are higher values obtained in other state farms in Turkey[29].

Heritability estimate for lactation length was 0.06±0.04 for Holstein Friesian. Higher and lower lactation length heritability estimates were found for this breed in India and Iraq, respectively[30,31].

305 days milk yield: Repeatability estimates for 305 days milk was 0.36±0.03 for Brown Swiss. While similar estimates were reported for the same breed in many state farms of Turkey[10,11] there are also higher[10,14,28] and lower estimates[29] obtained in different farms.

Repeatability estimates for 305 days milk was 0.54±0.16 for Holstein Friesian. Gürdoğan and Alpan[15], Yener[10] reported this value as 0.05±0.05 and 0.22, respectively for this breed maintained in Turkey. Holsteins raised in Iraq had a 0.183 repeatability estimate for 305 day milk[29]. This value appeared as 0.90 and 0.37±0.03 in Holstein x Mariana crosses[32] and Mariana breed[24], respectively.

Lactation length: Repeatability estimate for lactation length was 0.65±0.12 for Brown Swiss. There are higher[28] and lower estimates for this trait[29,33] in this breed. Repeatability estimate for lactation length was 0.22±0.03 for Holstein Friesian. This value is higher than those of obtained in Turkey[33] and India[34].

Apparently, there are differences in the estimation of genetic parameters of economically important parameters. Appearance of these differences is thought to be arisen from to main causes: These are (I) populations differ in genetic resources or were investigated in different conditions and (ii) calculations affect on estimates differently[35].

The aim in animal breeding was to increase the productivity of herd by allocating superior individual to establish for the next generation. For this purpose selection is utilized as a breeding aid. In order to estimates the degree of improvement for a trait by selection it was necessary to know the heritability, selection age and in order to estimate the exact productivity level. In the presented study the estimates of heritability of 305 days milk yield were moderate compared to other breeds. The heritability of milk yield of Brown Swiss was estimated as 0.164 higher than Holstein Friesian. Therefore a better improvement in Brown Swiss is expected in a breeding study. In the proposed breeding studies genetic improvements could be achieved if these heritability are taken into consideration. Because of moderate heritability improving of milk yield in herd via individual selection will be possible. The high repeatability of lactation length is promising for the possibilities of early selection practices.

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