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Estimates of Genetic Parameters of Productive Traits in Holstein-Native Crossbreds in W. Azarbaijan Province-Iran

[1]Ali Hashemi, [2]Iraj Bernousi, [3]Sarain Razzagh Zadeh and [1]Mehdi Ranjbari
[1]Department of Animal Science,
[2]Department of Plant Breeding, Agriculture College, Urmia University, Iran
[3]Department of Animal Science,
Agriculture and Natural Resources Research Center, W. Azarbaijan, Iran

Abstract: Genetic parameters for productive traits were estimated using data collected over a 10 years period (1995-2005) from the dairy herds of Holstein-Native crossbred Cows in the W. Azerbaijan province in Iran. Heritability for milk yield, Fat yield and Fat percentage were 0.26, 0.24 and 0.36, respectively and their repeatability were 0.55, 0.35 and 0.38, respectively. Fat yield and Fat percentage had medium repeatability estimates. It has been estimated that heritability of milk yield traits were moderate while repeatability of this trait was high. Thus, high repeatability estimates are promising opportunities for early selection practices.

Key words: Genetic parameters, productive traits, crossbred, native-holstein, dairy cattle, Iran

INTRODUCTION

Crossbred dairy cattle in W. Azerbaijan province in Iran commonly include Holstein-Native crosses. Potential of crossbred cows usually exceeds the average performance levels of native breeds and thus play an important role in livestock improvement. Crossbreds exhibit greater production and reproductive fitness than their parents. For these advantages, Iran undertook innumerable attempts to improve the milk production capacity of native cattle through crossbreeding with exotic breeds. The rate of genetic gain that could be made by selection is depends on the heritability (h^2) of the trait. Estimation of h^2 and Repeatability (R) of the traits are essential genetic parameters required in animal breeding research and in the design and application of practical breeding program. Genetic parameters are specific to population i.e., estimates of genetic parameters from a crossbreed may not appropriate when applied to other breeds.

The objective of this study were to estimate (co) variance components, heritabilities and repeatabilities for milk and fat yield and fat percentage traits of crossbred dairy cattle in W. Azerbaijan province in Iran.

MATERIALS AND METHODS

The data analyzed were kindly provided by the Livestock Service of the Ministry of Jihad Agriculture and concerned Holstein-Friesian cows involved in the Agriculture and Natural Resources Research Center of W. Azarbaijan Province. Test day yields for milk and fat percentage were the basic information used for calculation of yields. Milk recording practiced in Iran is classified as type A. During lactation, morning and evening milking of each cow was recorded once a month within an interval of 26-35 days. Lactation records were standardized to 305 days, except records of cows that went dry with less than 305 days of milk. Data were edited for errors, redundancy and incomplete observations. Further editing was carried for pedigree checks, consistent lactation number, data of calving and calving age. The final data file was restricted to cows milked twice a day, calving from 1995-2005. In this study herds that had <3 cows were omitted. Moreover, records with missing values on any of the traits of interest (milk yield, fat yield and fat percentage) were discarded. The remaining records included 19885 records from 10225 cows.

Statistical analyses: The total number of animal in the analysis was 20010 (10225 individual, 1425 sires and 8800 dams). The traits studied were milk yield, fat yield and fat percentage during 305 days of lactation.

The (co) Variance components and the resulting genetic parameters (heritability and repeatability) were estimated using the Derivative-Free Restricted Maximum Likelihood (DFREML) computer package of Meyer (1998). The basic single traitrepeatability model in matrix notation was:

Corresponding Author: Ali Hashemi, Department of Animal Science, Agriculture College, Urmia University, Iran

$$y = Xb + Za + Wpe + e$$

when:

- y = A vector of observations
- b = A vector of fixed effects with incidence matrix X
- $a \sim N(O, A\sigma^2_a)$ = A vector of random animal effects with incidence matrix Z
- $pe \sim N(O, I_c\sigma^2_{pe})$ = A vector of random permanent environmental effects with incidence matrix W
- $e \sim N(0, I_n\sigma^2 e)$ = A vector of random residual effects
- σ^2_a = The additive genetic variance
- σ^2_{pe} = The permanent environmental variance
- σ^2_e = The residual variance
- A = The additive genetic relationship matrix
- I_c and I_n = Identity matrics of order equal to the number of cows and number of records, respectively

Heritabilities were calculated from parental half-sib relationship according to the following equation:

$$h^2 = \frac{4\sigma^2_s}{\sigma^2_s + \sigma^2_w}$$

and repeatability was calculated by the following equation:

$$R = \frac{\sigma^2_B}{\sigma^2_s + \sigma^2_w}$$

where:

- σ^2_w = The within sire component of variance/within component of variance
- σ^2_s = The between sire component of variance
- σ^2_B = The between component of variance Standard error of estimated h^2 and R was also calculated according to the equation outlined by Becker (1975)

RESULTS AND DISCUSSION

Fixed effects: Unadjusted mean, standard deviation and coefficient of variation for milk, fat yield and fat percentage are presented in Table 1.

Mean of milk and fat, yield of and fat percentage were 5123.2 kg, 181.2 kg and 3.52%, respectively.

Table 2 shows heritability and repeatability estimates derived from the variance component estimates with single-trait analyses. The heritability estimates were 0.26 for milk yield, 0.24 for fat yield and 0.36 for fat percentage.

Table 1: Number of records, unadjusted means, standard deviation and coefficient of variation for milk yield, fat yield and fat percentage of Holstein-native crossbred cattle

Trait	No. records	X	SD	CV (%)
Milk yield (kg)	19885	5123.20	1519.90	27.60
Fat yield (kg)	19885	181.20	50.20	25.50
Fat (%)	19885	3.52	0.25	5.84

Single-trait analyse

Table 2: Variance components, heritability and repeatability estimates for milk yield, fat yield and fat percentage from single-trait analyses

Parameter[a]	Milk yield	Fat yield	Fat (%)
σ^2_P	799598.50	954.10	0.024
σ^2_a	231547.10	254.70	0.010
σ^2_{pe}	39544.10	41.80	0.000
σ^2_e	511410.80	655.80	0.014
h^2	0.26	0.24	0.360
R	0.55	0.35	0.380

σ^2_P = phenotypic variance; σ^2_a = additive genetic variance; σ^2_{pe} = permanent environmental variance; σ^2_e = residual variance; h^2 = heritability; R = Repeatability

The heritability estimate for milk yield agrees with those given by Touchberry (1992) was slightly lower than those from other studies (Abdollah and McDanie, 2000; Silvestere *et al*., 2005) and was slightly higher than those from yet other studies (Alba and Kennedy, 1994; Tom *et al*., 2005). The heritability of fat yield was comparable to those of Chauhan and Hayes (1991) and Van Vleck *et al*. (1988). The estimate of heritability for fat percentage was similar to that of Meyer (1985), but markedly smaller than those previously mentioned (Campos *et al*., 1994; Van Vleck and Dong, 1988). These heritabilities indicated that there was a considerable amount of variation in milk yield similar to fat that would be used for selection. The heritability was higher for fat percentage than those for milk and fat yields. This agrees with results reported in the literature (Chauhan and Hayes, 1991; Walper and Freeman, 1992). The estimate of heritability for milk yield was higher than that for fat yield. This result is similar to those of Boichard and Bonaiti (1987) and Van Vleck *et al*. (1988), but contrary to other reports (Chauhan and Hayes, 1991; Meiner *et al*., 1989).

The low heritabilities found in the present study may be explained by the low mean performance of Iranian cows. Hill *et al*. (1983) showed that heritability estimates of milk yield and composition may increase as the production level of herds increases.

Permanent environmental variance as a proportion of phenotypic variance was low and varied from almost zero for fat percentage to 39544,1 for milk yields. The repeatability estimates for milk and fat yields and fat percentage were 0.55, 0.35 and 0.38, respectively.

The repeatability estimates of the present study were lower than those reported by Abdollah and McDanie, (2000), Ibrahim *et al*. (2003), Van Vleck *et al*. (1988) and

Welper and Freeman (1992). The medium repeatabilities indicated that temporary environmental factors contributed appreciably to the variation in milk traits among parities, hence, culling of cows on single performance should be avoided.

CONCLUSION

This report is the first documentation of genetic and phenotypic parameter in West Azarbaijan province. The estimates of genetic parameters obtained from crossbred (Holstein and Native) cattle. Heritabilities indicated that there was considerable amount of variation in milk yield, similar to that found for fat.

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