Phenotypic and Genetic Parameters of Some Production Traits of Holstein Friesian Cows Raised at the State Farm of Koçaş

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Abstract: In this researh, six reproductive and three milk yield traits were determined and genetic and phenotypic parameters were estimated for these nine traits in the Holstein Friesian cows reared at the State Farm of Koçaş in Aksaray (Turkey). The least squares means of first service age (FSA), first calving age (FCA), calving interval (CI), number of insemination per conception (NIPC), gestation length (GL), service period (SP), lactation milk yield (LMY) , lactation length (LL), and dry period (DP) were 560.80±3.07 days, 855.43±2.66 days, 382.30±6.42 days, 1.76±0.06, 285.05±1.66 days, 110.57±6.28, 6937.63±1 09.46 kg, 320.51±3.29 days, 69.51±3.08 days and respectively. Heritabilities of these traits were 0.55±0.151, 0.69±0.162, 0.06±0.086, 0.04±0.062, 0.11±0.085, 0.21±0.000, 0.20±0.11, 0.078±0.007, and 0.34±0.000, respectively. The repeatibilities of CI, LPC, GL, SP, LMY, LL, and DP were 0.12, 0.042, 0.32, 0.44, 0.37, 0.065, and 0.42, respectively. The year had a significant effect on the FSA, CI, SP, and LMY at ($p<O.OI$) levels. lt was shown that lactation number had a significant effect on NIPC, LMY, and DP, the sex of calf had a significant effect on GL, the calving season had a significant effect on LMY, and DP at ($p<0.01$) levels. Also, linear regressions of LMY to LL, SP to LL, and LL to LMY statistically significant.

Keywords: Holstein Friesian, reproductivity, milk yield, heritability, repeatability

Introduction

Although the proportion of meat and milk production is high, the amount of yield per animal in Turkish breeds is low. Average milk yield obtained from per cattle is 2758 kg (Anonymous, 2008). Within imported cattle breeds, highest number is Holstein Friesian, and its average milk yield is up to 5000 kg. The objective of this study was to determine the milk and reproductive performances of Holstein Friesian cows reared at the Koçaş State farm in Aksaray. Also, phenotypic and genetic parameters for examined characteristics were calculated.

Material and Method

Material

This study was carried out by using Holstein-Friesian cattle reared at the Koçaş state farm in the middle Anatolia region in Turkey. In this region, summers are hot and dry, winters are cold. The data used in this study were collected from Holstein Friesian cattle from records maintained between the 1995 and 2005.

Method

Reproductive performance was estimated by using the following animal model as an example first service age and the mathematical model for first calving age, number of insemination per conception, calving interval, service period and gestation length were estimated by adding or get out from this model according to the effective factors:

$Y_{ij} = \mu + a_i + e_{ij}$

Y_{ij} = is first service age i. year, j. cow

μ = mean

a_i = effect of year (a_1: 1996, a_2: 1997,…….. a_{10}: 2005)

e_{ij} = random residual effect

Lactation milk yield was calculated according to the following mathematical model;

$Y_{ijkl} = \mu + a_i + b_j + c_k + bx_{ijk} + e_{ijkl}$

Y_{ijkl} = is lactation milk yield of cow in i. year, j. calf sex and k. season

μ = mean

a_i = effect of year (a_1: 1996, a_2: 1997,…….. a_{10}: 2005)

b_j = effect of parity (b_1: 2, b_2: 3,……..b_8: 9)

c_k =effect of season (k_1: September, October, November, k_2: December, January, February, k_3: March, April, May, k_4: June, July, August)

bx_{ijk}=partial regression coefficient to parity of lactation milk yield

e_{ijkl} = random residual effect

Season was classified as first group (September, October, November), second group (December, January, February), third group (March, April, May) and fourth group (June, July, August). Calf sex was classified as 1 (male) and 2 (female). To estimate of genetic parameters, Mixed models which were take into account environmental factors effect on yields, were based. Data were analyzed both Mixed Model Least Squares and Maximum Likelihood (LSMLMW) in the computer program of Harvey (1990) and by Multiple Trait Derivative Free Restricted Maximum Likelihood (MTDFREML) according to (Boldman et al., 1995) for all traits. To ensure global convergence, the algorithm by Boldman et al., (1995) was restarted with estimates until the log likelihood did not change at the fourth decimal. Duncan multiple comparison test (Duzgüneş, 1993) was used to test the differences between factors.

Variance structure of the model the fallowing matrix was used:

$$E\begin{pmatrix} a \\ e \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$$

$$V\begin{pmatrix} a \\ e \end{pmatrix} = \begin{pmatrix} \sigma_a^2 & 0 & 0 \\ 0 & I\sigma_{p_e}^2 & 0 \\ 0 & 0 & In\sigma_e^2 \end{pmatrix}$$

σ_a^2 = additive genetic variance,

$\sigma_{pe}^2 =$ Permanent environmental variance and

$\sigma_e^2 =$ The random residual effect associated with each observation.

To estimate heritability (h^2) and repeatability (r) the following equation was used:

$$h^2 = \sigma_a^2 / (\sigma_a^2 + \sigma_{pe}^2 + \sigma_e^2)$$

$$r = \sigma_a^2 + \sigma_{pe}^2 / (\sigma_a^2 + \sigma_{pe}^2 + \sigma_e^2)$$

For each feature according to the model that considered the sire, dam and cows for breeding values were calculated. Breeding values were estimated with MTDFREML program (El-Arian et al., 2003; Khattab et al., 2003).

The mixed model equations (MME) for the best linear unbiased estimator (BLUE) of estimablefunctions of b and for the best linear unbiased prediction (BLUP) of a and p in matrix notation was as follows:

$$\begin{vmatrix} X'X & X'Z & X'W \\ Z'X & Z'Z + A^{-1}\alpha_1 & Z'W \\ W'Z & W'Z & W'W + I\alpha_2 \end{vmatrix} \begin{vmatrix} \hat{b} \\ \hat{a} \\ p \end{vmatrix} = \begin{vmatrix} X'y \\ Z'y \\ W'y \end{vmatrix}$$

Where $\alpha_1 = \sigma_e^2 / \sigma_a^2$ and $\alpha_2 = \sigma_e^2 / \sigma_p^2$

Results and Recommendations

Reproductive Traits

First Service Age (FSA): The least square means of first service age belong to a total of 560 animals were 560.80 ± 3.07 days. The effect of Year was only statistically significant on first service age (P<0.01). The heritability of FSA was estimated as 0.55.

First Calving Age (FCA): The least square means of first calving age belong to a total of 559 animals were estimated as 855.43 ± 2.66 days. The effect of Linear Regression on FSA of FCA was statistically significant (P<0.01). The heritability of FCA was estimated as 0.69 ± 0.162.

Calving Interval (CI): Estimated CI value from a total of 1090 Holstein Friesian cows was 382.30 ± 6.42 days. The effect of year on CI was statistically significant (P<0.01). The heritability and repeatability values for CI were 0.06 and 0.12, respectively.

Number of Insemination Per Conception (NIPC): The least square means of NIPC belong to a total of 1148 data were estimated as 1.76 ± 0.06. The effect of year and parity on NIPC was statistically significant (P<0.01). The heritability and repeatability values of NIPC were estimated as 0.04 ± 0.062 and 0.042, respectively.

Gestation Length (GL): Gestation period was calculated from 900 data. The least square means of GL were estimated as 285.05 ± 1.66 days. The effect of age on GL was statistically significant (P<0.01). The heritability and repeatability values of GL were estimated as 0.11 ± 0.085 and 0.032, respectively.

Service Period (SP): The least square means of SP belong to a total of 464 animals were estimated as 110.57 ± 6.28 days. The effect of Linear Regression on SP of LMY was statistically significant (P<0.01). The effect of linear regression of year, season, parity and lactation length was not significant. The heritability and repeatability values were estimated as 0.21 ± 0.00 and 0.44, respectively.

Reproductive Traits

Lactation Milk Yield (LMY): The least square means of LMY belong to a total of 1269 lactation were determined as 6937.63 ± 109.46 kg. The effect of year, season, parity and lactation length on LMY was statistically significant (P<0.01). The heritability and repeatability values were estimated as 0.20 ± 0.11 and 0.37, respectively.

Lactation Length (LL): The least square means of LL belong to a total of 1269 lactation were determined as 320.51 ± 3.29 days. The effect of Linear Regression on LMY of LL and Parity was statistically significant (P<0.01). The effect of year, sex and season was not significant. The heritability and repeatability values were estimated as 0.07 ± 0.007 and 0.65, respectively.

Dry Period (DP): The least square means of LMY belong to a total of 363 data were determined as 69.51 ± 3.03 days. The effect of season (P<0.05), parity (P<0.01) on DP was statistically significant. The heritability and repeatability values were estimated as 0.34 ± 0.00 and 0.42, respectively.

In this study, calculated phenotypic parameters of reproductive and milk yield traits to the Holstein-Friesian cattle reared at the state farm of Koçaş when compared with the other Friesian cattle herds in Turkey was satisfactory. Examined phenotypic parameters belong to reproductive and milk yield characteristics in herd have been determined as 560.80 ± 3.07 days, 855.43 ± 2.66 days, 382.30 ± 6.42 days, 1.76 ± 0.06, 285.05 ± 1.66 days, 110.57 ± 6.28 days, 6937.63 ± 109.46 kg, 320.51 ± 3.29 days and 69.51 ± 3.03 days for FSA, FCA, CI, NIPC, GL, SP, LMY, LL and DP, respectively. Determined FSA value in herd in this study, 43 days is more than from 488-518 days being ideal value for FSA. Ideal value for first calving age is 793 days and calculated value for this study is more than 42 days from the ideal value. Obtained from the herd for calving interval value is close to ideal values. The Number of Insemination Per Conception values considered as normal values from 1.5 showed partial deviation. In practice the values calculated for the service period is acceptable, but 25 days are more than from being 85 days ideal value. Calculated LMY value is over the average in Turkey too. This value shows that closer to the desired level. Obtained value for the LS is 320 days. This value has shown that extended to 15 days from 305 days ideal lactation length. The values established for the Dry Period is ideal. In other words, to obtain the desired yields from the Holstein-Friesian cows, It is understood that necessary to provide of the environmental conditions in the farms like conditions Koçaş farm.

In brief, with reduction of FSA both FSA and FCA can approached to the ideal values. If desired value for NIPC is reached, CI and SP can be reach ideally. This two obvious examples are show interaction with each other to the yields.

Conclusion

As a result, the milk and reproductive characteristics of the Holstein-Friesian cows reared at the state farm of Koçaş was found higher over the Turkey's Holstein-Friesian's average and these values reach the ideal Holstein-Friesian's characteristics. In other words, the business environment in terms of providing adequate infrastructure have the capacity to uncover genetics of the herd, thus allowing yield characteristics have to be a positive influence. Opinion is formed that with additional environmental regulation will can reach the desired yield level.

Acknowledgments

This research was supported by a research project from the Coordinatory of Scientific Research Projects of Selcuk University, Turkey. We are thankful to KOÇAŞ State Farm for providing data

References

Anonymous, 2008. Türkiye İstatistik Kurumu. Access Date: 08.02.2008, www.tuik.gov.tr

Boldman, K. G., Kriese, L. A., Van Vleck, L. D., Van Tassell, C. P. & Kachman, S. D. 1995. *A Manual For use of MTDFREML. A Set of Programs to Obtain Estimates of Variances and Covariances (Draft)*. U. S. Department of Agriculture, Agricultural Research Service, pp:14.

Düzgüneş, O., 1993. *İstatistik Metodları (Statistical Methods)*. Ank. Üniv. Zir. Fak. Yay: 1291, Notebook: 369, Ankara.

El-Arian, M. N., H. G. El-Awady & A. S. Khattab, 2003. Genetic analysis for some productive traits of Holstein Friesian cows in Egypt through MTDFREML program. Egyptian *J. Anim. Prod*., (in Pres).

Harvey, W.R. 1990. *Users guide for LSMLMW PC-1 Version mixed model least squares and maximum likelihood computer program*. Ohio State Uni. Colombus, Mimco.

Khattab, A. S., H. G. El-Awady & M. N. El-Arian, 2003. Genetic analysis of some performance traits using an animal model in a herd of Egyptian buffaloes. *Egyptian J. Anim. Prod*. (in Press).