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Full Length Article

Milk Traits and Estimation of Genetic, Phenotypic and Environmental Trends for Milk and Milk Fat Yields in Holstein Friesian Cows

NESLIHAN KATOK AND METE YANAR[1]
Department of Animal Science, College of Agriculture, Atatürk University, 25240, Erzurum, Turkey
[1]Corresponding author's e-mail: mtyanar@gmail.com

ABSTRACT

Data on of 430 performance records (1995-2008) of 127 Holstein Friesian cows reared at Research Farm of Agricultural College at Atatürk University, Erzurum, Turkey was used to investigate the effects of environmental factors on the 305-days milk and milk fat yields. Genetic, phenotypic and environmental trends were also estimated in these traits. The data were analyzed by the least square technique to determine the influence of the environmental factors. Individual animal models were also fitted to 305-days milk and milk fat yields from all lactations to estimate breeding values by Restricted Maximum Likelihood methodology. The least square means for 305-days milk and milk fat yields were 3408.17±48.54 and 112.05±2.30 kg, respectively. The influence of the parity and years on the 305-days milk and milk fat yields were significant (P<0.01); while calving season significantly (P<0.05) affected 305-days milk yield. The estimated annual genetic, phenotypic and environmental trends were 3.73±4.07, -17.73±9.64 and -21.46 kg for 305-days milk yield and 0.22±0.15, -2.29±0.46 and -2.51 kg for milk fat yield, respectively. The genetic trends for 305-days milk and milk fat yields were slightly positive indicating that the sires used during last 14 years had better breeding values. The environmental trends for 305-days milk and milk fat yields depicted deteriorating trends indicating presence of some environmental inadequacies. © 2012 Friends Science Publishers

Key Words: Genetic trend; Non-genetic factors; Milk yield; Milk fat yield; Holstein-Friesian

INTRODUCTION

It is imperative to follow the results of an animal breeding program to assess its development as well as to make effective adjustments. One way of evaluating an animal breeding plan is to determine the phenotypic trends, and divide it into its genetic and environmental components. Thus, the study of genetic trend in a population is a significant element in monitoring of the selection, since it corresponds to the observed changes in the average breeding values of animals studied for a specific trait during the selection work (Potocnik *et al*., 2007). Determination of the genetic trend permits for the visualization of the efficiency of the selection procedures used and the quantification of the genetic changes of the traits under selection over time, besides the possibility of correcting eventual mistakes in the direction of selection (Razmkabir *et al.,* 2006; Yaeghoobi *et al.,* 2011). The interpretation of genetic trend estimates also allows monitoring the efficiency of improvement strategies and assures that the selection pressure is directed towards the traits of economic importance, besides assisting in the definition of the selection objectives. In this manner, animal breeding strategies used in different countries have to be assessed using genetic trend analyses.

The genetic parameters are predicted after adjusting for environmental factors. This is important to increase the accuracy in selection. It is also crucial that the records reflect, as precisely as possible, the animal's genetic potential for milk production traits (Kunaka & Makuza, 2005a). A number of environmental factors like year, calving season, parity and length of lactation are known to exert influence on the performance of dairy cattle. As the Holstein Friesian is a lowland breed of North Western Europe, the present study was planned to investigate the effects of various environmental factors on milk and milk fat yields of this breed reared at high altitude (about 1950 m above sea level) conditions of Eastern part of Turkey and to reveal phenotypic, genetic and environmental trends for the traits.

MATERIALS AND METHODS

A total of 430, 305-days milk and milk fat records (1995-1998) of 127 Holstein Friesian cows reared at Research Farm of Agricultural College at Atatürk University, Erzurum, Turkey was used in this study. The

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dairy cattle farm is located on the mountainous region of the Eastern Turkey and its altitude from sea level is about 1950 m. Average minimal and maximal temperatures range from -15.2 to 25°C, respectively during a year. It snows a lot about between September and April.

The data were analyzed by the least square technique and the following mathematical model was designed to determine the effect of environmental factors affecting the traits under consideration:

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

Where,

Y_{ijkl}: The observations of 305-days milk and milk fat yields,

a_i: the effects of calving seasons (winter, spring, summer, fall),

b_j: the effects of calving year (1995-2008),

c_k: the effects of parity (1-7+)

e_{ijk}: the random residual error.

Comparisons among subclass means were carried out following Duncan's multiple range test available in SPSS computer program (SPSS, 2004).

Before calculation of the phenotypic trend, a preliminary statistical analysis was carried out for the data to determine the significant non-genetic factors, such as calving seasons and parities by least square technique using the general linear model procedure of Harvey (1987). After standardization of the 305-days milk data according to the fixed effects, the phenotypic trend was calculated as the linear regression of the adjusted means for 305-days milk yield on the years of production (Bakir & Kaygisiz, 2009).

Breeding values of animals for 305-days milk and milk fat yields were estimated by Best Linear Unbiased Prediction (BLUP) procedure. Multiple trait derivative free restricted maximum likelihood (MTDFREML) set of computer programs (Boldman *et al.,* 1995) was used which also generated Estimated Breeding Values (EBVs) as a by product. The following animal model was used in the statistical analysis:

$$Y_{ijklm} = F_{ijk} + a_l + p_m + e_{ijklm}$$

Where,

Y_{ijklm}: The observations of 305-days milk and milk fat yields,

a_l: the direct additive genetic effect of the l^{th} animal,

p_m: random permanent environmental effect of the l^{th} animal,

e_{ijkl}: the random residual error,

F_{ijk} (fixed effects): $bm_i + by_j + ln_k$.

Where;

bm_i: the effects of calving seasons (winter, spring, summer, fall),

by_j: the effects of calving year (1995-2008),

ln_k: the effects of parity (1-7+).

The breeding values thus estimated were fitted in a fixed effect model (Harvey, 1987) having year of birth as the only fixed effect. The least squares solutions of breeding values were plotted against the year of birth to determine the genetic trend (Ahmad, 2007). Environmental trend was calculated by subtracting genetic trend from phenotypic trend as described by Kunaka and Makuza (2005b).

RESULTS AND DISCUSSION

Least square means with their standard errors for factors influencing 305-days milk and milk fat yields of Holstein Friesian cattle reared under high altitude and harsh climatic conditions of Eastern Turkey are presented in Table I. Average 305-days-milk yield determined in the present study was lower than that reported by Van Arendonk and Liianamo (2003), Türkyilmaz *et al.* (2005), Cilek (2009), Topaloglu and Günes (2010) and at par with the findings of Javed *et al.* (2004). As evident from Table I, average 305-days milk and milk fat yields showed fluctuations in different years. The cows calved in 2008 and 1996 produced maximum milk (3926.28±219.64 kg) and milk fat (141.09±5.78 kg). The milk and milk fat yields dropped to 2845.63±155.59 kg and 87.88±6.56 kg during 2004 and 2001, respectively. The variability of milk and milk fat yields due to years of calving were significant ($P<0.01$) in the present study. These result are in conformity with those of Pelister *et al.* (2000), Trifunovic *et al.* (2002), Javed *et al.* (2004), Kunaka and Makuza (2005a) and Topaloglu and Günes (2010) who reported similar findings in Western Turkey, Serbia, Pakistan, Zimbabwe and England, respectively. The variation in these traits might reflect the level of management, as well as environmental effects. The level of management varies according to the ability of farm manager, his efficiency in the supervision of the labour, system of crop husbandry, method and intensity of culling.

305-days milk yield of the cows calved in winter and summer seasons were significantly ($P<0.05$) higher than those of animals delivered in spring and fall (Table I). In contrast to the findings of the other studies (Javed *et al.,* 2004; Kunaka & Makuza, 2005a; Bayril & Yilmaz, 2010), Holstein cows calved in summer season were not adversely affected from environmental temperature since the Eastern Turkey doesn't have hot weather even in summer because of its high altitude from sea level. The calving season did not significantly affect 305-days milk fat yield in this study. These results are in agreement with the findings of Ugur *et al.* (1995).

Least square analysis revealed that parity had significant effect ($P<0.01$) on 305-days milk and milk fat yields. The trend of milk and milk fat yields associated with parity followed a well-known pattern, and peak lactation and subsequent fall was similar to the pattern observed by Cilek (2009), Topaloglu and Günes (2010) and Cilek and Bakir (2010).

The estimated breeding values (EBVs) for 305-days milk and milk fat yields from animal model evaluations varied from 455 to -656 kg and from 17.6 to -21.6 kg,

Table I: Least square means with standard errors for 305-days milk and milk fat yields

	N	305-Days Milk Yield (kg) $\bar{X} \pm S_{\bar{x}}$	305-Days Milk Fat Yield (kg) $\bar{X} \pm S_{\bar{x}}$
Overall Mean	430	3408,17 ± 48,54	112,05 ± 2,3
Parity		**	**
1	96	2958,44 ± 80,17^{d}	101,09 ± 3,80^{d}
2	100	3229,25 ± 76,81^{c}	110,68 ± 3,64^{c}
3	81	3486,37 ± 85,67^{b}	118,11 ± 4,06^{b}
4	57	3654,48 ± 101,35^{a}	125,88 ± 4,80^{a}
5	40	3507,19 ± 120,75^{b}	118,51 ± 5,72^{b}
6	31	3408,85 ± 139,51^{b}	111,08 ± 6,61^{c}
7+	25	3612,59±154,43^{a}	98,71 ± 7,32^{d}
Calving Season		*	NS
Winter	107	3519,30 ± 78,04^{a}	118,03 ± 3,69
Spring	159	3264,31 ± 65,10^{b}	108,39 ± 3,08
Summer	89	3508,34 ± 85,20^{a}	113,39 ± 4,03
Fall	75	3340,71 ± 102,99^{b}	108,23 ± 4,88
Years		**	**
1995	35	3638,75 ± 127,86^{bc}	127,75 ± 6,06^{c}
1996	38	3660,26 ± 121,99^{bc}	141,09 ± 5,78^{a}
1997	42	3709,51 ± 117,60^{b}	135,03 ± 5,57^{b}
1998	52	3474,49 ± 104,16^{de}	125,11 ± 4,93^{c}
1999	53	3409,05 ± 102,84 ^{e}	115,47 ± 4,87^{d}
2000	43	3121,57 ± 115,77^{h}	102,34 ± 5,48^{f}
2001	32	3227,39 ± 138,51^{g}	87,88 ± 6,56^{g}
2002	15	3373,21 ± 197,24^{ef}	109,52 ± 9,35^{e}
2003	16	3063,88 ± 190,94^{h}	105,85 ± 9,05^{ef}
2004	24	2845,63 ± 155,59^{ı}	88,54 ± 7,37^{g}
2005	23	3270,58 ± 157,57^{fg}	116,72 ± 7,42^{d}
2006	18	3557,66 ± 176,66^{cd}	124,13 ± 8,37^{c}
2007	27	3436,06 ± 148,11^{e}	103,11 ± 7,02^{f}
2008	12	3926,28 ± 219,64^{a}	85,62 ± 10,41^{g}

*: P<0.05, **: P<0.01, NS: Non-Significant, ^{a,b,c,d,e,f}: Means within columns with different superscript are significantly different

respectively for all Holstein Friesian cows maintained under the period of study. The corresponding values for the cows present alive in the herd under study ranged from 386 to -186 kg, from 16.57 to -7.35 kg and from 0.19% to -0.28%, respectively. The genetic trends for 305-days milk and milk fat yields were determined as 3.73±4.06 kg year^{-1} and 0.22±0.14 kg year^{-1}, respectively. All genetic trends for the traits studied depicted positive trends (Fig. 1 & 2) indicating a genetic improvement in the present Holstein Friesian herd reared in high altitude conditions of Eastern Turkey. These results could be due to the use of imported semen of the sires having better breeding values for milk and milk fat yields during the recent years. On the other hand, there were some declining trends in 305-days milk and milk fat yields in 1996 and 2000 years, which might be due to the use of bulls raised on this farm. Positive genetic trends for milk yield such as 6.36 kg by Vargas and Gamboa (2008), 7.99 kg by Bakir and Kaygisiz (2009), 13.42 kg by Bakir *et al.* (2009), 19.61 kg by Yaeghoobi *et al.* (2011) and milk fat yields such as 0.090 kg by Musani and Mayer (1997) and 0.127 kg by Kunaka and Makuza (2005b), 0.64 kg by Razmkabir *et al.* (2006), and 0.171 kg by Yaeghoobi *et al.* (2011) were already reported in different countries.

Fig. 1: Genetic trend for 305-days milk yield in Holstein Friesian cows

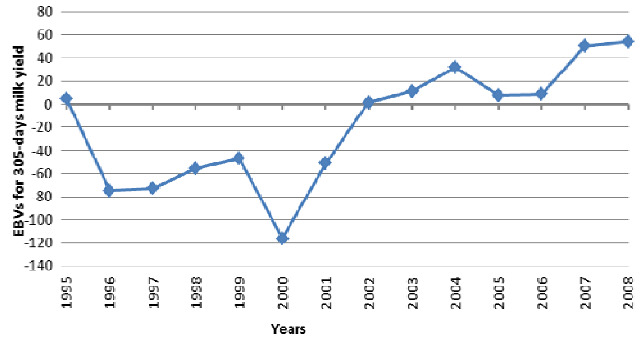


Fig. 2: Genetic trend for 305-days milk fat yield in Holstein Friesian cows

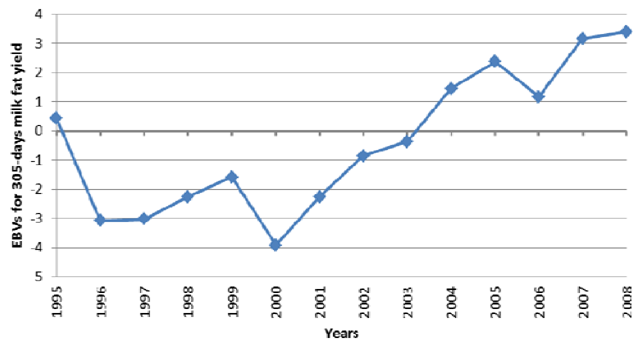


Fig. 3: Phenotypic trend for 305-days milk yield in Holstein Friesian cows

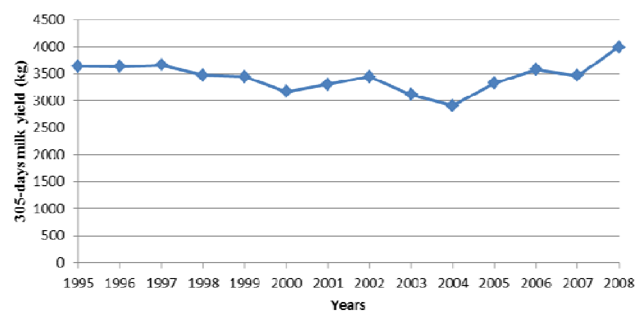
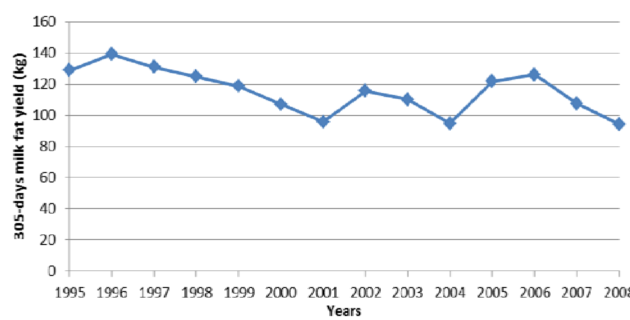


Fig. 4: Phenotypic trend for 305-days milk fat yield in Holstein Friesian cows



The phenotypic trends for 305-days milk and milk fat yields were calculated as -17.73±9.64 kg year^{-1} and -2.29±0.46 kg year^{-1}, respectively. Phenotypic deteriorations in 305-days milk and milk fat yields were found out in the present Holstein Friesian herd during the period under study (Fig. 3 & 4). Similarly, Tonhati and Lobo (1997) and Bakir and Kaygisiz (2009) reported declining phenotypic trends in two different Holstein Friesian herds as -3.46 kg year^{-1} and -23.59 kg year^{-1} respectively. The declines in these phenotypic traits might be attributed to the adverse environmental factors. Diseases such as, foot and mouth disease, mastitis as well as insufficient feeding of Holstein cattle, harsh climatic and geographical conditions could be some of the responsible environmental reasons for this deterioration. In the present study, environmental trends for 305-days milk and milk fat yields were also determined as -21.46 kg year^{-1} and -2.51 kg year^{-1}. Even though genetic trend values of 305-days milk and milk fat yields were positive in this study, high negative magnitudes of the environmental trends resulted in worsening the phenotypic trend.

CONCLUSION

The present study concludes that parities and years of calving from environmental factors had significant (P<0.01) effects on the 305-days milk and milk fat yields while the effect of the calving season on the 305-days milk yield was significant (P<0.05). Positive genetic and negative phenotypic and environmental trends for 305-days milk and milk fat yields were also estimated from Holstein Friesian cows reared in harsh geographical and climatic conditions of Eastern Turkey.

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REFERENCES

Ahmad, M., 2007. Estimated breeding values and genetic trend for milk yield in Nili Ravi buffaloes. *Italy J. Anim. Sci.,* 6: 393–396

Bayril, T. and O. Yilmaz, 2010. Milk yield traits of Holstein cows raised in Kazova Vasfi Diren Agriculture Farm. *YYU Vet. Fak. Derg*., 21: 113–116

Bakir, G. and A. Kaygisiz, 2009. Estimation of genetic and phenotypic trends heritability and repeatability for some production traits of Holsteins. *Kafkas University Vet. Fak. Derg.,* 15: 879–884

Bakir, G., A. Kaygisiz and S. Cilek, 2009. Estimates of genetic trends, for 305-Days milk yield in Holstein Friesian cattle. *J. Anim. Vet. Adv*., 8: 2553–2556

Boldman, K.G., L.A. Kriese, L.D. Van Vleck, C.P. Van Tassell and S.D. Kachman, 1995. *A Manual for Use of MTDFREML*. Agricultural Research Service, USDA, Washington DC, USA

Cilek, S., 2009. Milk yield traits of Holstein Cows Raised at Polatli State Farm in Turkey. *J. Anim. Vet. Adv*., 8: 6–10

Cilek, S. and G. Bakir, 2010. Milk yield traits of Brown cows reared at Malya State Farm and effects of some environmental factors on these traits. *Kafkas University Vet. Fak. Derg.,* 16: 347–350

Javed, K., M. Afzal, A. Satar and R.H. Mirza, 2004. Environmental factors affecting milk yield in Friesian cows in Punjab, Pakistan. *Pakistan Vet. J.,* 24: 58–61

Harvey, W.R., 1987. *Mixed Model Least-Squares an Maximum Likelihood Computer Program PC-1*. Agriculture Research Ser., USDA, Washington DC, USA

Kunaka, K. and S.M. Makuza, 2005a. Genetic and environmental trends for milk traits in the Zimbabwean Holstein-Friesian population. *Pakistan J. Biol. Sci*., 8: 1011–1015

Kunaka, K. and S.M. Makuza, 2005b. Environmental factors affecting milk production in the Holstein-Friesian population of Zimbabwe. *Pakistan J. Biol. Sci*., 8: 989–994

Musani, S.K. and M. Mayer, 1997. Genetic and environmental trends in a large commercial Jersey herd in the central Rift Valley, Kenya. *Trop. Anim. Health Pro.,* 29: 108–116

Pelister, B., A. Altinel and H. Günes, 2000. An investigation on the milk yield characteristics of Holstein cattle of different origin in commercial farm conditions. *Istanbul University Vet. Fak. Derg.,* 26: 201–214

Potocnik, K., M. Stepec and J. Krsnik, 2007. Genetic trends for production and non-production traits in Simmental breed in Slovenia. *Biotechnol. Anim. Husbandry*, 23: 47–53

Razmkabir, M., A. Nejati-Javaremi, M. Moradi-Shahrbabak, A. Rashidi and M.B. Sayadnejad, 2006. *Proceedings of the 8th World Congress on Genetics Applied to Livestock Production, Belo Horizonte*, pp: 1–38. 13-18 August 2006, Instituto Prociencia, Minas Gerais, Brazil

SPSS, 2004. *SPSS 13.0 for Windows*. Released 13.0, SPSS Inc., Chicago

Tonhati, H. and R.B. Lobo, 1997. Genetic trends for milk and fat yield in Holstein-Friesian cattle. *J. Brazil Soc. Anim. Sci.,* 26: 714–718

Topaloglu, N. and H. Günes, 2010. Effects of Some Factors on Milk Yield and Components of Holstein Friesian Cattle in England. *Istanbul University Vet. Fak. Derg.,* 36: 65–74

Trifunovic, G., D. Latinovic, Z. Skalicki, R. Edovic and P. Perisic, 2002. Influence of some non-genetic factors on milk traits in the Black Pied cattle population. *Biotechnol. Anim. Husbandry,* 18: 43–49

Türkyilmaz, M.K., H.E. Bardakcioglu and A. Nazligül, 2005. Effect of Some Factors on Milk Yield in Holstein Cows. *Kafkas University Vet. Fak. Derg.,* 11: 69–72

Ugur, F., M. Yanar, M. Ozhan, N. Tüzemen, R. Aydin and O. Akbulut, 1995. Milk production characteristics of Simmental cattle reared in research farm of Ataturk University. *Turk. J. Vet. Anim. Sci*., 19: 365–368

Vargas, L.B. and Z.G. Gamboa, 2008. Genetic trends, genotype-environment interaction and inbreeding in Holstein and Jersey dairy cattle from Costa Rica. *Tec. Pecu. Mex.*, 46: 371–386

Van Arendonk, J.A.M. and A. Liianamo, 2003. Dairy Cattle Production in Europe. *Theriogenology,* 59: 563–569

Yaeghoobi, R., A. Doosti, A.M. Noorian and A.M. Bahrami, 2011. Genetic parameters and trends of milk and fat yields in Holstein's Dairy cattle of west provinces of Iran. *Int. J. Dairy Sci.,* 6: 142–149

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