Kafkas Univ Vet Fak Derg
16 (4): 533-536, 2010
DOI:10.9775/kvfd.2009.1083

RESEARCH ARTICLE

Estimation of Genetic and Phenotypic Trends of 305-day Milk Yield for Simmentals Reared in Kazova State Farm in Turkey

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Makale Kodu (Article Code): KVFD-2009-1083

Summary

This study was conducted to estimate breeding values of 232 Simmental cows for 305-day milk yield calved between 1990 to 2000. Breeding values were obtained for animals by using individual animal model. Although, phenotypic values of 305 day milk yield showed a smooth increasing trend in the examined period, genetic trend has not shown a substantial trend among the years, generally an irregular fluctuation was observed. It is concluded that there was not any standard selection programme in the evaluated Simmental herd reared in Kazova state farm.

Keywords: *Breeding value, Genetic trend, Milk yield, Simmental*

Kazova Tarım İşletmesinde Yetiştirilen Simentallerde 305 Gün Süt Verimi Yönünden Genetik ve Fenotipik Yönelim

Özet

Araştırmada, Kazova Tarım İşletmesinde yetiştiriciliği yapılan ve 1990-2000 yılları arasında buzağılayan 232 Simmental ineğin 305-gün süt verimi bakımından damızlık değeri tahmin edilmiştir. Hayvanlara ait damızlık değerleri bireysel hayvan modeli ile tahmin edilmiştir. 305-gün süt verimine ait fenotipik değerler düz bir artış eğiliminde olmasına rağmen, genetik yönelim yıllar arasında dalgalı bir seyir takip etmiştir. Sonuç olarak, Kazova Tarım İşletmesinde yetiştirilen Simmental ırkı sığırlar için standart bir seleksiyon programı uygulanmadığı anlaşılmaktadır.

Anahtar sözcükler: *Damızlık değeri, Genetik yönelim, Süt verimi, Simmental*

INTRODUCTION

Milk is the source of nutrients and immunological protection for the calves and its production continues for an average of 305 days. Traditionally, aggregated 305 day milk yield has been used as the breeding goal for production in dairy cattle. The 305 day milk yield has been estimated from individual test-day records [1] that are usually taken at monthly intervals. Additionally, genetic evaluation of dairy system including sires and cows are generally based on 305 day lactation yields. These applications show that, 305 day milk yield is a significant measurement for cattle milk industry. During the lactation period quite large amount of milk is produced considering the calf only needs for growth. This exceeded amount of milk play an important role in human life for nutritional and economical sides. Therefore genetic aspects of milk yield become vital for the producers and high milk yield has been the primary selection emphasis in dairy breeding [2,3]. Being an

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economic trait for selection in dairy cattle it makes the milk yield essential for both farmers and researchers. Precise estimates of genetic parameters are required for the prediction of breeding values using mixed models or selection indices [4]. In addition, animal breeders use breeding values to predict genetic progress [5]. Especially following the applications of new techniques during the last decades, selection supported with breeding values which were estimated by Best Linear Unbiased Prediction (BLUP), brought better input on the genetic values of dairy cows [6,7]. Yang et al.[8] used the similar analyzing methods and reported the strong genetic correlations between the milk traits and heritabilities ranging from 0.28 to 0.32 for the 305 day milk yield in Simmental cows reared in China. Ilahi and Kadarmideen [9] employed the same analyzing method to estimate the variance components and heritabilities of milk flow for Holstein, Brown Swiss and Simmental cows. Heritability values for milk traits including 305 day milk yield (0.34) were also reported for the Croatian Simmental dairy cattle by Kaps and Spehar [10]. They additionally calculated the mean breeding values of the herd according to evaluated years to define the genetic trend as aimed in this study. Comparable calculations were made using a simplified analyzing method for 305 day milk traits in Italian Simmentals [11]. Özkan and Güneş [12] studied on the Simmental population which was reared in Kayseri city, Türkiye, they defined the environmental factors effecting on milk traits without dealing with genetic parameters. Additive and non-additive genetic variances were studied in detail for the Simmental's milk yields in Austria and showed the importance of variance components to calculate the genetic parameters [13].

Nearly 50% of Turkey's cattle population is consisted of European originated cattle (Holstein, Brown Swiss, Simmental, Jersey) and their crosses. Simmental has a special place among them with more meat producing capacity besides the milk yield on Anatolian highlands. Therefore many breeders, especially in east part of the country, prefer Simmentals. It is a reality that, recording is essential to apply the new techniques in modern livestock breeding but only cattle reared in state farms and limited numbers of private farms have records for milk production. Hence, limited recording practice in the industry restricts the application of new techniques, such as BLUP, on the animal population.

It was clearly demonstrated in the above explanations that estimating the breeding values for milk yield are the most important steps for the future progress of the sector. Therefore the aim of this study was to predict the breeding values of 305 day milk yield for Simmental cows reared in Kazova state farm between 1990 and 2000.

MATERIAL and METHODS

Data

Data consisted of lactation records of 232 cows born from 1987 and onwards and calved between 1990 to 2000. Pedigree information and the data used in this study were obtained from the Kazova state farm. Prior to analyses, abnormal records affected by diseases or abortion and animals having calving interval less than 310 and greater then 650 days, and lactation length less then 220 and greater then 550 days were excluded from the data set. Additionally, parities more than 5 were also removed form the data set due to less number of observations. The calving months were grouped into four seasons: December to February (winter), March to May (spring), June to August (summer), and September to November (autumn). After editing, the data set consisted of 691 multiple lactation records (up to parity 5) on 232 cows which are daughters of 67 sires. Milk records were pre-adjusted for 305-day lactation length. Characteristics of the data set are given in *Table 1*.

Table 1. *Characteristics of the data set used for genetic parameter estimates*

Tablo 1. *Genetik parametrelerin tahmininde kullanılan veri setinin özellikleri*

Description	Total
Records in data	691
Cows in data	232
Sires in data	67
Dams in data	163
Animals in pedigree	407
Years (1990-2000)	11
Seasons	4
Lactation classes	5

Statistical Analyses

Preliminary analyses were conducted for 305-day milk yield to identify the significant fixed effects, eliminating non significant terms by backwards elimination until all factors were significant ($P<0.05$) using a General Linear Model [14]. The final model included the fixed effects of calving year, calving season and parity.

Estimates of breeding values of 305-day milk yield were obtained by Restricted Maximum Likelihood fitting an animal model and utilising all pedigree information using the program ASREML [15]. The following was used for the analyses.

$$Y_{ijklm} = \mu + cm_i + cy_j + l_k + \beta_j Age(l_k) + a_l + p_l + e_{ijklm}$$

Where, Y_{ijklm} is the observation of cow milk yield; a_l is the random direct additive genetic effect of lth animal; p_l is the random permanent environmental

effect lth animal; cm_i is the effects of calving season (1,..,4); cy_j is the effects of calving year (1990,..,2000); l_k is the effects of lactation (1,..,5); β_j is the regression coefficient for age at calving (Age) nested within lactation k (l_k); and e_{ijklm} the random residual term.

Genetic trends of cows were estimated by averaging the estimated breeding values (EBVs) by birth year of cows and regressing the averages against year of birth. Because of the insufficient numbers in the years 1990 and 1991, they were combined in 1992 (*Figs. 1* and *2*).

RESULTS

As seen from *Table 1*, a suitable data set for phenotypic and genetic analyses was used. Comparisons among the years in terms of 305 day milk yield were made and the detected trend was demonstrated in *Fig. 1*. The smallest amount was in the year of 1993, after this time a constant increase was continued up to year 2000.

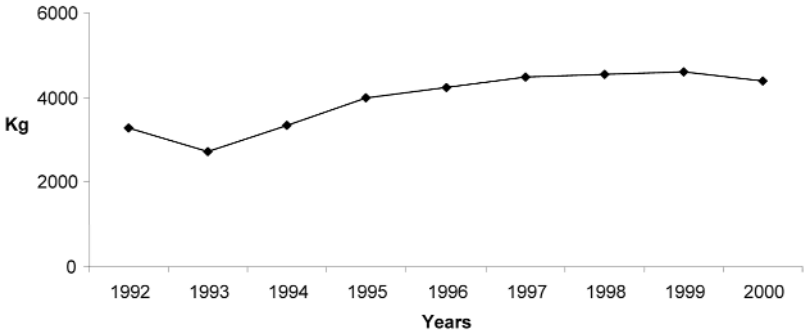

Fig 1. 305 day milk yields during the years

Şekil 1. Yıllara göre 305 gün süt verimi

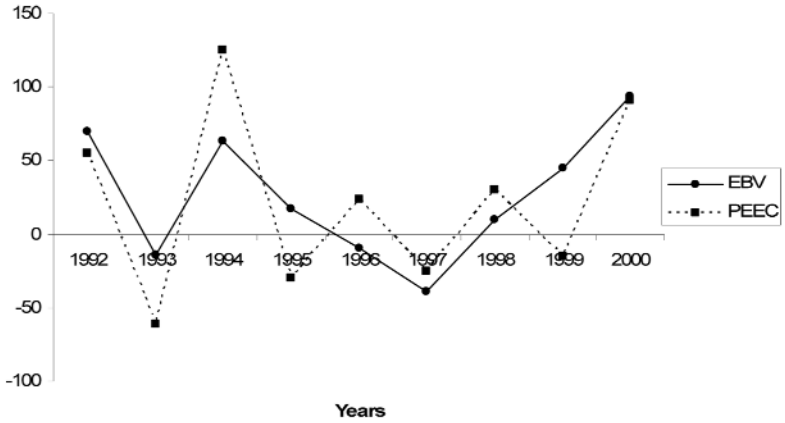

Fig 2. Breeding values and permanent environmental effects due to cow during the years

Şekil 2. Yıllara göre damızlık değerleri ve inekten kaynaklanan daimi çevresel etkiler

Estimated Breeding Values (EBS) for each animal was detected and the mean values of EBVs according to birth years were calculated. Similarly Permanent Environmental Effect due to Cow (PEEC) was also estimated according to years. *Fig. 2* shows the mean cow breeding values and permanent environmental effect for birth year. Genetic and environmental trends have not shown a substantial tendency among the years, generally an irregular fluctuation was observed. But a promising positive trend was detected after the year of 1997 and the highest mean EBV was found in the last year.

DISCUSSION

Used data and analyzing methods gave an opportunity to make a comparison between the evaluated years. According to phenotypic values of 305 day milk yield, a smooth increasing trend was observed in the examined period as shown in *Fig. 1*, but in the year of 2000 a tiny decrease was also detected. This trend might be accepted as a reflection of the management system and the characteristics of the herd. Similar trends for milk production were also reported by many authors [16-19]. Little differences of milk yield in the successive years may also show that any selection was not applied on the herd to improve the milk yield. Therefore it can be said that milk yield of the studied Simmental herd can be increased with management applications. Similar explanations about the 305 day milk yield for Simmental breed in various countries were made by Özkan and Güneş [12], Yang et al.[8] and Kaps and Spehar [10]. These explanations were also supporting the effects of management techniques on animals according to evaluated years.

Same instability was reported in the EBVs of milk yield for different cattle breeds [19-22]. This waving in the mean EBVs can be observed in many herds and it can be a reflection of applying management system which does not have a systematic selection. Similar trend was also defined in permanent environmental effect due to cow. The fluctuation in this parameter was sharper than the EBVs, because permanent environmental effect due to cow easily shows any environmental influence on milk yield. This sharp waving among the years also shows the non-stability in the management system. As can be seen in the figures, an increase in the *Fig. 2* for permanent environmental effect after the year 1999 caused a decrease in milk yield in year 2000 *(Fig. 1)*. This influence might be accepted as a negative environmental effect on milk production by cows originated from management faults.

The obtained parameters for estimated breeding values, permanent environmental effects and 305 day milk yield, from the recorded data gave an opportunity to compare the phenotypic and genetic sides of the studied Simmental herd. This situation also shows that recorded data in livestock breeding can bring new applications to improve the production traits. Management systems in dairy herds can also be easily assessed with the confidently recorded datasets.

It was evident from the trend analyses that there was no standard selection programme in the evaluated Simmental herd. This decision was also supported with the irregular trends among the examined years. Additionally, this study showed that recording systems are essential for the livestock breeding to be made reliable decisions. Therefore, breeders can be supported to keep the records of their livestock and only with this condition they can apply the new techniques, such as BLUP and selection based on EBV, on their animals. Simmental cows can be introduced to the new breeders in Turkey, with their genetically analyzed records with the support of these new techniques.

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