KSÜ Tarım ve Doğa Derg 25 (3): 629-639, 2022
KSU J. Agric Nat 25 (3): 629-639, 2022
https://doi.org/10.18016/ksutarimdoga.vi.957343

Determination of Milk Production Characteristics, Phenotypic, Genetic and Environmental Trends in Jersey Cattle

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ABSTRACT

This study was conducted to determine the effects of environmental factors on milk yield traits of Jersey breed cattle reared at the Karakoy State Farm located in Samsun Province of Turkey, as well as the phenotypic, genetic and environmental trends in relation to 305 day milk yield. The Wombat software was used to estimate heritability and breeding values for milk yield. The effects of parity, season and year factors on actual and 305 day milk yields were found to be statistically significant ($P<0.01$). The mean values of lactation length, actual and 305 day milk yields of Jersey cattle were found as 310 ± 5 days, 4462 ± 90 kg and 4183 ± 70 kg, respectively. A phenotypic trend of 29.97 kg year^{-1}, genetic trend of 18.71 kg year^{-1} and environmental trend of 11.26 kg year^{-1} were estimated. The heritability of 305 day milk yield was 0.344. The overall results of this study showed that an improvement in Jersey cattle reared at the Karakoy State Farm between the years 2006 and 2014 was provided remarkably on the basis of phenotypic, genetic and environmental trends and the enterprise had a good genotype and a good management.

Animal Science

Research Article

Article History
Received : 01.07.2021
Accepted : 20.08.2021

Keywords
Jersey
Phenotypic
Genetic
Environmental trend
Heritability

Jersey Irkı Sığırlarda Süt Verim Özellikleri, Fenotipik, Genetik ve Çevresel Yönelimlerin Belirlenmesi

ÖZET

Bu çalışmada Karaköy Tarım İşletmesinde Yetiştirilen Jersey Irkı sığırlarda gerçek ve 305 günlük süt verimini etkileyen çevre faktörleri ile 305 günlük süt verimine ait bazı genetik parametreler, çevresel, genetik ve fenotipik yönelimler hesaplanmıştır. Genetik parametrelerden olan kalıtım derecesinin ve damızlık değerlerin hesaplanmasında Wombat istatistik paket programı kullanılmıştır. Verim yılları ve mevsimin, gerçek ve 305 günlük süt verimi üzerine etkisi çok önemli bulunmuştur ($P<0.01$). Araştırmada Jersey sığırlarına ait ortalama laktasyon süresi 310 ± 5 gün, gerçek süt verimi 4462 ± 90 kg ve 305 gün süt verimi ise 4183 ± 70 kg olarak tespit edilmiştir. İşletmede yıl başına fenotipik yönelim 29,97 kg year^{-1}, genetik yönelim 18,71 kg year^{-1} ve çevresel yönelim ise 11.26 kg year^{-1} olarak tahmin edilmiştir. Üçyüzbeş günlük süt verimine ait kalıtım derecesi (h^2) 0,344 olarak saptanmıştır. 2006-2014 yılları arasında Karaköy Devlet Çiftliği'nde yetiştirilen Jersey sığırlarında fenotipik, genetik ve çevresel eğilimler bazında dikkate değer bir gelişme sağlandığını ve işletmenin iyi bir genotip ve iyi bir yönetime sahip olduğunu göstermiştir.

Zootekni

Araştırma Makalesi

Makale Tarihçesi
Geliş Tarihi : 01.07.2021
Kabul Tarihi : 20.08.2021

Anahtar Kelimeler
Jersey
Fenotipik
Genetik
Çevresel yönelim
Kalıtım derecesi

To Cite Kabakcı D, Aydın R 2022. Determination of Milk Production Characteristics, Phenotypic, Genetic and Environmental Trends in Jersey Cattle . KSU J. Agric Nat 25 (3): 629-639. https://doi.org/10.18016/ksutarimdoga.vi.957343.

Atıf İçin: Kabakcı D, Aydın R 2022. Jersey Irkı Sığırlarda Süt Verim Özellikleri, Fenotipik, Genetik ve Çevresel Yönelimlerin Belirlenmesi. KSÜ Tarım ve Doğa Derg 25 (3): 629-639. https://doi.org/10.18016/ksutarimdoga.vi.957343.

INTRODUCTION

Jersey's origin is from Jersey Island which is located between France and the United Kingdom. Jersey cattle were brought from the USA to the Samsun-Karakoy state farm in the year 1958, and then, imported from the United Kingdom and Denmark (Eliçin et al., 1991). Jersey breed are reared densely in Black Sea Region of Turkey. Most particularly, this breed had a high adaptability considerably under environmental conditions of central and eastern Black Sea Region over time and therefore it was used by the region farmers for breeding purpose. The cattle breed used for crossbreeding and pure breeding have been reared officially for pure breeding purpose in Karaköy Agricultural Enterprise connected with general directorate of agricultural enterprises in Turkey (Çankaya and Ünalan, 2008).

Jersey cattle is originated from *Bos longifrons (brachyceros).* The desired weight in mature Jersey cows is 400-500 kg. Mature Jersey bulls weigh approximately 600-725 kg. Jersey's milk is superior in fat and dry matter to other breeds with a fat percentage range of 4 to 8%. On average, the breed produces 3800-4600 kg with the fat percentage of 5.3%. Butter production costs cheaper due to high fat percentage in its milk dry matter. The milk of the breed, preferred for obtaining fat and cream, has a high carotene amount; therefore, its milk color is yellow. The dry matter-fat ratio in the milk is high for cheese making or concentrated milk production (Özhan et al., 2001). Birth weights of Jersey calves range from 19.8 to 23.3 kg. In the first periods of their lifetime, their weight gains are low, and they are not appropriate for young cattle fattening. Their meat is also not in good quality or delicious (Özbeyaz et al., 1997). A large quantity of data for breeding studies is needed, and the number of subgroups in the obtained data is generally unbalanced. In this context, classical estimation methods could not meet the requirements in unbalanced datasets. Software used in evaluation of animal datasets can estimate variance components, heritability and phenotypic, genetic and environmental correlations between traits by providing agreement of genetic and statistical models with the data. By means of software, the breeding values of animals may also be estimated (Akbaş, 1998).

Recent developments in computer technologies offer the opportunity of constructing statistical models evaluating animals as a factor and using nonlinear converge techniques in estimating variance components. Accordingly, Wombat (a tool for mixed model analyses in quantitative genetics by the restricted maximum likelihood function) is a popular program performing simultaneous analysis of random and fixed factors and using techniques that reduce possible data losses. With each passing day, more attention on the program has emerged. Heritability may be estimated in the event of knowing the error variance and variance between animals within the scope of an animal model. The Wombat program enables analysts to estimate the effect sizes of factors by solving random (animal, dam and sire, etc.) and fixed factors simultaneously and then the breeding values of animals by selecting the best linear unbiased prediction option (BLUP). The program estimates converging variance components of random factors, such as animal, dam and sire, on the basis of the Restricted Maximum Likelihood algorithm (REML). Therefore, prior variance values from previous studies facilitate the program's work in estimating variance components. Otherwise, a convergence operation cannot be performed in the event that these prior values are not close to actual values (Tekerli et al., 2014).

To date, various methods have been used to estimate the genetic parameters of 305 day milk yield and the phenotypic, genetic and environmental trends in Turkey. Environmental trend has been computed by the regression of differences obtained from successive yields of cows on calving years, whereas phenotypic trend has been calculated by the regression of standardized yields of cows on calving year (Kaygısız 1996; Aydın et al., 1998; Musani and Mayer 1997). Afterwards, the REML, DFREML and MTDFREML methods have been employed (Ahmad et al., 2001; Leitona and Zeledon, 2008; Rehman et al., 2008, Bakır and Kaygısız, 2009, Çetin and Koç, 2011; Missanjo et al., 2011; Katok and Yanar, 2012; Şahin et al., 2014;, Demirgüç 2015; Selvi and Yanar, 2016). Nowadays, the Wombat software developed based on the REML procedure by Meyer (2011) has been used by Şahin (2012) and Tekerli et al., (2014).

There is no information about the estimation of phenotypic, genetic and environmental trends for the 305 day milk yield on Jersey cattle breed reared in Turkey. Hence, the aim of this study was to determine the effects of environmental factors on milk yield traits (actual and 305 day milk yields) of Jersey breed cattle reared at the Karakoy State Farm located in the Black Sea Region of Turkey and estimate the phenotypic, genetic and environmental trends in relation to 305 day milk yield in the past decade.

MATERIALS and METHODS

The material of the study comprised milk yield records of Jersey breed cattle reared at the Karakoy State Farm located in Samsun province of Turkey between the years 2005 and 2014.

In this study, 704 lactation records of 215 cows belonging to 26 sires were evaluated. In the herd management of Jersey breed cattle reared at the Karakoy State Farm, the computer-aided Westfalia

Dairy Plan has been used as a herd management program to remove problems resulting from human errors in order to make better evaluations on Jersey cows. Thanks to this program, the individual data of animals were recorded manually and automatically. The records of the cattle used in this study were obtained from the computerized herd management program. Cows available in the enterprise have been milked twice a day, i.e., in the morning and evening.

In this study, macro environmental factors, i.e., calving year, calving season and parity, were considered to be able to affect actual and 305 day milk yield traits. The SPSS software was used to determine the influential factors for the traits (SPSS 2004). The mean separation was determined for significant environmental factors by Duncan's multiple comparison test (Yildiz et al., 2011).

The statistical model used for the analysis of variance was as follows:

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

Where,

Y_{ijkl} = i^{th} parity, j^{th} calving season, kth calving year, l^{st} animal effect,

μ = Population mean,

a_i = i^{th} parity effect (i = 1, 2, ….7),

b_j = j^{th} calving season effect (j = 1^{st} winter, 2^{nd} spring, 3^{rd} summer, 4^{th} fall), c_k = k^{th} calving year effect (k = 2006, 2007, … 2014), and

e_{ijkl} = random error with zero mean and variance, σ_e^2.

To estimate the phenotypic trends for 305 day milk yield traits and the effects of environmental factors (parity and calving season), the following statistical model was used in the SPSS statistical package program. 305 day milk yields were standardized according to the determined effect sizes. The statistical model built with these purposes may be written as follows:

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

Where;

Y_{ijk} = i^{th} parity, j^{th} calving season, k^{th} cow's standardized 305 day milk yield amount,

μ = Population mean, a_i = i^{th} parity effect (i = 1, 2, ….,7),

b_j = j^{th} calving season effect (j = 1^{st} winter, 2^{nd} spring, 3^{rd} summer, 4^{th} fall), and

e_{ijk} = random error with zero mean and variance σ_e^2.

The genetic trend for 305 days milk yield was obtained by calculating the regression between the birth years of the animals and the milk yield averages. The phenotypic trend was obtained by calculating the regression between the calving years of the animals and the average breeding value. Phenotypic trends were calculated by regression of standardized 305-day milk yields by years using the SPSS statistical program. With the objective to determine the genetic trends in this study, the Wombat statistics program developed by Meyer (2011) was utilized.

The following regression equation was used to estimate the phenotypic trend and genetic trend.

$Y_i = a + bx_i + e_i$

Y_i = i^{th} calving year milk yield (for phenotypic trend) or i^{th} birth year breeding value (for genetic trend)

i=2006, 2007, …2014 (calving years), or i = 2003, 2004, 2011 (Birth years)

a : Constant,

bx_i: phenotypic trend or genetic trend

e_i : random error with zero mean and variance σ_e^2

The Windows version of Wombat and user notes can be downloaded from http:/didgeridoo.une.edu.au/km/wombat.php (Meyer 2011). A "pedigri file" from which the entire pedigree of the animals will be extracted, the "parameter file" that constitutes the syllabus of the work to be done, and the "data file" containing the data of the individuals have been prepared. Wombat.exe and these files have been transferred to the same folder.

First, the data set file was created. The pedigree and data files to be used in this program are prepared as follows (Figure 1).

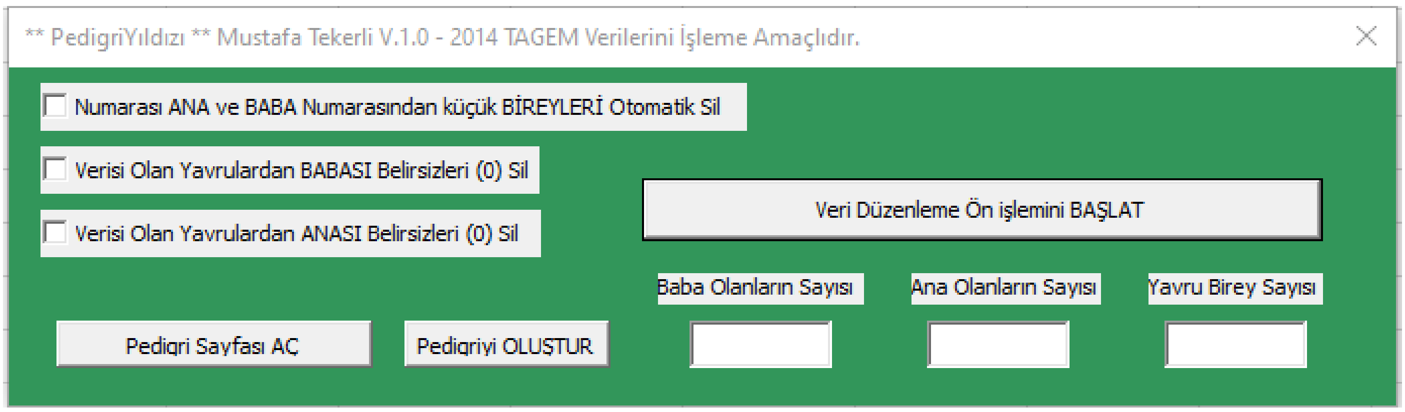

Figure 1. Pedigree Star Program placed in Excel program

Şekil 1. Excel programına yerleştirilen Pedigri Yıldızı Programı

- It is ensured that the sire and dam numbers are smaller than the cow itself. For this purpose, the sire are renumbered (as 1-26). Dam numbers have been renumbered (as 27-241).

-The numbers given to individuals (cows) in the enterprise must be greater than the dam and sire numbers. In this study, the individual numbers were not changed because they were already greater than the dam and sire numbers.

-The pedigri file was created as pedigri.xls file in Excel program.

By pressing the Ctrl + Z key, the "Pedigree Star" program in Figure 1 was started. A pedigree file was created from here.

Then, the corrected data file and pedigree files were saved as two different files in Windows Notepad (txt) format using the save as option. In the first lines of both pedigree and data files, abbreviations are written with the symbol "#" and indicating the data names.

Pedigri and Data files were saved as Windows Notepad (Figure 2 and 3). While creating the parameter file, the data name for each lactation was created with the extension (kitap1.par) as follows (Figure 4).

Table 1. Data file
Çizelge 1. Veri dosyası

birey	baba	ana	dyıl	mevkod	byıl	lakkod	Laksure (gün)	Tsv (kg)	Usv (kg)
Cow number	sire number	dam number	birth year	season code	calving year	parite	lactation length (day)	total milk yield (kg)	305 daily milk yield (kg)
464	1	27	2003	2	2005	1	378	4698	3752
476	1	28	2003	2	2005	1	301	1655	1655
494	1	29	2003	3	2005	1	267	3976	3976
519	1	29	2003	4	2005	1	294	4130	4130
547	1	31	2003	2	2006	1	347	4196	3621
555	2	32	2003	4	2005	1	377	2836	2291
596	1	33	2003	1	2006	1	332	4066	3845
648	1	34	2004	4	2006	1	314	3376	3313
666	3	35	2004	1	2006	1	304	5094	5094
703	1	36	2004	1	2007	1	326	4226	4009
796	4	41	2005	2	2007	1	293	5070	5070
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
66991	19	241	2010	2	2012	1	280	3462	3462

Just after the model statement, the animal itself was written as a random factor, one line down and one column inside, and the expression NRM (numerator relationship matrix) was included with a space distance in case of the pedigree file showing kinship relations. Similarly, RAN for random factors; FIX prefix was used for fixed factors. The TRAIT pre-statement was used to report the examined feature to the program. The model is finished with the END MODEL statement.

Prediction of genetic parameters, breeding values and genetic trend with Wombat program

The following sequence is followed as an example for the prediction of genetic orientation.

1. In the first study, after creating a folder named "milk yield records", the files Kitap1.dat, Kitap1.ped, and Kitap1.par were copied to this folder.

2. A folder has been created for each lactation (kitap1, kitap2, kitap3,.....kitap7). In order to run Wombat on the command line, the CMD program has been transferred to the milk yield records folder.

3. To run the CMD program, write wombat kitap1 on the command line and run the program with the enter key. The desired information was entered in the program and the process was continued until the end.

4. After the process is finished, the SumEstimate.out file is opened from the kitap1 folder. Heritability data for the first lactation were obtained from here.

5. In order to calculate breeding values, RnSoln_ana.dat and RnSoln_Individual.dat files were created in the folder by giving the wombat --blupkitap1 command to the blup program in the Wombat

command line. Among these files, BLUP values (breeding values), standard errors, hit degrees and relatedness degrees of the animals were seen in the RnSoln_Individual.dat file.

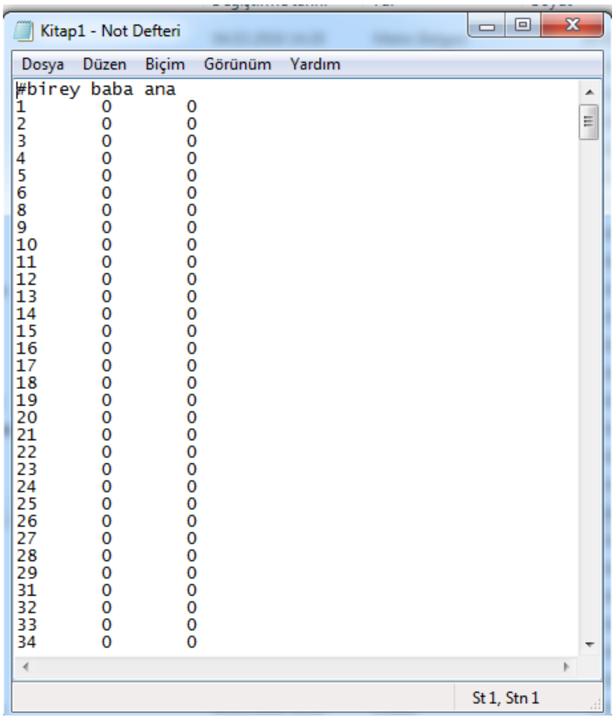

Figure 2. Ped (Pedigri) file (Kitap1.ped)
Şekil 2. Ped (Pedigri) dosyası (Kitap1.ped)

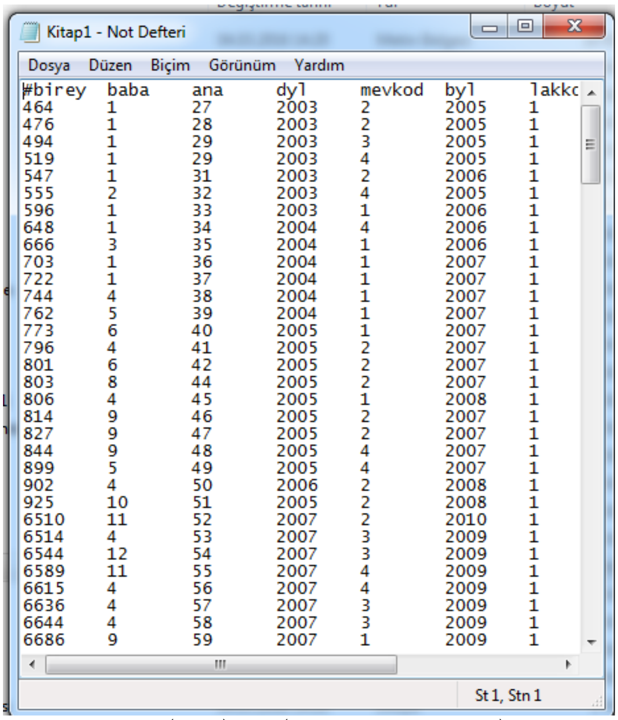

Figure 3. Dat (data) file (sample; Kitap1.dat)
Şekil 3. Dat (veri) dosyası (örnek; Kitap1.dat)

6. Breeding values were calculated separately for seven lactations as stated above than combined in an excel file and average breeding values were calculated for each animal.

7. Genotypic trend was estimated by regression of mean breeding values to "year of birth" in the SPSS statistical program.

The effect sizes of the factors were estimated by solving random (animal, dam and sire, etc.) and fixed factors simultaneously, and then, breeding values of animals by selecting the BLUP option in the 305 day milk yield trait with the help of the Wombat program (Tekerli et al., 2014; Kabakcı 2017). Preparation of pedigree, parameter and data files is explained in detail by Kabakcı (2017) with examples. In addition, genetic parameters and breeding values estimation with Wombat were explained in detail by Kabakcı. Presenting the method here will increase manuscript volume.

Genetic trend was calculated by the regression of breeding values on the birth years of the cows with SPSS statistic program. Heritability and breeding values were estimated by the Wombat program (Tekerli et al., 2014; Kabakcı 2017).

Environmental trend was estimated using the phenotype = genotype + environmental formula. First, the phenotypic and genetic trends were estimation. Second, these values were applied to the formula. Finally, the genetic trend value was subtracted from the phenotypic trend value and thus the environmental trend was calculated.

RESULTS and DISCUSSION

Environmental Factors Affecting Actual and 305 Day Milk Yield Traits

The results of least squares means with standard errors and multiple comparison test of lactation length, actual and 305 day milk yield traits in Jersey cattle are given in Table 1.

The effects of parity, calving year and calving season on actual and 305 day milk yield traits were found significant ($P < 0.01$), which was in agreement with those reported by several authors (Bashir et al., 2008; Lateef et al., 2008; Lemma et al., 2009; Teke and Akdag, 2010, Ünalan and Çankaya, 2010;2012; Missanjo et al., 2011).

The mean lactation length of Jersey cattle reared at the Karakoy State Farm was found as 310 ± 5 days, which was within the limits of the 297 - 323 days given in the relevant literature. (Tahtabiçen, 2008; Lemma et al., 2009; Şahin, 2009; Ünalan and Çankaya, 2010;2012, Kul, 2013; Fernando et al., 2016). It could also be suggested that this figure was a good value for the enterprise. When calving years in lactation length were examined, small fluctuations were observed. The longest lactation length was recorded in the year 2011 with 324 days, whereas the shortest lactation length with 248 days was obtained in the year 2014. When the effects of the season factor on lactation length were evaluated, it was determined that cows in winter seasons were milked for a longer time (322 days) in comparison to other seasons.

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```
Kitap1 - Not Defteri
Dosya  Düzen  Biçim  Görünüm  Yardım

#Kitap1

#Analiz tipi
ANALYSIS UNI

#Pedigri dosyası
 PEDS Kitap1.ped

#Verilerin düzeni
DATA Kitap1.dat
 birey 213
 baba 25
 ana 213
 dyıl 10
 mevkod 4
 byıl 10
 lakkod 7
 laksure
 tsv
 usv
END DATA

#Modelin belirlenmesi
MODEL
 RAN birey NRM
 RAN ana
 FIX lakkod
 FIX mevkod
 TRAIT usv
END MODEL

#Varyans compenenti priorları
VAR birey 1
1200000
VAR ana 1
1300000
VAR residual 1
1000000

St 1, Stn 1
```

Figure 4. Par (parameter) file (sample Kitap1.par)
Şekil 4. Par (Parametre) dosyası (örnek Kitap1.par)

Actual milk yield mean value of the Jersey cattle was estimated at 4462 ± 90 kg. When actual milk yield was examined based on parity, it reached the peak point (4721 ± 135 kg) at the third lactation, and it started to decrease from the fourth lactation on. When change in actual milk yield was examined in reference to calving years, actual milk yield was recorded on the lowest level (3910 ± 52 kg) in the year 2005, but it reached the highest level with the mean value of 4926 ± 93 kg in the year 2013. When change in actual milk yield was evaluated based on calving season, it was seen that higher milk yield was obtained in the winter season.

In this study, 305 day milk yield reached the peak level by increasing from the first lactation to the third lactation. In agreement with those reported by Nyamushamba et al., (2014), the mean value of 305 day milk yield in the Jersey cattle was 4183 ± 70 kg. The lowest 305 day milk yield amount was recorded in the year 2005, while the highest was obtained in the year 2013 (Table 1). The 305 day milk yield amount recorded in winter was relatively higher than those recorded in other seasons, and lower 305 day milk yield was found in summer. Due to the fact that the Karakoy State Farm is located in the Black Sea Region of Turkey, the warm-rainy winter season could have positively affected milk yield.

Table 1. Results of least squares means, standard errors and multiple comparison test of lactation length, actual and 305 day milk yield traits in Jersey cattle

Çizelge 1. Jersey sığırlarda laktasyon süresi, gerçek süt verimi, 305 günlük süt verimine, ait en küçük kareler ortalamaları, standart hataları ve çoklu karşılaştırma testi sonuçları

Variables *Değişkenler*	N	**Lactation Length (day)** *Laktasyon süresi (gün)* $\overline{X} \pm S_{\overline{x}}$	**Actual Milk Yield (kg)** *Gerçek süt verimi (kg)* $\overline{X} \pm S_{\overline{x}}$	**305 Day Milk Yield (kg)** *305 Gün Süt Verimi* $\overline{X} \pm S_{\overline{x}}$
Parity		NS	**	**
1	213	313 ± 4	4103 ± 87^{b}	3771 ± 68^{b}
2	157	308 ± 5	4616 ± 104^{a}	4360 ± 81^{a}
3	108	305 ± 6	4752 ± 122^{a}	4548 ± 96^{a}
4	69	312 ± 8	4693 ± 150^{a}	4394 ± 117^{a}
5	65	315 ± 8	4713 ± 156^{a}	4370 ± 122^{a}
6	45	304 ± 10	4348 ± 187^{b}	4121 ± 146^{b}
7	47	312 ± 9	4232 ± 184^{b}	3903 ± 144^{b}
Calving Year		**	**	**
2006	12	319 ± 17^{b}	4305 ± 342^{b}	4082 ± 267^{c}
2007	20	312 ± 13^{b}	4438 ± 266^{ab}	4148 ± 207^{bc}
2008	38	319 ± 10^{b}	4286 ± 195^{ab}	3904 ± 152^{bc}
2009	52	316 ± 9^{b}	4454 ± 168^{ab}	4166 ± 131^{abc}
2010	69	306 ± 7^{b}	4549 ± 144^{ab}	4293 ± 113^{abc}
2011	87	324 ± 6^{b}	4830 ± 128^{a}	4477 ± 100^{a}
2012	143	323 ± 5^{b}	4636 ± 104^{ab}	4276 ± 81^{abc}
2013	182	322 ± 5^{b}	4926 ± 93^{a}	4580 ± 73^{a}
2014	101	248 ± b	4023 ± 119^{b}	3960 ± 93^{bc}
Season		**	**	**
Winter	147	322 ± 6^{b}	4789 ± 114^{a}	4463 ± 89^{a}
Spring	176	316 ± 5^{b}	4548 ± 104^{a}	4247 ± 81^{a}
Summer	208	304 ± 5^{b}	4237 ± 98^{b}	3960 ± 76^{b}
Fall	173	299 ± 5^{b}	4401 ± 106^{ab}	4168 ± 83^{a}
Overall Mean	704	310 ± 4	4494 ± 72	4210 ± 56

** : $P < 0.01$; * : $P < 0.05$, $\overline{X} \pm S_{\overline{x}}$: mean and standard error of mean, NS: Non significant

a, b, c, d : Means in same columns with different superscripts are significantly different on the level of $P < 0.05$ or $P < 0.01$

Phenotypic Trend

Phenotypic trend is named as the change provided in a particular of period of time in a yield trait. Phenotype is composed of two parts i.e. genotype and environment. "Environmental trend" is described as the change that joint effects of all environmental factors affecting quantitative yield traits showed according to years, and "genetic trend" is expressed as the effect degree that genetic improvement studies conducted in order to improve the studied yield traits indicated according to years (Kaygısız, 2000).

In the estimation of phenotypic trends, the year factor was excluded from the studied linear model due to the fact that the regression of 305 day milk yield on years was accounted for. The effect sizes of the environmental factors that influenced the 305 day milk yield trait in the Jersey cattle are given in Table 2.

The coefficients including the obtained regression parameters are presented in Table 3.

The regression equation was obtained by taking the regression of standardized milk yields to yield year. The phenotypic trend was estimated at 29.97±17,10 kg year^{-1}, with the help of the regression prediction equation. These findings were consistent with those reported by Palmer et al., (1972) and Musani and Mayer (1997). In the relevant literature, there is no published information on the estimation of the phenotypic, genetic and environmental trends of Jersey cattle reared in Turkey.

Genetic Trend

The annual genetic trend was calculated as 18.71 ± 7.34 kg year^{-1} (Table 3), indicating that the genetic capacity of the sires used for breeding purposes was good. These estimates were higher than those reported by previous studies (Musani and Mayer, (1997) 0.8 kg, Leiton and Zeledon, (2008) 7.95 kg and Şahin, (2009) 5.90 kg).

Table 2. The effect sizes of environmental factors that influenced the 305 day milk yield trait in Jersey cattle
Çizelge 2. Jersey sığırlarda 305 günlük süt verimini etkileyen çevre faktörleri ve etki miktarları

Variables *Değişkenler*	N	305 day milk yield (kg) *305 gün süt verimi (kg)* $\overline{X} \pm S_{\overline{x}}$	Effect sizes *Etki miktarları*
Overall Mean	704	4290 ± 41	
Parity		**	
1	213	3848 ± 63^{b}	-442
2	157	4494 ± 74^{a}	204
3	108	4597 ± 89^{a}	306
4	69	4517 ± 111^{a}	226
5	65	4516 ± 116^{a}	226
6	45	4101 ± 139^{b}	-189
7	47	3959 ± 135^{b}	-331
Season		**	
Winter	147	4501 ± 81^{a}	211
Spring	176	4291 ± 74^{a}	1
Summer	208	4056 ± 65^{b}	-234
Fall	173	4312 ± 73^{a}	22

$^{a, b, c, d}$: Means in same columns with different superscripts are significantly different on the level of P < 0.05 or P < 0.01
**: P<0.01; *: P<0.05
$\overline{X} \pm S_{\overline{x}}$: mean and standard error of mean

Table 3. The coefficients including the obtained regression parameters from the 305 daily standardized milk yield and Breeding Values.
Çizelge 3. 305 günlük standardize edilmiş süt verimi ve damızlık değerlerinden elde edilen regresyon parametrelerini içeren katsayılar

Regression equations	a	b	R^2	Signification
Fenotypic Trend				
Y=-56003.07 + 29.97 X	-56003.07 ± 34390.14	29.97 ± 17.10	0.004	NS
Genetic Trend				
Y= -37549.89 + 18.71 X	-37549.89 ± 14740.02	18.71 ± 7.34	0.008	*

Y: predicted milk yield (kg), a: constant, b: linear coefficient for year or breeding value
NS: Non significant, *:P<0.05

To estimate the genetic trend, the regression of the breeding values of the cows on calving years was taken, and the regression prediction equation obtained from this data was as follows (Table 4).

The variation of breeding values by years is presented in Table 4. It is seen that the highest average breeding value belongs to 51 Jersey cows born in 2008 (247,322±41.004 kg), while the lowest average breeding value belongs to 47 cows born in 2004 (-154.648±42.713 kg) (Table 4).

Breeding values of 305 days milk yield were found to be negative in some years and positive values in some years. However, it can be said that the breeding value is positive and high indicates that the breeder selection in the herd is made accurately. It is known that an individual inherits half of his genotype from his mother and the other half from his father, but these halves are passed on to the offspring by chance. Since the parents can be heterozygous for many genes, the genes passed on to the offspring can be good or bad. In other words, the fact that an individual's parents have good yield records does not necessarily require that the offspring be highly productive (Özhan et al. 2001)

Environmental Trend

The environmental trend, which is defined as the difference between the phenotypic and genetic trends, was estimated at 11.26 kg $year^{-1}$. The estimates of the phenotypic, genetic and environmental trends reflected that the managerial conditions were on a sufficient level. The environmental trends estimated from the Jersey cows were in agreement with Musani and Mayer (1997) who found the value of 14.6 kg $year^{-1}$, but higher than those reported by Palmer et al. (1972) and Njubi et al. (1993) (-14.0 and 32.2 kg $year^{-1}$).

Genetic Parameters

The genetic parameters of the Jersey cattle reared at the Karakoy State Farm were used to estimate heritability values (Table 5). The mean heritability estimate of 0.344 was recorded for the Jersey cattle (Table 5). These heritability estimates for the 305 day milk yield trait were in agreement with those reported by several authors (Makuza et al., 2001, Şahin 2004; Şahin 2009, Ünalan and Çankaya 2010), whereas different results were reported by some authors including Leiton and Zeledon (2008) as 0.21 h^2, Missanjo et al., (2011) as 0.30 h^2 and Banga (1992) as 0.54 h^2.

Table 4. Variation of breeding values by birth years
Çizelge 4. Damızlık değerlerin doğum yıllarına göre değişimi

			95% Confidence Interval %95 Güven Sınırları	
Birth Year *Doğum Yılı*	**n**	**Breeding Values**** *Damızlık değerler*	**Lower Bound** *En Düşük*	**Upper Bound** *En Yüksek*
2003	58	18.474 ± 38.450[cd]	-57.018	93.967
2004	47	-154.648 ± 42.713[e]	-238.511	-70.786
2005	67	-7.667 ± 35.775[cd]	-77.906	62.572
2006	122	24.512 ± 26.511[cd]	-27.540	76.563
2007	88	-24.039 ± 31216[cd]	-85.327	37.249
2008	51	247.322 ± 41.004[a]	166.816	327.829
2009	70	73.997 ± 35.000[bc]	5.280	142.715
2010	140	-40.599 ± 24.748[d]	-89.189	7.992
2011	61	128.299 ± 37.493[b]	54.686	201.911
Grand Mean		29.517 ± 11.751	6.446	52.588

**:P<0.01

Table 5. Heritability calculated for 305 daily milk yield in parity
Çizelge 5. Laktasyon sırasına göre 305 gün süt verimi için hesaplanan kalıtım dereceleri

Parity *Laktasyon sırası*	**h^2 (Heritability)** *Kalıtım derecesi*
1	0.346
2	0.345
3	0.344
4	0.344
5	0.343
6	0.343
7	0.343
Mean	0.344

CONCLUSIONS

The overall results of this study reflected that a significant improvement was recorded in the phenotypic, genetic and environmental trends for the Jersey cattle reared at the Karakoy State Farm located in the Black Sea Region of Turkey in the period of 2005-2014. In this study, the estimated positive phenotypic, genetic and environmental trends showed that the Karakoy State Farm had a good herd management process. The enterprise has taken a significant task in elite cattle breeding, especially in presenting elite cattle to farmers. Application of the available herd management process should be sustained identically for many years, in accordance with the phenotypic, genetic and environmental improvements provided by years.

Conflict of Interest

The authors declare that they do not have any competition and any conflicts of interest.

Author Contributions

The data of the study was prepared by DK. Statistical analyzes were made by DK and RA. This study was written by DK as a PhD thesis. This research has been updated and rewritten by DK and RA. Authors declare the contribution of the authors is equal.

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