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Non-genetic factors affecting milk and reproductive traits of Swedish Red and White cattle raised organically in Turkey

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Abstract

The data on breeding and performance records of Swedish Red and White (SRW) cows kept in a private organic dairy farm in Kelkit, Turkey, during the period from 2006 through 2009 were used to study the effect of some non-genetic factors such as calving year, calving season, parity, age of dam and sex of calf on the various milk and reproductive traits. The actual lactation milk yield, daily milk yield, peak daily milk, days to attain milk yield and lactation length averaged as 5887.2±94.9 kg, 19.9±0.3 kg, 31.5±0.3 kg, 79.4±2.7 days and 302.5±3.2 days, respectively. The actual lactation milk yield, days to attain peak milk yield and lactation length were significantly affected by calving year and calving season. The effect of the parity on the daily milk yield, peak daily milk yield and days to attain peak milk yield were significant (P<0.01). The least squares means for calving interval and gestation length were 380.2±4.3 days and 275.4±0.6 days, respectively. Age of dam and calving season significantly (P<0.01) affected the days open. Mean age at first calving of SRW cows raised organically was 26.4±0.2 months and was significantly affected by the calving years. Significant (P<0.01) and positive phenotypic correlations of the actual lactation milk yield with daily milk yield (r = 0.71), peak milk yield (r = 0.53), lactation length (r = 0.53), days open (r = 0.43), calving interval (r = 0.36) and days attain to peak milk yield (r = 0.14) (P<0.05) were determined. In conclusion, the significant effects of environmental variables must be taken into consideration when developing and comparing models to be used in adjusting data to provide the best estimates of genetic values and parameters in evaluation of SRW cattle reared organically in Turkey.

Key words: Swedish Red and White, milk yield, lactation length, days open, age at first calving, gestation length, organic dairy farming.

Introduction

Number of organic dairy farms in Turkey has been increased in recent years since Turkish consumers demand high quality and safe milk that is produced with minimal environmental losses, under optimal conditions for animal welfare and health [1]. In this country, exotic cattle breeds (Holstein Friesian, Brown Swiss, Jersey and Simmental) and their crosses with native breeds have been raised in organic and conventional dairy farms for a long time. Swedish Red and White (SRW) is a most recent cattle breed imported from Sweden to Turkey in order to improve the milk production.

Diversities in milk and reproductive performance of the dairy cattle depend on genetic and several environmental factors. In order to maximize the level of the production, it is required to optimize the environmental conditions as well as to improve the genetic structure of the cattle [2]. Environmental factors could be classified as factors with measurable effects such as parity, calving year, age of dam, calving season, stage of lactation etc., and factors with non-measurable effects, for example infectious diseases, parasitic infestations etc. The measurable effects determined can be useful in formulating the future breeding programs [3]. In these programs, performance records of animals should be adjusted for the environmental sources of variation in order to reduce known environmental differences between animals. As a consequence of that, genetic differences among animals can be recognized and used for effective breeding plans for improvement [4].

There is no available information about non-genetic factors affecting milk and reproductive traits of SRW raised under organic dairy farming conditions in Turkey. Therefore, the study was undertaken to reveal milk and reproductive performances of SRW cattle, and to investigate the environmental factors that have influence on the milk yield and reproductive traits, and to evaluate associations among milk and fertility traits of the breed.

Materials and Methods

Description of the research herd: The data on milk yield and reproductive traits of SRW cows was obtained from a private organic dairy farm located in Kelkit county of Gumushane Province at Eastern Black Sea Region of Turkey. The performance records were kept in this farm during the period from 2006 through 2009. The SWR herd was first established by 350 female animals imported from Sweden. Before they were brought to Turkey, the animals were raised extensively in pastures of Southern Sweden. Ages of the cattle imported from Sweden ranged from 5 to 15 months old.

The SRW cattle herd under study was kept in a farm whose altitude from sea level was about 1400 m. The climate in this region is relatively dry and rains usually occur during spring and autumn seasons. During winter months, it snows a lot and the night temperature may fall up to -10°C. In this farm, practices of organic

dairy farming are based on a combination of general principles and detailed rules of organic milk production as indicated in the Organic Farming Law [5]. Dry meadow hay and dry alfalfa hay and corn silage are used as sources of roughage in the diets of the animals. All feeds offered to the cows were grown organically in this region. Lactating cows were fed daily 6 kg/head concentrate, 20 kg/head dry meadow hay and dry alfalfa hay and 10 kg/head corn silage.

Heifers and cows in the organic dairy farm were artificially inseminated by semen of SWR bulls throughout a year. While the calves were housed in calf hutches for 6 months, adult animals were kept in a free stall barn.

After SRW cows were milked three times in a day during 3 weeks of the postpartum, they were milked twice a day until the end of the lactation period. Daily milk yield was recorded by a computerized milking system that can recognize each cow by using transponders carried by each cow. Actual lactation milk yield, peak daily milk yield, days to attain peak milk yield and lactation length were determined from the daily milk records.

Statistical analysis: The data were analyzed by the least squares techniques by using SPSS statistics software program [6]. No interaction effect was included in the statistical model, since their effects were found as insignificant in preliminary statistical analysis. The following different mathematical models were designed to determine the effects of factors such as parity, calving year, calving season, age of dam and sex of calf on the milk yield and reproductive traits:

$Y_{ijkn} = \mu + a_i + b_j + c_k + e_{ijkn}$ …… for analysis of actual lactation milk yield, daily milk yield, 305 days lactation milk yields, peak daily milk yield and days to attain peak milk yield),

$Y_{ijn} = \mu + a_i + b_j + e_{ijn}$ ….. for analysis of age at first calving,

$Y_{ilmn} = \mu + a_i + d_l + f_m + e_{ilmn}$ ….. for analysis of gestation length,

$Y_{ijln} = \mu + a_i + b_j + d_l + e_{ijln}$ ….. for analysis of days open,

$Y_{ijlmn} = \mu + a_i + b_j + d_l + f_m + e_{ijlmn}$ ….. for analysis of calving interval

where Y_{ijkn} = actual lactation milk yield, daily milk yield, 305 days lactation milk yields, peak daily milk yield and days to attain peak milk yield, Y_{ijn} = age at first calving, Y_{ilmn} = gestation length, Y_{ijln} = days open, Y_{ijklm} = calving interval.

μ = Overall mean

a_i : Effect of calving year (i: 2006, 2007, 2008).

b_j: Effect of calving season (j: winter, spring, summer, fall).

c_k: Effect of parity (k: 1, 2).

d_l: Effect of age of dam (l: ≤45, 45.1-47.0, 47.1-49.0, 49.1-51.0, ≥51.1 months).

f_m: Effect of sex of calf (m: male, female).

e : Random error.

Comparisons among subclass means were carried out by the method of Duncan's multiple-range test, and phenotypic correlations between milk yield and fertility traits were estimated by SPSS software program [6].

Results

Least square means and results from Duncan's multiple range test for milk production traits are presented in Tables 1and 2. The effects of the calving year on the actual lactation milk yield and lactation length were significant (P<0.01). However, the calving year did not have a significant effect on the daily milk yield (Table 1). While the calving year did not have significant effect on the peak daily milk yield, days to attain peak milk yield were influenced significantly (P<0.01) by the calving year (Table 2). Effects of the calving season on the actual lactation milk yield, lactation length (P<0.01), peak daily milk yield and days to attain peak milk yield (P<0.05) were significant. On the other hand, daily milk yield was not significantly affected by the calving season. Parity had significant (P<0.01) effect on the daily milk yield, peak daily milk yield and days to attain peak milk yield (Tables 1 and 2).

Gestation length was significantly influenced by the sex of calf (P<0.05). However, effects of the age of dam and the calving year on the gestation length were not significant (Table 3). While the calving year (P<0.01) and calving season (P<0.05) affected significantly on the calving interval of SRW cows, the sex of calf and the age of dam did not have significant influence on the trait.

While the effect of the calving year on the days open was not significant, the calving season and age of dam had significant (P<0.01) influence on the trait (Table 4). Age at first calving was only influenced significantly (P<0.01) by the calving year. However, the effect of the calving season was not significant.

Phenotypic correlations between milk and fertility traits are also presented in Table 5. The phenotypic correlations of the actual lactation milk yield with daily milk yield, peak milk yield lactation length, days open, calving interval (P<0.01) and days attain to peak milk yield (P<0.05) were statistically significant. Positive correlations of calving interval with daily milk yield, days attain to peak milk yield (P<0.05), lactation length and days open (P<0.01) are also given in Table 5.

Discussion

The average lactation milk yield (5887.2 ± 94.9 kg) of SRW cows raised under the environmental conditions of the Eastern Black Sea Region of Turkey is lower than earlier results [7, 8] on milk yields 8427 kg and 8730 kg of SRW in Sweden, respectively. However, average lactation length determined in the present study (302.5±3.21 days) is in accordance with findings of Rehn *et al*. [9] who reported 303±9 days for lactation length of SRW cows. Least squares means for actual lactation milk yield, daily milk yield, lactation length and days to attain peak milk yield revealed that there were much fluctuations but no specific trends in different years. On the other hand, the peak daily milk yield was stable during the years 2006 through 2008. Maximum and minimum actual lactation milk yield and lactation length were in the year 2007 and 2008, respectively. The results of analysis of variance for all milk production traits, excluding daily milk yield and peak daily milk yield, demonstrated that variability due to the calving year was significant. The results are in conformity with those of Ugur *et al*.[10] and Yanar *et al*. [11] who reported similar findings in Simmental and Brown Swiss breeds of cattle raised in this same area, respectively. The variation in milk yield observed in different years reflected the level of management as well as environmental effects. The level of management varies according to the ability of the farm manager, his efficiency in the supervision of the labour, system of crop husbandry, method and intensity of culling and use of financial resources. The differences in milk production also could be due to different nutritional qualities of the feed resources offered to the cows in different years.

Table 1. Least squares means for actual lactation milk yield, daily milk yield and lactation length.

Trait effect	N	Actual lactation milk yield (kg) Mean ± SE[1]	Daily milk yield (kg) Mean ± SE	Lactation length (days) Mean ± SE
Overall mean	400	5887.2 ± 94.9	19.9 ± 0.3	302.5 ± 3.2
Calving year		**	NS[2]	**
2006	85	6286.8 ± 257.3^{a}	19.6 ± 0.7	328.3 ± 8.7^{a}
2007	181	6326.1 ± 135.8^{a}	19.3 ± 0.4	330.2 ± 4.6^{a}
2008	134	5048.5 ± 227.7^{b}	20.8 ± 0.6	248.8 ± 7.7^{b}
Calving season		**	NS	**
Winter	135	6270.4 ± 151.2^{a}	19.5 ± 0.4	321.4 ± 5.1^{b}
Spring	108	6020.9 ± 201.9^{b}	20.6 ± 0.5	300.3 ± 6.8^{c}
Summer	86	5214.7 ± 190.5^{b}	20.6 ± 0.5	263.3 ± 6.4^{d}
Autumn	71	6042.6 ± 223.9^{ab}	18.9 ± 0.6	324.9 ± 7.6^{a}
Parity		NS	**	NS
1	207	5631.1 ± 160.2	18.8 ± 0.4	305.5 ± 5.4
2	193	6143.2 ± 184.4	20.9 ± 0.5	299.5 ± 6.2

[1]Mean ± SE = Least squares means ± Standard Error of Mean, [2]NS = Non-significant, ** P<0.01, ^{a,b} = Least squares means with different superscripts within a column and within a group are statistically different.

Table 2. Least squares means for peak daily milk yield and days to attain peak milk yield.

Trait effect	N	Peak daily milk yield (kg) Mean ± SE	Days to attain peak milk yield (kg) Mean ± SE
Overall mean	400	31.5 ± 0.3	79.4 ± 2.7
Calving year		NS	**
2006	85	31.1 ± 0.8	85.9 ± 7.3^{b}
2007	181	31.8 ± 0.4	62.5 ± 3.8^{b}
2008	134	31.7 ± 0.7	89.6 ± 6.4^{a}
Calving season		*	*
Winter	135	31.8 ± 0.5^{ab}	78.4 ± 4.3^{ab}
Spring	108	32.9 ± 0.6^{a}	68.4 ± 5.7^{b}
Summer	86	30.4 ± 0.6^{b}	77.2 ± 5.4^{b}
Autumn	71	31.1 ± 0.7^{b}	93.4 ± 6.3^{a}
Parity		**	**
1	207	29.4 ± 0.5	92.2 ± 4.52
2	193	33.7 ± 0.6	66.5 ± 5.20

[1] Mean ± SE = Least squares means ± standard error, [2] NS = Non-significant, * P<0.05, ** P<0.01, ^{a,b} = Least squares means with different superscripts within a column and within a group are statistically different.

Table 3. Least squares means for calving interval and gestation length.

Trait effect	N	Calving interval (days) Mean ± SE	Trait effect	N	Gestation length (days) Mean ± SE
Overall mean	235	380.2 ± 4.3	Overall mean	232	275.4 ± 0.6
Age of dam (months)		NS	*Age of dam (months)*		NS
≤ 45	31	377.8 ± 10.9	≤ 45	32	274.7 ± 1.6
45.1-47.0	34	386.2 ± 9.6	45.1-47.0	35	273.8 ± 1.4
47.1-49.0	46	379.7 ± 8.7	47.1-49.0	48	276.5 ± 1.2
49.1-51.0	55	375.5 ± 7.7	49.1-51.0	59	276.0 ± 1.1
≥ 51.1	59	381.7 ± 7.4	≥ 51.1	58	276.1 ± 1.1
Calving year		**	*Calving year*		NS
2006	72	395.1 ± 7.4	2007	62	275.4 ± 1.1
2007	153	365.3 ± 4.6	2008	170	275.4 ± 0.6
Sex of calf		NS	*Sex of calf*		*
Male	113	373.5 ± 5.6	Male	115	276.5 ± 0.8
Female	112	386.8 ± 5.8	Female	117	274.3 ± 0.8
Calving season		*			
Winter	64	367.7 ± 7.4^{b}			
Spring	59	401.1 ± 8.4^{a}			
Summer	47	378.3 ± 8.7^{b}			
Autumn	55	373.6 ± 7.9^{b}			

[1] Mean ± SE= Least squares means ± standard error, [2]NS = Non-significant, * P<0.05, ** P<0.01, ^{a,b} = Least squares means with different superscripts within a column and within a group are statistically different.

Table 4. Least squares means for days open and age at first calving.

Trait effect	Days open N	Days open Mean ±SE	Trait effect	Age at first calving (months) N	Age at first calving (months) Mean ± SE
Overall mean	399	114.7 ± 3.6	Overall mean	199	26.4 ± 0.2
Age of dam (months)		**	*Calving year*		**
≤ 45	66	104.1 ± 8.7^{b}	2006	90	24.9 ± 0.3
45.1-47.0	67	111.8 ± 8.3^{b}	2007	109	27.8 ± 0.3
47.1-49.0	87	137.1 ± 7.3^{a}	*Calving season*		NS
49.1-51.0	90	101.1 ± 7.1^{b}	Winter	60	26.3 ± 0.4
≥ 51.1	89	119.3 ± 7.1^{ab}	Spring	65	25.9 ± 0.4
Calving year		NS	Summer	37	26.3 ± 0.5
2006	84	114.2 ± 7.7	Autumn	37	26.6 ± 0.5
2007	181	110.2 ± 4.9			
2008	134	119.6 ± 6.2			
Calving season		**			
Winter	134	98.8 ± 6.0^{b}			
Spring	108	120.2 ± 6.9^{ab}			
Summer	86	107.7 ± 7.2^{b}			
Autumn	71	131.9 ± 8.3^{a}			

[1] Mean ± SE = Least squares means ± standard error, [2] NS = Non-significant, * P<0.05, ** P<0.01, ^{a,b} = Least squares means with different superscripts within a column and within a group are statistically different.

Table 5. The phenotypic correlations between reproductive and milk traits of SRW cows.

	Actual lactation milk yield	Daily milk yield	Peak milk yield	Days attain to peak milk yield	Lactation length	Age at first calving	Gestation length	Days open
Daily milk yield	0.71 **							
Peak milk yield	0.53 **	0.51 **						
Days attain to peak milk yield	0.14 *	0.06	0.04					
Lactation length	0.53 **	-0.21 **	0.09	0.14 *				
Age at first calving	0.09	0.06	0.15 *	-0.12	0.03			
Gestation length	-0.09	-0.11	-0.27 **	0.12	0.02	0.03		
Days open	0.43 **	0.11	0.04	0.11	0.77 **	-0.03	-0.02	
Calving interval	0.36 **	-0.16*	-0.04	0.14 *	0.76 **	-0.03	0.09	0.89 **

* = P<0.05, ** = P<0.01.

Actual lactation milk yield and daily milk yield of cows in the second parity group were higher than those of SRW cattle in the first parity (Table 1). Similar results were reported by Rehn *et al.* [9] who revealed that the actual lactation milk yields of the multiparous SRW cows in Sweden were greater than these for primiparous cows. Milk production of SRW cows reared organically increased with lactation number. This could be a result of the increasing development and size of the udder and the increasing body size over that of the first lactation animal. Rehn *et al.* [9] also reported longer (327±42 days) lactation length in primiparous SRW cows compared to multiparous cows (294±33 days) as indicated in the present study.

Variability due to the calving season was significant (P<0.01) for the actual lactation milk yield. The results are in conformity with those of the Murdia and Tripathi [12] , Javed *et al.* [3] and Bayram *et al.* [1], who reported similar findings in Jersey (India) and Holstein Friesian (Pakistan and Turkey), respectively. The actual lactation milk yield of the SRW cows calved in winter was highest as already reported by Cilek and Tekin [2] and Rhone *et al.* [13]. The result could be attributed to the fact that when milk production of the SRW cows calved in winter season begin to decline at about 3-4 months of the lactation, they were subjected to better environmental conditions of spring season which may help the animals to keep their milk yield constant with higher persistency.

Average peak daily milk yield in second parity was 4.3 kg greater than that in first parity. Conversely, days to attain peak milk yield decreased in second lactation (Table 2). The result is in agreement with finding of Guler and Yanar [14] who indicate that the days to reach peak milk yield decreases with advancing parity.

The average calving interval of SRW cattle raised under organic dairy farming conditions in Turkey was determined as 380.2±4.3 days in the present study (Table 3). The least squares mean value was lower than findings of Lindhe [7] and Anonymous [8] who reported average calving intervals for the SRW breed as 13 and 13.1 months in Sweden, respectively. The calving interval varied significantly among calving years (P<0.01) and calving season (P<0.05). Maximum calving interval was 401.1±8.4 days for the cows calving in the winter season and minimum calving interval was 373.6±7.9 days for those calving in autumn. The calving season and calving year had significant effect on the trait. The result is in accordance with findings of Ozbeyaz *et al.* [15] and Yanar *et al.* [16].

The gestation length of the SRW cows averaged 275.4±0.6 days. Similarly, Kornmatitsuk *et al.* [17] also observed that the gestation period in SRW varied from 261 to 281 days. The gestation length was significantly influenced by the sex of calf, and cows calving male calves had 2.2 days longer gestation length than these calving female calves. The result is in agreement with finding of Tilki *et al.* [18] who reported that dams of the male calves had average 2.9 days longer gestation length than these of female calves.

The average days open of SRW cattle raised organically was 114.7±3.6 days in the present study. The average value was lower than findings of Kolmodin *et al.* [19] who reported average days open for the SRW cows in Sweden as 117.9±55.0 days. While the lowest means for days open were observed from cows calving in winter (98.8±6.0 days), the days open of the cows calving in autumn had maximum average value (131.9±8.3 days).

The overall means for age at first calving (26.4 months) for SRW cows in Turkey was lower than finding of Lindhe [7] who reported average 29.4 months for the same trait in Sweden. The result suggested that age at first calving of SRW cows kept in the organic dairy farm is within normal range for the breed.

Positive and significant (P<0.01) phenotypic associations of the actual lactation milk yield with days open and calving interval revealed that SRW cows with good fertility had lower milk yields on average than animals with poor fertility. The result was in agreement with findings of Oltenacu *et al.* [20], Windig *et al.* [21] and Quintero and Gil [22] who reported antagonistic associations between fertility and milk production traits. In the present study, calving interval and days open were positively (P<0.01) correlated with lactation length, indicating that animals with increasing days open and calving interval will have high lactation length. However, amount of milk and number of calves that cow gives during its life decrease. The result is in conformity with findings of Banerjee and Banerjee [23].

The phenotypic correlations between age at first calving and actual lactation milk yield (r = 0.09), daily milk yield (r = 0.06) and peak milk yield (r = 0.15) in the present study was in accordance with results of Moore *et al.* [24] and Pirlo *et al.* [25] who reported positive effects of delayed age at first calving on milk yield.

As previously reported by Ozcelik and Dogan [26] and Cilek and Tekin [27], phenotypic association between lactation milk yield and lactation length was positive and significant (P<0.01). The phenotypic correlation between lactation milk yield and peak milk yield for SRW cows raised in the organic dairy farm conditions was also positive and significant (P<0.01). Similar result was already observed by Yuksel and Yanar [28].

Conclusions

Significant effects of non-genetic factors including parity, age of dam, calving season, calving year and sex of calf on the milk and reproductive traits of SRW cows raised organically in Turkey was reveal in the present study. Therefore, the effects of environmental variables must be taken into consideration when developing and

comparing models to be used in adjusting data to provide the best estimates of genetic values and parameters in evaluation of SRW cattle reared organically in Turkey.

References

[1]Bayram, B., Yanar, M. and Akbulut, O. 2008. Reproductive and milk production traits of Holstein Friesian cows in pre-organic and organic dairy husbandry in Turkey. J. Anim. Vet. Adv. **7**:808-811.

[2]Cilek, S. and Tekin, M. E. 2005. Environmental factors affecting milk yield and fertility traits of Simmental cows raised at the Kazova State Farm and phenotypic correlations between these traits. Turk. J. Vet. Anim. Sci. **29**:987-993.

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

[4]Kanuka, K. and Makuza, S. M. 2005. Environmental factors affecting milk production in the Holstein Friesian population of Zimbabwe. Pak. J. Biol. Sci. **8**:989-994.

[5]Anonymous. 2005. Turkish Republic Official Gazette,10.06.2005, No. 25841.

[6]SPSS 2004. SPSS for Windows, Release 13.0.SPSS Inc. Chicago, IL, USA.

[7]Lindhe, B. 2004. Two competing Swedish Breeds with different profiles but of equal size. http//www.milkproduction.com/library/articles/Two_competing_Swedish_Breeds_with_ different_profiles_but_of_equal_size.htm.

[8]Anonymous 2008. Breed statistics Swedish Red. http// www.vikinggenetics.com/en/svavel/statistics.asp?ras=1.

[9]Rehn, H., Berglund, B., Emanuelson, U., Tengroth, G. and Philipsson, J. 2000. Milk production in Swedish dairy cows managed for calving intervals of 12 and 15 months. Acta. Agric. Scand. Sect. A. Animal Sci. **50**:263-271.

[10]Ugur, F., Yanar, M., Ozhan, M. and Tuzemen, N. 1994. The reproductive performance of Simmental cattle raised in Eastern Turkey. World Review of Animal Production **29**:58-63.

[11]Yanar, M., Tuzemen, N., Akbulut, O., Aydin, R. and Ugur, F. 1998. Milk and reproduction characteristics of Brown Swiss cattle raised in the farm of Agricultural College at Atatürk University. Proceedings of Eastern Anatolian Agricultural Congress, 14-18 September 1998, Erzurum, Türkiye, pp. 757-768.

[12]Murdia, C. K. and Tripathi, V. N. 1991. Factors affecting performance traits in Jersey cattle in India. Ind. Vet. J. **68**:1129-1142.

[13]Rhone, J. A., Koonawootrittriron, S. and Elzo, M. A. 2007. Factors affecting milk yield, milk fat, bacterial score, and bulk tank somatic cell count of dairy farms in the central region of Thailand. Trop. Anim. Health Pro. **40**:147-153.

[14]Guler, O. and Yanar, M. 2009. Factors influencing the shape of lactation curve and persistency of Holstein Friesian cows in high altitude of eastern Turkey. J. Appl. Anim. Res. **35**:39-44.

[15]Ozbeyaz, C., Kucuk, M. and Colakoglu, N. 1996. Fertility of Swiss Brown cattle at the Malya State Farm. J. Lalahan Livestock Res. Inst. **36**:1-17.

[16]Yanar, M., Tuzemen, N., Akbulut, O., Aydin, R. and Ugur, F. 1997. The reproductive performance of Brown Swiss cattle raised in Eastern Turkey. Ind. J. Dairy Sci. **50**:307-313.

[17]Kornmatitsuk, B., Franzen, G., Gustafsson, H. and Kindahl, H. 2003. Endocrine measurements and calving performance of Swedish Red and White and Swedish Holstein Dairy cattle with special respect to stillbirth. Acta. Vet. Scand. **44**:21-33

[18]Tilki, M., Tekin, M. E. and Colak, M. 2003. The estimation of phenotypic and genetic parameters for calf birth weight and gestation length of Brown Swiss cows reared at the Bahri Dagdas International Agricultural Research Institute. Turk J. Vet. Anim. Sci. **27**:1343-1348.

[19]Kolmodin, R., Strandberg, E., Dannell, B. and Jorjani, H. 2004. Reaction norms for protein yield and days open in Swedish Red and White Dairy cattle in relation to various environmental variables. Acta Agric. Scand. A. Anim. Sci. **54**:139-151.

[20]Oltenacu, P. A., Frick, A. and Lindhe, B. 1991. Relationship of fertility to milk yield in Swedish cattle. J. Dairy Sci. **74**:264-268.

[21]Windig, J. J., Calus, M. P. L. and Veerkamp, R. F. 2005. Influence of herd environment on health and fertility and their relationship with milk production. J. Dairy Sci. **88**:335-347.

[22]Quintero, G. P. and Gil, M. G. 2009. Genetic and environmental factors affecting productive performance in a Brown Swiss herd in the tropic. 2. Relationship between calving interval and milk yield. Revista Cientifica Facultad De Ciencias Veterinarias **19**:77-83.

[23]Banerjee, S. and Banerjee, S. 2002. Correlations between some reproduction and production traits in Holstein Friesian x Sahiwal crosbred cows. Ind. Vet. J. **79**:928-931.

[24]Moore, R. K., Kennedy, P. P. Schaeffer, L. R. and Moxley, J. E. 1991. Relationships between age and body weight at calving and production in first lactation Ayrshires and Holsteins. J. Dairy Sci. **74**:269-278.

[25]Pirlo, G., Miglior, F. and Speroni, M. 2000. Effect of age at first calving on production traits and on difference between milk yield returns and rearing costs in Italian Holsteins. J. Dairy Sci. **83**:603-608.

[26]Ozcelik, M. and Dogan, I. 1999. The genetic and phenotypic correlations between milk and reproductive traits in Holstein cows. Turk. J. Vet. Anim. Sci. **23**:249-255 (Sup. 2).

[27]Cilek, S. and Tekin, M. E. 2007. Environmental factors affecting milk yield traits of Brown Swiss cows raised at Ulas State Farm and phenotypic correlations between milk yield and fertility traits. Ind. J. Anim. Sci. **77**:154-157.

[28]Yuksel, S. and Yanar, M. 2009. Determination with different mathematical models of lactation curve parameters of Brown Swiss cows and the effects of some environmental factors on these parameters. J. Lalahan Livestock Res. Inst. **49**:17-26.