Bulgarian Journal of Agricultural Science, 19 (No 5) 2013, 1126-1129
Agricultural Academy

EFFECT OF AGE AT FIRST CALVING ON FIRST LACTATION MILK YIELD, LIFETIME MILK YIELD AND LIFETIME IN TURKISH HOLSTEINS OF THE MEDITERRANEAN REGION IN TURKEY

B. TEKE[1]* and H. MURAT[2]
[1] *Ondokuz Mayis University of Veterinary Medicine, Department of Animal Science, 55210 Atakum, Samsun, Turkey*
[2]*Cattle Breeders' Association of Turkey, Ankara, Turkey*

Abstract

TEKE, B. and H. MURAT, 2013. Effect of age at first calving on first lactation milk yield, lifetime milk yield and lifetime in Turkish Holsteins of the Mediterranean region in Turkey. *Bulg. J. Agric. Sci.,* 19: 1126-1129

The aim of this study was to determine the effect of age at first calving on first lactation milk yield, lifetime milk yield and lifetime and to determine optimal age at first calving in order to get the highest milk yield in Turkish Holsteins in the Mediterranean Region in Turkey. Data were provided by the Cattle Breeders' Association of Turkey' and included milk yield of Turkish Holstein heifers between 1997 and 2011. A total of 11 097 records of 305 day lactations were analysed according a fixed model, using PROC GLM. In current study, mean first lactation milk yield, age at first calving, lifetime milk yield and lifetime was 5541 kg, 29.81 mo, 9820 kg and 50.63 mo, respectively. The effect of AFC on lifetime milk yield and lifetime were significant ($P<0.05$) while the effect of AFC on first lactation milk yield was not significant ($P>0.05$). In conclusion, the determined optimum age at first calving was 23 month for the maximum first lactation milk yield and maximum lifetime milk yield.

Key words: Age at first calving, first lactation milk yield, Holstein, lifetime, lifetime milk yield

Introduction

There are many factors affecting profitability in dairy production one of the most important factors is longevity. Increased longevity reduces the direct costs of raising or replacement increases total profit (Setati et al., 2004). Age at first calving (AFC), calving intervals, length of each lactation and success in surviving to another lactation are effective on longevity (Van-Raden and Klaaskate, 1993; Gröhn and Rajala-Schultz, 2000).

An important factor in the cost of raising dairy replacements is AFC in these factors. The advantages of reduced AFC were lower overhead costs, decreased feed costs, and increased production per day of herd life (Lin et al., 1988; Goodger et al., 1989). However, there are negative effects of lower and higher values of AFC (than optimum AFC) on longevity and some milk yield characteristics (Thompson et al., 1983; Simerl et al., 1992). Nilforooshan and Edriss (2004) stated that it was helpful to their milk yield for heifers to calve at less than two years of age. However, Ettema and Santos (2004) found that AFC at less than 23 mo reduced first lactation milk yields. Hoffman (1997) noticed AFC between 22 and 24 mo is optimal to attain sufficient milk yield in first lactation. Strandberg (1992) found that lifetime milk yield increased slightly when AFC increased up to 30 month.

The Mediterranean Region is one of Turkey's seven geographical regions and takes place in the south of Turkey. The Mediterranean Region has a Mediterranean climate at the coast, with hot, dry summers and mild to cool, wet winters. Mediterranean region is one of the growing areas in Turkey intensive Holstein heifers (Alpan and Arpacik, 1996; Anonymous, 2012).

The purpose of this study was to determine the effect of AFC on first lactation milk yield, lifetime milk yield and lifetime and to obtain the highest yield to identify optimum AFC in Turkish Holsteins in the Mediterranean Region in Turkey.

Materials and Methods

Data were provided by the Cattle Breeders' Association of Turkey' and included milk yield of Turkish Holstein-Friesian

*Corresponding author: bulentteke@gmail.com

heifers between 1997 and 2011 in eight provinces (Adana, Antalya, Burdur, Hatay, Isparta, Kahramanmaraþ, Mersin Osmaniye) in Mediterranean Region. Heifers that calved before 19 month of age and after 45 month of age were discarded in data sets. A total of 11 097 records of 305-d lactations were analysed according to the following fixed model, using PROC GLM in SAS (SAS, 2008).

$Y= X\hat{a} + {}^{a}$ ordinary fixed model using to AFC,

where Y: observations of lifetime (day), lifetime milk yield (kg) and 305 days first lactation milk yield (kg), X: Incidence matrix of AFC, Â: vector of unknown effects of AFC, ^{a}: e_{ijk} ~ MNID, individual random errors.

Investigating effects of traits (lifetime, lifetime milk yield, first lactation milk yield) on environmental factors such as AFC, calving seasons and continuous environmental effect of calving year were analysed by the following mixed effect model:

$Y= X\hat{a} + Zu + {}^{a}$;

where, X, Z: Incidence matrices for fixed effects (AFC and calving season) and continuous effects such as calving year, respectively.

Â, u: vectors of the unknown factors, for fixed and continuous environmental effects, respectively; u_{ij} ~ MNID.

Besides, trends of the year effects were analysed by correlation coefficients and ordinary regression analyses.

Results and Discussion

The effect of AFC values on milk yield and longevity traits of Holstein heifers are given in Table 1. The effect of AFC on first lactation milk yield was not significant (P>0.05), while on lifetime was significant. In current study, the mean first lactation milk yield, AFC, lifetime and lifetime milk yield were 5541 kg, 29.81 mo, 50.63 mo 9820 kg, respectively. Mean age at first calving of this population (29.81 mo) was greater than the estimated mean of 25.9 mo in the United States (Heinrichs et al., 1994), and the guess of 26 mo in Italy (Pirlo, 1997), and the guess of 26.84 mo in Iranian (Nilforooshan and Edriss, 2004), and the guess of 27.13 mo in Croatia (Raguz et al., 2011), and the estimated mean of 28.6 mo in Spain (Perez et al., 1999) while it was lower than the mean of 32.4 mo in Turkey (Bayram et al., 2009). On the other hand, the average first lactation milk yield and lifetime values in the study of Nilforooshan and Edriss (2004) (6428 kg, 57.20 month) and in the study of Raguz et al. (2011) (5814 and 12571 kg) were higher than the mean first lactation milk yield and lifetime values in current study.

Mean AFC values for Holstein heifers between the years 1997-2011 are given in Figure 1. The effect of calving year on AFC was significant (P<0.001). Mean age at first calving declined from 31.15 month in 1997 to 28.21 month in 2011 in present study. Mean AFC decreased over the 14-years period (per year 0.21 month/year).

The relationship between the first lactation milk yield and AFC of Holstein heifers are given Table 2. In current study, 929 kg less milk were obtained from 19- month heifers than 27 mo heifers in terms of first lactation milk. This difference was lower than the difference (1052 kg) of the study of Gardner et al (1977) in terms of the same AFC values. In present study, first lactation milk yield increased from 19 month (4611 kg) to 23 month (5511 kg). Nilforooshan and Edriss (2004) informed that first lactation milk yield increased from

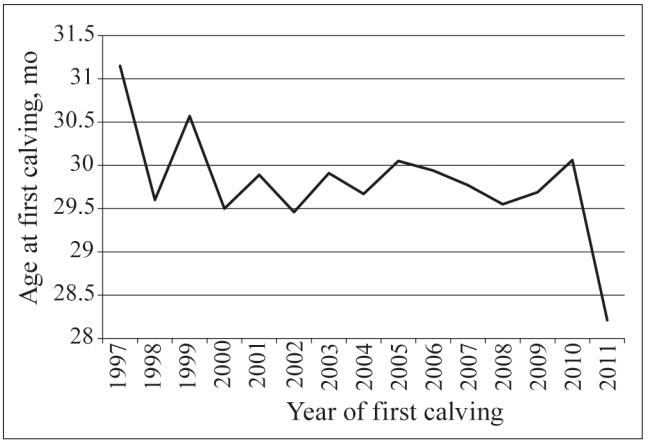

Fig. 1. Trend in age at first calving by year of first calving

Table 1
The effect of AFC on some milk yield and longevity traits

Traits	N	Minimum	Maximum	Mean	SD	P Value
First lactation milk yield, kg	11097	1072.00	11420.00	5541.00	1202.00	ns
AFC, mo	11097	19.00	45.00	29.81	5.17	
Lifetime milk yield, kg	11097	1072.00	53892.00	9820.00	6480.00	*
Lifetime, mo	11097	26.73	135.00	50.63	14.73	***

^{ns} P>0.05; * P< 0.05; *** P< 0.001

Table 2
Phenotypic correlations among the traits

	Calving year	First lactation milk yield	Lifetime milk yield	AFC	Lifetime
Calving year	1.00	0.12***	-0.19***	-0.01	-0.21***
First lactation milk yield		1.00	0.12***	0.01	-0.11***
Lifetime milk yield			1.00	-0.02	0.87***
AFC				1.00	0.32***
Lifetime					1.00

*** Correlation is significant at the 0.001 level

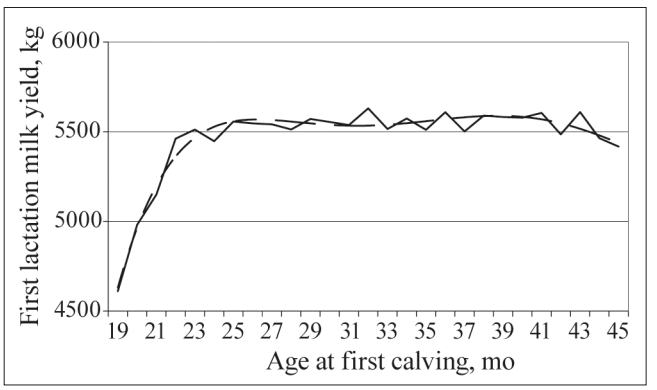

Fig. 2. The relationship between AFC and the first lactation milk yield

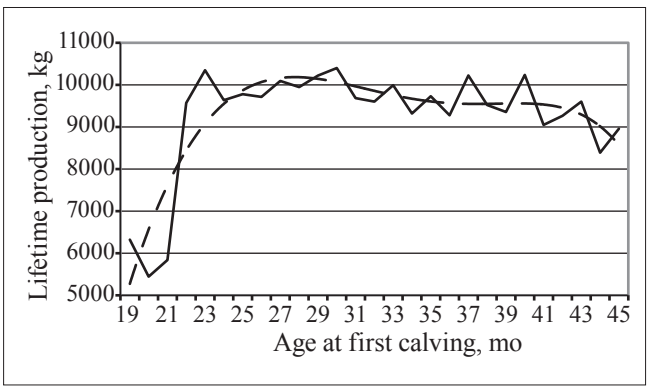

Fig. 3. The relationship between AFC and the lifetime production

21 month (5500 kg) to 24 month (7000 kg). This result is almost similar to our study. In current study, the increase in AFC related with the increase in first lactation milk yield can be explained by the development of the mammary glands Insufficient development of heifers may be the reason of negative effect of early calving on milk yield in present study.

Milk yield is related to the development of the mammary glands, most of which happen before first calving. Therefore, a lower AFC can affect milk yield in the first lactation due to the insufficient development of mammary tissue (Serjsen, 2005).

The maximum first lactation milk yield was obtained in current study, when the AFC value was 23 mon th. The researchers reported that the optimum AFC value must be 22-24.5 month to get the highest first lactation milk yield. (Thompson et al., 1983; Simerl et al., 1992; Hoffman, 1997; Ettema and Santos, 2004; Nilforooshan and Edriss, 2004). Our result is similar to these values while less than the results (24-30 month) in the study of Haworth et al. (2008). This may be due to different genetic structure, climatic, and breeding conditions.

In this study, the highest lifetime milk production was obtained, when the AFC was 23 month. Our result was almost similar with the result of Nilforooshan and Edriss (2004), but was lower than the result (30 month) of Strandberg (1992). Phenotypic correlations among the traits are given in Table 2. There was a slight positive correlation between the AFC and First lactation milk yield in present study ($r = 0.01$; $P>0.05$). The correlation result was lower than the correlation results in the study of Lee (1976), Moore et al. (1991), Pirlo et al. (2000). In their study, they reported a positive effect of increasing age at first calving on milk yield. Nilforooshan and Edriss (2004) and Bewley et al. (2001) reported a negative effect of increasing age at first calving on milk yield in their study and our results were not similar to the results of their studies.

In present study, the highest phenotypic correlation relationship was between lifetime and lifetime milk yield ($r = 0.87$; $P<0.001$). As for relationships between AFC and lifetime, there was moderate positive correlation ($r = 0.32$; $P<0.001$). This result was further than the result of Nilforooshan and Edriss' study (2004) ($r = 0.052$), but not similar to the result of Gill and Allaire's study (1976) ($r = - 0.15$).

Conclusion

Age at first calving can affect lifetime milk yield, lifetime, and productive life. Reducing age at first calving is an ef-

fective method for dairy farmers to decrease payments and reducing age at first calving allow an earlier return on investment. However, there are negative effects of lower and higher values of age at first calving than optimum age at first calving on longevity and some milk yield characteristics. In present study, the effect of AFC on the lifetime milk yield was significant. Overall results suggested that the optimum AFC value for the maximum lifetime milk yield was 23 month.

Acknowledgements

The authors would like to thank to Cattle Breeders' Association of Turkey.

References

Alpan, O. and R. Arpacik, 1996. SýgýrYetiþtiriciliði. Ankara, Þahin Matbaasý, pp. 26.

Anonymous, 2012. .Mediterranean Region. Retrieved 12 August 2012 from:
http://en.wikipedia.org/wiki/Mediterranean Region, Turkey.

Bayram, B., M. Yanar and O. Akbulut, 2009. The effect of average daily gain and age at first calving on reproductive and milk production traits of Brown Swiss and Holstein Friesian cattle. *Bulgarian Journal of Agricultural Science,* **15:** 453-462.

Bewley, J., R. W. Palmer and D. B. Jackson-Smith, 2001. Modeling milk production and labor efficiency in modernized Wisconsin dairy herds. *Journal of Dairy Science,* **84:** 705–716.

Ettema, J. F. and J. E. Santos, 2004. Impact of age at first calving on lactation, reproduction, health and income in first-parity Holsteins on commercial farms. *Journal of Dairy Science,* **87:** 2730-2742

Gardner, R. W., J. D. Schuh and L. G. Vargus, 1977. Accelerated growth and early breeding of Holsteinheifers. *Journal of Dairy Science,* **60**: 1941-1948.

Gill, G. S. and F. R. Allaire, 1976. Relationship of age at first calving, days open, days dry, and herd life to a profit function for dairy cattle. *Journal of Dairy Science,* **59:** 1131-1139.

Goodger, W. J., J. Fetrow, G. M. Ferguson, H. F. Trout and R. McCabe, 1989. A computer spreadsheet program to estimate the cost of raising dairy replacements. *Preventive Veterinary Medicine,* **7:** 239-254.

Gröhn, Y. T. and P. J. Rajala-Schultz, 2000. Epidemiology of reproductive performance in dairy cows. *Animal Reproduction Science,* **60–61:** 605-614.

Haworth, G. M., W. P. Tranter, J. N. Chuck, Z. Cheng and D. C. Wathes, 2008. Relationships between age at first calving and first lactation milk yield, and lifetime productivity and longevity in dairy cows. *Veterinary Record,* **162:** 643-647.

Heinrichs, A. J., S. J. Wells, H. S. Hurd, G. W. Hill and D. A. Dargatz, 1994. The National Dairy Heifer Evaluation Project: a profile of heifer management practices in the United States. *Journal of Dairy Science,* **77:** 1548-1555.

Hoffman, P. C., 1997. Optimum body size of Holstein replacement heifers.*Journal of Animal Science,* **75:** 836-845.

Lee, A. J., 1976. Relationship between milk yield and age at first calving in first lactation. *Journal of Dairy Science,* **59:** 1794-1801.

Lin, C. Y., A. J. McAllister, T. R. Batra, A. J. Lee, G. L. Roy, J. A. Vesely, J. M. Wauthy and K. A. Winter, 1988. Effects of early and late breeding heifers on multiple lactation performance of dairy cows. *Journal of Dairy Science,* **71:** 2643-2735.

Moore, R. K., B. W. Kennedy, L. R. Schaeffer and J. E. Moxley, 1991. Relationships between age and body weight at calving and production in first lactation Ayrshires and Holsteins. *Journal of Dairy Science,* **74:** 269-278.

Nilforooshan M. A. and M. A. Edriss, 2004. Effect of Age at First Calving on Some Productive and Longevity Traits in Iranian Holsteins of the Isfahan Province. *Journal of Dairy Science,* **87:** 2130-2135.

Perez, M. A., D. Hernandez, R. Alenda, M. J. Carabano and N. Charfeddine, 1999. Genetic analysis of true profit for Spanish dairy cattle. www.interbull.slu.se/bulletins/bulletin23/ perez.pdf.

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

Raguz, N., S. Jovanovac, V. Gantner, G. Meszaros and J. Solkner, 2011. Analysis of factors affecting the length of productive life in Croatian dairy cows. *Bulgarian Journal of Agricultural Science,***17:** 232-240.

SAS, 2008.SAS ver. 9.1.3, SAS Campus Drive Cary, NC 27513 USA.

Serjsen, K., 2005. Mammary development. In Calf and Heifer Rearing: Principles of Rearing the Modern Dairy Heifer from Calf to Calving. First edn. Ed P. C. Garnsworthy. *Nottingham University Press*, pp 237-251.

Setati, M. M., D. Norris, C. B. Banga and K. Beyni, 2004. Relationships between longevity and linear type traits in Holstein cattle population of Southern Africa. *Tropical Animal Health and Production,* **36:** 807-814.

Simerl, N. A., C. J. Wilcox and W. W. Thatcher, 1992.Postpartum performance of dairy heifers freshening at young ages. *Journal of Dairy Science,* **75:** 590-595.

Strandberg, E., 1992. Lifetime performance in dairy cattle. *Acta Agriculturae Scandinavica,* **42:** 71-81.

Thompson, J. R., E. J. Pollak and P. L. Pelissier, 1983. Interrelationships of parturition problems, production of subsequent lactation, reproduction, and age at first calving. *Journal of Dairy Science,* **66:** 1119-1127.

VanRaden, P. M. and E. J. H. Klaaskate, 1993. Genetic evaluation of length of productive life including predicted longevity of live cows. *Journal of Dairy Science,* **76:** 2758-2764.

Received accepted for printing September, 2, 2013.