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Determination of the Effective Factors for 305 Days Milk Yield by Regression Tree (RT) Method

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Abstract: The purpose of this study was to determine the effects of dry period, lactation parity, farm, calving season and age on 305 days milk yield using Regression Tree (RT) method. For this purpose 3315 data of 735 Holstein-Friesian raised in Ceylanpinar, Reyhanli and Tahirova State Farms were analyzed. Dry period-lactation parity and farm-calving season and calving age were determined to affect 305 days milk yield at the first, second and third degree factors, respectively. The 305 days milk yield was affected by dry period, calving age and season and being of the dry period around ideal period (60 days) affected milk yield positively. It was suggested that dry period should be around 60 days and some precautions to decrease the adverse effects of heat on milk yield are required to be taken.

Key words: Regression tree, 305 days milk yield, Holstein cows, season, age, party, farm

INTRODUCTION

The yields of farm animals are the result of the combined effects of genotype and environmental conditions. In lactation parity to increase the yield level, it is necessary to optimize the environmental conditions and to improve the genetic structure of the animals. Environmental factors can be classified as factors with measurable effects (age, year, season, milking frequency, etc.) and factors with unmeasurable effects (infectious diseases, parasitic infestations, etc.). The measurable effects can be determined and used in the management of the farm (Cilek and Tekin, 2005).

The purpose of this study is to investigate the effect level of possible environmental conditions on milk yield. Accordingly, the effect of calving age and season with lactation parity upon 305 days milk yield is declared as significant (Akbulut *et al*., 1992; Gundogdu and Ozder, 1993; Yener *et al*., 1994; Atay *et al*., 1995; Kaygisiz, 1997; Ozcelik and Arpacik, 2000; Duru and Tuncel, 2002; Bakir and Cetin, 2003; Ozcakir and Bakir, 2003; Bilgic and Alic, 2005; Turkyilmaz *et al*., 2005; Erdem *et al*., 2007; Kocak *et al*., 2007; Cilek, 2009). The purpose of this study was to determine the effects of dry period, lactation parity, farm, calving season and age on 305 days milk yield using Regression Tree (RT) method.

MATERIALS AND METHODS

The material of study is 3315 lactation records of 735 Holstein cows raised in Ceylanpinar, Reyhanli and Tahirova State Farm. The possible factors that could be effective on milk yield are considered as dry period, lactation parity, calving age, calving season and farm. While the effect of dry period on 305 days milk yield is investigated, it is taken into consideration that the effect of leaving the cow to dry period is valid for next lactation. The Regression Tree (RT) has been used to determine the relationship between these factors and 305 days milk yield (Chang and Wang, 2006; D'Alisa *et al*., 2006; Hebert *et al*., 2006). All calculations for the analysis has been done SPSS (1999) statistical package program.

RESULTS AND DISCUSSION

In this study, 305 days milk yield is considered as milk yield (dependent variable) and descriptive statistics belonging to continuous-independent factors which could be effective on it is shown in Table 1.

At the result of RT analysis committed, as dry period (days) is primary effective variable on milk yield, lactation parity and farm is secondary, season and calving age is determined as tertiary. If the structure of regression tree is investigated, it is seen that Node 0 which is root node and including descriptive statistics of depend variable is placed at the top of tree (Fig. 1). Dry period (day) factor,

Table 1: Descriptive statistics

Variables	Mean±SD	Min.	Max.
Calving age	46.31±20.17	20	120
Milk yield	5272.11±1382.79	1007	10320
Dry period	67.30±24.39	18	179

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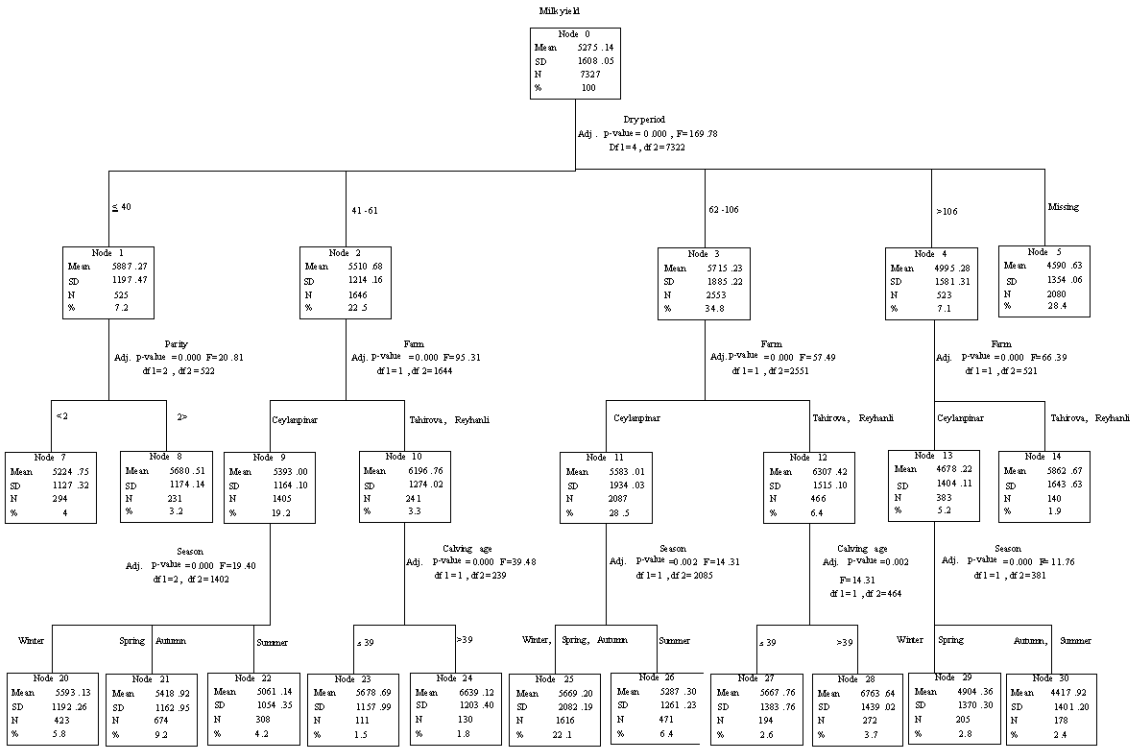

Fig. 1: Regression tree diagram for 305 days milk yield

root node and primary effective on 305 days milk yield, is separated to 4 subgroups. First subgroup named as Node 1 consists 525 cows with predicted mean 5887.27 kg 305 days milk yield. Within all of cows in this group, the percentage of cows with dry period time below than 40 is 7.2. Node 2, second subgroup, includes 1646 cows with 40-60 days of dry period time (22.5%) and milk yield average of these cows is estimated as 5510.68 kg. On the other hand, third subgroup (Node 3) has average 5715.23 kg 305 days milk yield. It consists 2553 cows having 61-105 days dry period time (34.8%). This subgroup is the one having the highest 305 days milk yield average from four subgroups which are developed by considering dry period time.

On the other hand, first subgroup is separated to 2 subgroups with respect to lactation parity, while second, third and fourth subgroups are parted each in two subgroups according to farm. First subgroup of cows parted into two subgroups and having <40 days dry period time consists of 294(4%) cows with lactation parity ≤2. The 305 days milk yield average of these cows is expected as 5224.75 kg. Besides, 305 days milk yield average of the cows with lactation parity ≥3 is expected as 5680.51 kg. Within lactation parity subgroup, the highest milk yield average has been determined with the cows having lactation parity >2 (Fig. 1).

Cows having dry period time >41 is parted into two subgroups. One of these subgroups is Ceylanpinar and other is Reyhanli and Tahirova farms. The subgroups 9, 11 and 13 are re-branched into groups according to season variable. On the other hand, Tahirova and Reyhanli subgroups (11, 12, 14) are parted into each two subgroups with respect to calving age factor. From these farms, the highest milk yield average is expected as 6307.42 kg in Node 12 including Tahirova and Reyhanli farms and the lowest milk yield average is expected as 4678.22 kg at Ceylanpinar farm, in Node 13 (Fig. 1).

At Ceylanpinar Farm, season has been affected milk yield of cows having 41-61 days dry period time. At this point, season factor is parted into 3 subgroups as winter, autumn-spring and summer. Within these subgroups, the highest milk yield (5593.13 kg) is expected for the cows starting to lactation in winter, while the lowest milk yield is obtained from the cows starting to lactation in summer. On the other hand, calving age has been effective on milk yield of cows with 41-61 days dry period time in Tahirova and Reyhanli farm. According to that, average milk yield of cows having calving age ≤39 is expected as 5678.69 kg and average milk yield of cows with calving age >39 is expected as 6639.12 kg (Fig. 1).

Cows raised in Ceylanpinar farm and having >61 dry period time are parted into two subgroups according to

season effective on milk yield (Winter-autumn-spring and summer). Cows raised in Tahiorova and Reyhanli farms and having dry period time 62-106 days is branched into two subgroups as ≤39 and >39 month calving age. From these subgroups, milk yield of ones with >39 calving age is observed higher compared to other subgroup. On the contrary, at the same farms, calving age is not observed as an effective factor on milk yield within cows having dry period time >106 days (Fig. 1).

R^2 of the model has been found as 81.8%. Therefore, it could be accepted that variables of the model (dry period, farm, lactation parity and calving season and age) is adequate for 305 days milk yield.

From the factors of which the effect on milk yield is studied, it is determined dry period time as primary factor, lactation parity and farm as secondary, calving season and age as tertiary. From these factors, since dry period time significantly affects milk yield, milking a cow for 10 months and leaving it to dry period for 2 months is desired (Ozhan *et al*., 2007).

Dry period time up to 106 days has positive effect on milk yield and the highest milk yield is provided between interval 62-106 days. However, it is observed that dry period time >106 days negatively affects milk yield and this causes almost 280 kg decrease in overall average.

The most adequate dry period time is indicated as 61-80 days by Tuzemen *et al*. (1998), 56-65 days by Sogut and Bakir (1999). On the other hand, Duru and Tuncel (2004) claims that the highest 305 days milk yield (5302.7 kg) is obtained with 71-80 days dry period time.

Lactation parity, secondary effective of milk yield, is parted into 2 subgroups and milk yield (5224.75 kg) of cows with lactation parity ≤2 is observed <51 kg overall average. Milk yield of cows having lactation parity ≥3 is positively affected and milk yield of this group cows is observed 405 kg much than overall average. In various researches, the effect of lactation parity on milk yield is claimed as considerable (Gundogdu and Ozder, 1993; Atay *et al*., 1995; Kaygisiz, 1997; Ozcelik and Arpacik, 2000; Duru and Tuncel, 2002; Ozcakir and Bakir, 2003; Erdem *et al*., 2007).

Farm, which is one of factors affecting milk yield, is parted into two subgroups and Reyhanli and Tahirova is one group, while Ceylanpinar is other group. Average milk yield of cows raised in Ceylanpinar Farm is found 803 kg less compared to other farms. Sub-factor of Ceylanpinar Farm is calving season and sub-factor of other group (Tahirova and Reyhanli) is calving age. As known, Ceylanpinar Farm is geographically located on a hotter region. Thus, negative effect of temperature on milk yield is considered.

For the cows with dry period time 41-61 days, calving season which is being subgroup of Ceylanpinar Farm is parted into three subgroups as winter, autumn-spring and summer. Within these three subgroups, the lowest milk yield is obtained in summer when heat stress on cows emerges with high temperature. Milk yield obtained in this season is found <214 kg overall average, on the other hand, milk yield of winter time is calculated >318 kg overall average (Fig. 1). In various researches, it is observed that temperature has negative effect on milk yield and causes overall yield decrease (McGuire *et al*., 1991; Bucklin *et al*., 1992; Keowen and Grant, 1997; Kadzare *et al*., 2002; Frazzi *et al*., 2003; Summer, 2003; Ozhan *et al*., 2007).

Many researchers reported that the effect of calving season on 305 days milk yield was as significant and indicated that milk yield was higher in autumn and winter (Bakir and Cetin, 2003; Ozcakir and Bakir, 2003; Kaya and Kaya, 2003; Yaylak and Kumlu, 2005; Sehar and Ozbeyaz, 2005; Erdem *et al*., 2007; Kocak *et al*., 2007; Cilek, 2009). However, some researchers reported that effect of calving season on 305 days milk yield was non-significant in commercial farm conditions (Pelister *et al*., 2000b; Bakir and Cetin, 2003; Bilgic and Alic, 2005).

Akcay *et al*. (2007) reported that calving season has an effect on 305 days milk production. This is because of high environmental temperature and high humidity in summer months in Mediterranean climates. By changing some management practices such as preferring the first season as calving season will be beneficial. In addition to that some of the losses can be saved with an additional investment i.e., evaporative cooling etc. Yildiz *et al*. (1999) estimated that the losses is between 101 and 400 kg of milk in summer season and added that about 70% of the milk losses can be saved back with evaporative cooling. The cooling system costs should be taken in consideration.

Bakir and Cetin (2003) reported that the cows calving in winter has higher milk yield than that of calving season is summer. Also reported that the difference of milk yield between winter and summer calving season is 376 kg.

Although, season effect is not observed in Tahirova and Reyhanli Farms, calving age affects milk yield in these farms. Because of geographic location, it is thought that temperature does not cause heat stress on cows within these farms. Besides, milk yield of cows with calving age ≤39 month is found as <961 kg cows with calving age >39 month and >403 kg overall average in these farms.

Secondary effective factor for cows having 62-106 days dry period time is farm and average milk yield is less in Ceylaninar Farm. Average milk yield difference between two farms is found as 724 kg. The reason of low

milk yield in Ceylanpinar Farm could be shown as season from sub-factors. Topaloglu and Gunes (2005) indicates that milk yield has been affected significantly ($p<0.001$).

Furthermore, tertiary effective factor is calving age in Tahirova and Reyhanli Farms. Calving age is parted into two subgroups as ≤39 month and >39 month. For both two groups, milk yield is observed higher than overall average. In various researches, the effect of calving age to milk yield is indicated as a significant point. Effects of calving age on 305 days milk yield have been reported as significant ($p<0.001$) (Pelister *et al*., 2000a; Cilek, 2009).

CONCLUSION

For 365 days milk yield, it is determined dry period time as primary, lactation parity as secondary and calving age as tertiary effective. Approximation of dry period time to ideal time (60 days) positively affects milk yield. If dry period time is longer than this value, it does not increase milk yield, on the contrary, it affects negatively. Average milk yield has been determined differently in different farms. The reason of that is calving season for Ceylanpinar Farm and calving age for other two farms. Since, Ceylanpinar Farm is geographically within hot climate, serious decrease of milk yield is observed in summer with the effect of temperature. In this research, the highest milk yield is obtained with 61-106 days dry period time, in Tahirova-Reyhanli farm group, with cows having >39 age. On the other hand, the lower milk yield is determined in Ceylanpinar Farm during summer-autumn season with cows having dry period time >106 days. In farms, milk yield is seriously affected by dry period time, calving age and season. Hence, taking steps to decrease the negative effect of milk yield is advised, while dry period time is preserved on ideal point.

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