Milk Yield Characteristics of Holstein Cows and the Effect of Calving Month on Milk Yield

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ABSTRACT: In this study, effects of calving month on milk yield in Holstein cows raised in Ceylanpınar State Farm were investigated. In this study, 5801 lactation records obtained during the years 1996-2007 was evaluated The averages for lactation length, lactation milk yield, 305-day milk yield and dry period were 318,9±0,83 days, 5929±23 kg, 5523±27 kg and 70,0±0,35 days, respectively. According to calving months, the highest milk yield was handled by cattle which were calved in January, and the lowest milk yield was handled by cattle which were calved in August. Values of the highest heat-humidity index were handled for June, July, and August respectively as 74,16±1.37, 77,89±1.90 and 76,73±2.07. The monthly average temperature in May increased up to above 24 °C and it could affect milk yield, and was maximum (32.7 and 31.0 °C) on July and August, minimum (7.1, 5.6 and 7.0 °C) from December to February. Calving month, calving year and parity on milk yield traits were significant (P<0.01). Milk yield started dropping in May, and this decrease continued from June to August, and partly in September.
Key words: Milk traits, heat stress, Holstein

Siyah Alaca Sığırların Süt Verim Özellikleri ve Buzağılama Ayının Süt Verimine Etkisi

ÖZET: Bu araştırmada, Ceylanpınar Tarım İşletmesinde yetiştirilen Siyah Alaca sığırların süt verim özelliklerine buzağılama ayının etkisi araştırılmıştır. 1996–2007 yılları arasındaki 5801 laktasyon kaydı incelenmiştir. Süt verimi özelliklerinden laktasyon süresi, laktasyon süt verimi, 305 günlük süt verimi ve kuruda kalma süresi için ortalamalar sırasıyla, 318,9±0,83 gün, 5929±23 kg, 5523±27 kg ve 70,0±0,35 gün olarak belirlenmiştir. Buzağılama aylarına göre en yüksek süt verimi Ocak ayında buzağılayan ineklerden, en düşük süt verimi ise Ağustos ayında buzağılayan ineklerden elde edilmiştir. En yüksek sıcaklık-nem indeksi (THI) değerleri Haziran, Temmuz ve Ağustos ayları için sırasıyla 74.16±1.37, 77.89±1.90 ve 76.73±2.07 olarak elde edilmiştir. İşletmede ortalama aylık sıcaklığın Mayıs ayında süt veriminin etkilendiği 24 °C'nin üzerine çıktığı, Temmuz ve Ağustos aylarında maksimum (32.7 ve 31.0 °C) düzeye ulaştığı, Aralık, Ocak ve Şubat aylarında ise minimum (7.1, 5.6 ve 7.0 °C) olduğu belirlenmiştir. Süt verim özelliklerine buzağılama ayı, buzağılama yılı ve laktasyon sırası etkisi çok önemli (P<0.01) bulunmuştur. Süt veriminin Mayıs ayından itibaren düşmeye başladığı ve düşüşün Haziran, Temmuz, Ağustos ve kısmen de Eylül aylarında devam ettiği tespit edilmiştir**.**
Anahtar kelimeler: Süt verim özellikleri, sıcaklık stresi, Siyah-Alaca

INTRODUCTION

The main goal of cattle breeding is to obtain the optimum yield with the least cost. The level of yield is limited by two basic factors; genetic structure of animal and environmental conditions. In order to provide a maximum level of production, these two basic factors must be considered together.

With the aim of increasing income acquired from animal farming, the relationship between climate factors and animal farming must be understood and evaluated well.

Heat stress affects the comfort of cattle more than cold stress does (Anonymous, 2012). As reported by many authors, ambient temperature and relative humidity are the most well-known factors significantly affecting milk yield in dairy cattle. Heat stress can reduce feed intake, weight gain, reproductive efficiency and milk production, while increasing susceptibility to diseases (Kazdere et al., 2002; West, 2003; Hansen, 2007; Dikmen and Hansen, 2009; Chichester and Mader, 2012). Ideal temperature, for cattle in lactation, is between 15 to 24 °C (Allen et al. 2003; Frazzi et al. 2003).

A cow that produces 30 kg of milk per day will start sweating at an environmental temperature of 12°C (Berman and Meltzer 1973). When environmental temperatures raise above the upper critical temperature cows will eat less. Thus it will be results in a lower milk yield (Frazzi et al. 2003). Cows calving in late fall to spring produce more milk than cows calving in the summer. However, if better feeding and management is provided, seasonal differences may become less significant (Mustafa, 2012).

On the other hand, the Temperature-Humidity Index (THI) has been widely used in hot areas all over the world in order to assess the impact of heat stress on dairy cows. According to Johnson (1985) and Du Preez et al. (1990a), milk production is not affected by heat stress when mean THI values are had a range of 35 and 72. However, milk production and feed intake begin to decline when THI reaches at 72 and continues to decline sharply at 76 or greater THI values (Johnson, 1980).

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In this study, the main goal is to determine changes of milk yield traits of Holstein cattle over years in Ceylanpınar State Farm and effect of calving month on milk yield.

MATERIALS and METHODS

The lactation records of 5801 for milk yield characteristics of 2257 Holstein cows calved between years 1996 and 2007 at Ceylanpınar State Farm was provided. Holland method was used to calculate milk yield (Özhan et al., 2007).

Cows were artificially inseminated. 15 to 24 ^{o}C is considered as comfort temperature and used to determine the effect of temperature. Climate values for the region of the farm were provided from Diyarbakır Meteorology Region Management (Anonim, 2007).

Daily THI values were also found for the considered period using the equation, THI = 1.8 × Ta – (1 –RH) × (Ta – 14.3) + 32, as described previously by Bouraoui et al. (2002) where Ta is the average ambient temperature in ^{o}C and RH is the average relative humidity as a fraction of the unit.

Least square means for milk yield traits were calculated and variance analysis for environmental factors (year, parity and calving month) was estimated by SAS statistical program , the Duncan test were used to determine significant differences (SAS, 1998).

The linear model adopted for analyzing effective factors on milk yield traits can be written as follows:

$$Y_{ijkl} = « + a_i + b_j + c_k + e_{ijkl}$$

In this model, μ = Population average, a_i = i. effect of calving year (i=1996, ……2007), b_j = j. effect of calving month (j=1, 2, ….. 12), c_k = k. parity effect (k= 1,2,….6), e_{ijkl} = random error.

RESULTS

Milk Yield Traits

Means for lactation length, lactation milk yield, milk yield for 305 days and dry period were 318,9±0,83 days, 5929±23 kg, 5523±27 kg and 70,0±0,35 days, respectively (Table 1).

Environmental factors, viz. parity, calving year and calving month were significant on all traits for variance analysis (P<0.01).

The Effect of Calving Month on Milk Yield

The effect of calving month on milk yield traits (P<0.01) were significant. The temperature-relative humidity index is given in Table 2 and Figure 1.

This was consistent with long-term data (1996-2007) for the region which indicates the summer period and was characterized by heat stress conditions. As illustrated in Table 2, the THI values were 74.16±1.37, 77.89±1.90 and 76.73±2.07 for June, July and August respectively.

The lowest monthly average RHs were 31,6±4,3%, 32,7±4,6%, 36,7±5,2 and 36,5±5,0 % June, July, August and September, respectively.

Accordingly, it was observed that temperature reached at critical level to affect milk yield in the middle of May and dropped in September.

In the present study, milk yield was determine to be lower in cows begun lactating or reached at their maximum daily milk yield during June, July and August which was characterized with THI 72 or higher.

However, decrease in milk yield for last three years is not sharp as observed in other years (Figure 2). It was observed that calving was distributed over year, although calving was slightly higher in winter and spring seasons.

DISCUSSION and CONCLUSION

The analysis of variance revealed that, the analysis of variance revealed that, the effects of all factors on lactation length (P<0.01) were significant. Average lactation length was 318,9±0,83 days. In dairy farming, it is desired to milk a cow for 10 months and leave a dry period for 2 months. The value found for lactation time is a bit higher than the value desired. In dairy farm, it is required to pay attention on drying cows and keeping service period at normal levels. While the longest lactation length is observed during first lactation, lactation time decreased to 305 days as parity increased. This may be happened because conceiving delayed in cows having first calving. The value found for lactation length was in agreement with the values reported in some studies (Soysal ve Özder, 1992; Şahin and Ulutaş, 2010), higher than those of many studies (Somuncu and Şengonca, 1990; Yıldız and Şengonca, 1990; Kaygısız, 1996; Bilgiç and Yener, 1999; Akman e al, 2001; Duru and Tuncel, 2002; Özçakır and Bakır, 2003; Bakır and Çetin, 2003; Erdem et al, 2007; Koçak et al, 2007) and less than other studies (Akbulut et al, 1992; Atay et al, 1995; Topaloğlu and Güneş, 2010) in related State farms.

The effect of all environmental factors to lactation milk yield was significant (P<0.01). Positive progresses in farm conditions, developments on feeding and housing techniques and new milking shed provided positive effect on the increase of yield during the last years. Lactation milk yield changed also with calving month. It was observed that while cows calved at winter had higher lactation milk yield average, the ones calved at summer had the lowest average. For cows started lactating at winter, peak phase occurred at spring when climate conditions are convenient, whereas, for cows calved at summer lactation started with a low yield because of negative climate effect. Lactation milk yield average was 5929±23 kg.

Table 1. Least Square Means of Milk Yield Traits in Holstein Cattle

Factors	N	Lactation duration (day)	Lactation milk yield (kg)	305 days milk yield (kg)	Dry period (day)	
		$\overline{X} \pm S_{\overline{X}}$	$\overline{X} \pm S_{\overline{X}}$	$\overline{X} \pm S_{\overline{X}}$	N	$\overline{X} \pm S_{\overline{X}}$
Average	5801	318,9±0,83	5929±23	5523±27	4435	70.0±0,35
Parity		**	**	**		**
1	2257	325,8±1,4 ^{a}	5975±38 ^{a}	5452±36 ^{a}	1841	68,6±0,53 ^{b}
2	1600	312,0±1,5 ^{c}	5895±44 ^{a}	5565±46 ^{a}	1223	70,9±0,71 ^{ab}
3	1037	315,5±1,9 ^{bc}	5974±57 ^{a}	5712±106 ^{a}	770	70,9±0,85 ^{ab}
4	541	315,9±2,6 ^{bc}	5875±71 ^{a}	5497±60 ^{a}	369	70,3±1,13 ^{ab}
5	245	321,1±4,2 ^{ab}	5972±112 ^{a}	5482±91 ^{a}	158	73,1±1,81 ^{a}
6	121	319,6±4,7 ^{abc}	5467±136 ^{b}	5078±120 ^{b}	74	72,4±2,57 ^{ab}
Calving year		**	**	**		**
1996	451	316,9±2,6 ^{cd}	5305±78 ^{fg}	4904±65 ^{e}	395	73,8±1,33 ^{d}
1997	560	305,6±2,0 ^{de}	5123±63 ^{g}	4940±58 ^{e}	479	71,0±1,37 ^{c}
1998	561	312,9±1,8 ^{cde}	5469±52 ^{f}	5183±45 ^{de}	452	74,2±1,34 ^{bc}
1999	531	307,6±1,9 ^{de}	5270±43 ^{fg}	5037±33 ^{e}	381	72,8±1,25 ^{ab}
2000	590	316,5±3,1 ^{cd}	6386±80 ^{c}	5871±55 ^{bc}	390	73,0±1,84 ^{a}
2001	511	368,3±4,7 ^{a}	7167±118 ^{a}	6542±274 ^{a}	383	67,7±1,55 ^{a}
2002	469	351,2±3,8 ^{b}	7301±115 ^{a}	6459±87 ^{a}	353	67,9±1,38 ^{ab}
2003	499	301,2±13,9 ^{e}	6798±365 ^{b}	6507±331 ^{a}	376	63,0±0,72 ^{a}
2004	500	308,0±2,6 ^{de}	5946±65 ^{e}	5598±48 ^{bc}	402	66,8±0,81 ^{a}
2005	387	302,1±2,3 ^{e}	6320±64 ^{cd}	5978±51 ^{a}	269	68,2±0,92 ^{a}
2006	342	315,3±2,5 ^{cd}	6073±65 ^{de}	5664±53 ^{bc}	257	70,9±1,07 ^{bc}
2007	400	317,6±2,9 ^{cd}	5914±68 ^{e}	5535±106 ^{cd}	298	71,9±1,21 ^{bc}
Calving month		**	**	**		**
1	521	321,2±2,8 ^{ab}	6263±74 ^{a}	5776±59 ^{a}	391	68,2±1,16 ^{de}
2	557	326,4±3,0 ^{a}	6257±79 ^{a}	5736±60 ^{ab}	440	67,6±1,04 ^{de}
3	612	322,0±2,6 ^{ab}	6064±65 ^{ab}	5577±48 ^{ab}	468	70,6±1,16 ^{bcd}
4	453	319,4±2,9 ^{abc}	5823±77 ^{cde}	5641±193 ^{ab}	361	70,3±1,28 ^{bcde}
5	431	323,1±3,1 ^{a}	5964±85 ^{bcd}	5441±61 ^{bcd}	322	73,8±1,43 ^{ab}
6	380	323,6±3,3 ^{a}	5770±89 ^{de}	5253±67 ^{cd}	272	75,1±1,59 ^{a}
7	425	313,6±2,7 ^{bc}	5665±84 ^{ef}	5471±189 ^{bc}	326	71,1±1,29 ^{bcd}
8	469	311,5±2,8 ^{c}	5527±86 ^{f}	5170±69 ^{d}	345	71,0±1,28 ^{bcd}
9	458	312,3±2,7 ^{c}	5757±90 ^{de}	5485±126 ^{abc}	354	72,2±1,31 ^{abc}
10	428	313,7±3,0 ^{bc}	5615±87 ^{ef}	5262±71 ^{cd}	328	68,5±1,19 ^{cde}
11	457	318,5±2,9 ^{abc}	6018±83 ^{bc}	5569±68 ^{ab}	359	68,1±1,06 ^{de}
12	610	318,6±2,5 ^{abc}	6110±70 ^{ab}	5670±54 ^{ab}	469	66,6±0,92 ^{e}

** P<0.01 a,b,c,d,e,f: Differences between means within the same column having different letters were significant (P<0.05).

Table 2. The Monthly Changes of Tempetature, Relative Humidity and Temperature-Relative Humidity Index

Month	Temperature (ºC)	Relative Humidity (%)	THI
1	5,6±1,4	69,1±5,9	45,53±1,78
2	7,0±1,3	63,7±6,4	47,63±2,17
3	10,9±1,7	59,9±7,8	53,16±2,42
4	15,9±1,7	57,2±7,5	59,97±2,18
5	23,2±1,1	42,8±6,6	68,27±1,51
6	29,4±0,7	31,6±4,3	74,16±1,37
7	32,7±1,0	32,7±4,6	77,89±1,90
8	31,0±1,1	36,7±5,2	76,73±2,07
9	25,4±0,8	36,5±5,0	70,31±1,44
10	19,4±1,1	43,8±7,3	63,81±1,20
11	11,8±1,4	54,4±9,3	54,49±1,85
12	7,1±1,8	66,5±8,8	47,75±2,57

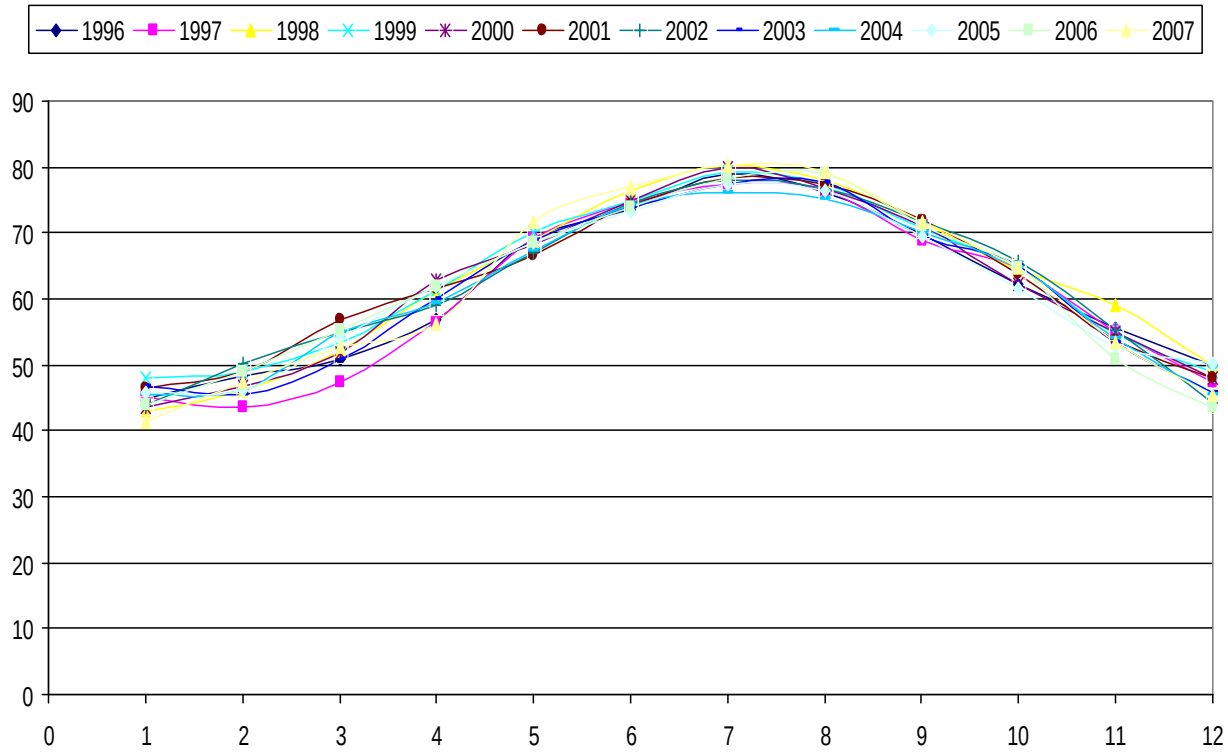

Figure 1. The Monthly Changes of Temperature-Relative Humidity Index between 1996 and 2007

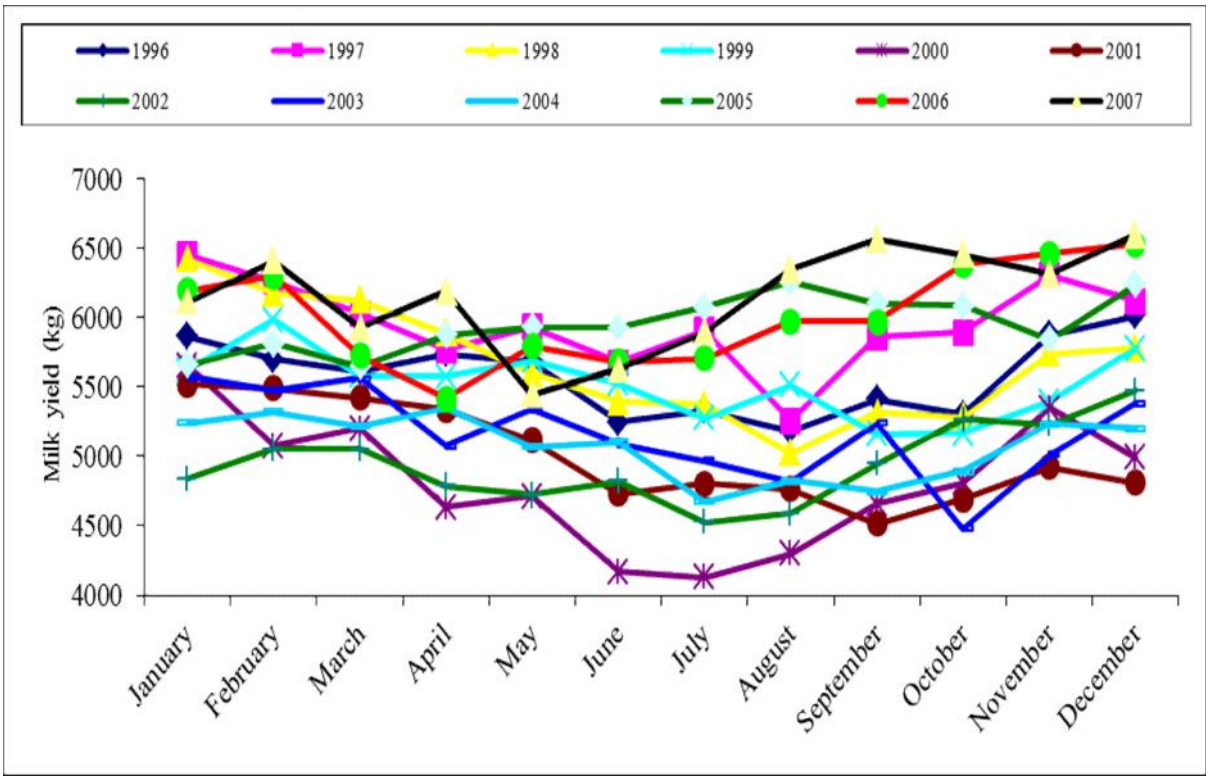

Figure 2. The Monthly Changes in of 305 Days Milk Yield between 1996 and 2007 According to Calving Month

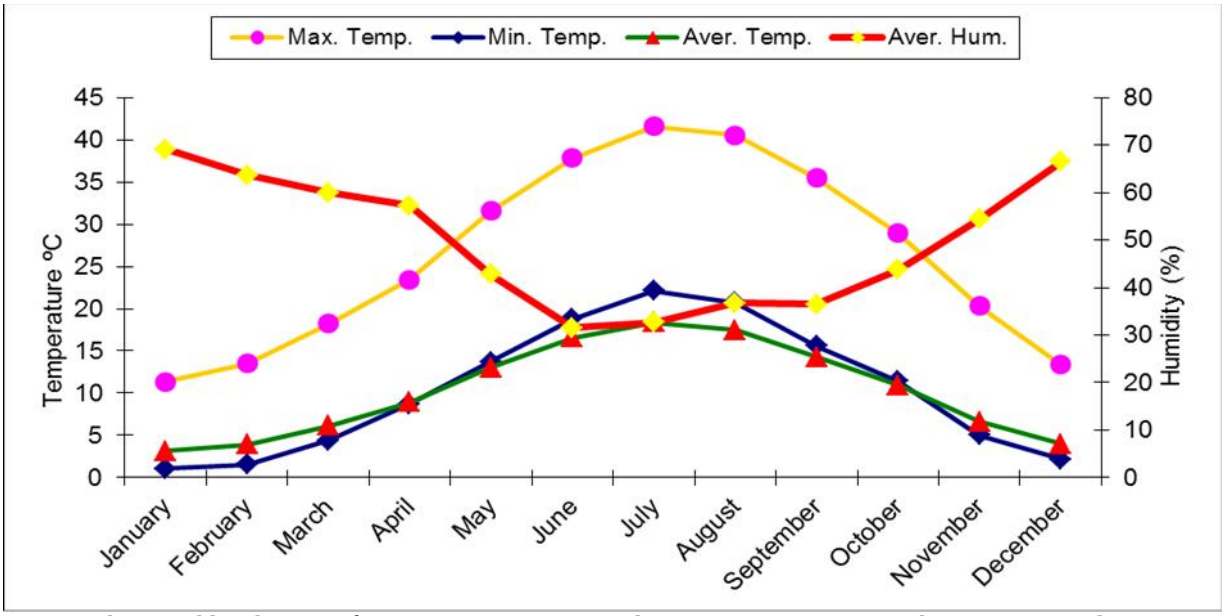

Figure 3. The Monthly Changes of Maximum, Minimum and Average Temperature and Average Humidity

According to variance analysis implemented for 305 days milk yield, the effect of parity, calving year and calving month was considered to be significant (P<0.01). Average milk yield for 305 days was found as 5523.11±165.48 kg. Average value found, for Turkey conditions, was higher than from the most of other farms (Somuncu ve Şengonca, 1990; Soysal and Özder, 1992; Akbulut et al, 1992; Atay et al, 1995; Kaygısız, 1996; Bilgiç and Yener, 1999; Özçakır and Bakır, 2003; Bakır and Çetin, 2003; Ulutaş et al, 2004; Erdem et al, 2007; Koçak et al, 2007) and less than the value 6776.9 kg found by Yener et al (1994), 6853-7757 kg found by Gurses and Bayraktar (2012), 6976 kg found by Şahin and Ulutaş (2010).

The analysis of variance reflected that, the effect of all factors on dry period were significant (P<0.01). The average for this trait was, 70,0±0,35 days, which was higher than 60 days and not a desired value for dairy cattle. It must be considered that more care is required for drying cows in a farm. The value found was quite less than the values between 114-209 days (Somuncu and Şengonca, 1990; Bilgiç and Yener, 1999), less than the research results between 85-99 days, which was similar to some research results (Kaygısız, 1996; Koçak et al, 2007) and higher than some other results between 61-78 days for other farms.

Negative effect of temperature on milk yield is inevitable since Ceylanpınar State farm is within hot belt. It was determined that milk yield, at the region, has been affected negatively within months June, July, August and some part of September due to very high temperature

Present results indicate that milk yield declined for a THI had higher than 72 in June, July and August month. These results were in agreement with those reported by Johnson et al. (1980), Mallonee et al. (1985) and Du Preez et al. (1990b).

However, during last three years, the effect of temperature on milk yield was not serious compared to other years. At this point, variation in content of ration to prevent decrease of feeding within these months at enterprise may have been effective. Furthermore, it was understood that modern milking shed established by farm had a significant effect without serious decrease in milk yield. Many researchers studying on the connection between calving season (or month) and milk yield reported that cows calving at winter produced higher milk yield than ones calving at summer and the lowest milk yield was recognized between months June-September and June – July owing to high temperature (Akbaş and Türkmut, 1990; Hamşa, 2002; Akçay et al, 2007; Topaloğlu and Güneş, 2010; Şahin and Ulutaş, 2010; Gürses and Bayraktar, 2012) reported that cows calving at winter produced higher milk yield than ones calving at summer and the lowest milk yield was recognized between months June-September and June – July owing to high temperature. Cows calving at fall have lower milk yield compared to ones calving at other seasons and, Wood (1970) attributed this fact to the lack of rangeland and roughage beside the climatologically changes.

It could be suggested that Holstein cattle maintained at this farm were in good condition despite the temperature stress. It is thought that, besides making changes in ration content, enabling cows take shower could reduce temperature stress and decreases in yield.

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