8

Current Debates on Health Sciences

Ali BİLGİLİ
Başak HANEDAN



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Investigation Effect Of Some Environmental Factors And Timing Of Artificial Insemination On Milk Yield In Holstein Cows*

Bahattin ÇAK[1]
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Introduction

Maintenance and profit on a dairy cow farm are dependent on high-yielding animals and effective herd management. The amount of milk produced by these cows during their lifetime, as well as their contribution to the farm, are used to assess them. As a consequence, these farms monitor herd and animal production regularly, as well as current positive and negative environmental factors. Dairy cow breeding is a success on the majority of Turkish farms (Cak & Yilmaz 2015). Lactation performance in dairy cattle is regulated by genetic and environmental variables. Milk development, lactation time, and dry period have all been shown to be influenced by genetic history, environment, illnesses, food, calving year, and season. Productivity is affected by breed, era, lactation time, parity, and milking frequency (Msanga et al 2000; Epaphras Karimuribo & Msellem et al 2004). Holstein cows were once thought to be the world's most dairy cows (M'hamdi et al 2012). The reproductive productivity of the dairy cow is crucial to the dairy enterprise's financial viability. Artificial insemination (AI) is a vital reproductive technology in the dairy industry. AI minimizes the occurrence of sexually transmitted diseases in cattle while simultaneously enhancing the use of genetically superior sires to improve herd performance (Hagevoort & Garcia 2013).

Estrus identification and AI are the most expensive procedures in many dairy farms. Correct estrus identification is connected to extended calving cycles, milk loss, increased veterinary expenditures, increased heifer breeding costs, and slower genetic development (Anonymus 2017).

It is critical to precisely identify cows to be inseminated in order for them to become pregnant, calve, and return to peak milk production, as well as to generate a steady supply of replacements (Roelofs et al 2010). Many approaches for predicting estrus have been tried, and automatic behavior tracking is one of the methods that has been implemented by producers and is proving to be useful (Fricke et al 2014; LeRoy 2016).

For more than 70 years, scientists have studied the timing of insemination in relation to the first symptom of estrus. The "a.m.-p.m. rule" indicated that if a cow was seen in standing estrus in the morning, AI should take place that day, and if a cow was seen in estrus in the afternoon, AI should take place the next morning (LeRoy 2016). For over a century, researchers have researched the effect of artificial insemination timing on the sex ratio of cow progeny (Ericsson & Ericsson 1998). Many contradictory results have been reported in the last decade about the

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* This study was presented as a poster at the VII Ulusal Veteriner Zootekni Kongresi.

influence of artificial insemination timing on the sex ratio of progeny in cows (Rorie 1999; Martinez et al 2004). The purpose of this study was to look into the influence of several environmental conditions and the timing of artificial insemination on milk output in Holstein cows.

Materials and Methods

Location

The farm where we received the data in our work; It is a dairy farm located in the Mediterranean Region of Turkey, Kadirli District of Osmaniye Province (37^{o}, 22'28.1 North, 36^{o}, 05'51.3 East). The district is at an altitude of 96 m, with an average annual maximum temperature of 36^{o}C in August and a minimum temperature of 3^{o}C in January, with an average annual rain of 890 mm3 (MGM 2017).

Animal Materials

This study was conducted on healthy Holstein cows (parity ranging from 1 to 6) at an Osmaniye dairy farm during a 5-year period. Cows were kept in free-stall barns and fed a total mixed ration (TMR) of corn silage, alfalfa hay, concentrate, and mineral mix twice daily. They had free access to water. Using an automated milking system, cows were milked twice a day at about 12-hour intervals, and the average lactation milk output was 9042 kg per lactation.

Methods

Milk Yield Traits

Data were obtained from Holstein cows housed on a commercial dairy farm in Osmaniye between December 2010 and February 2014. Individual cow milk outputs were recorded twice a day at each milking and preserved as daily milk yields (kg). Each cow's average daily milk output was determined. A total of 91 cow's lactation records and 60 cow's dry period records were included in the analysis. Since 31 cows were in the first lactation period, dry periods were not calculated.

Estrus and AI

Estrus was seen by two experienced herders three times each day (at 08:00, 16:00, and 24:00), with each observation lasting around 30 minutes. When the cows stood to be mounted, the beginning of estrus was determined. Two veterinarian technicians used normal cattle methods to perform artificial inseminations. The cows were inseminated with frozen-thawed sperm 0-12 h (Group 1) and 13-24 h (Group 2) after the beginning of estrus was identified.

Statistical Analysis

SPSS (2013) was used to examine the data. Duncan and chi-squared tests were used to examine the effects of environmental conditions and artificial insemination timing on milk output in Holstein cows.

Results

Least square means for milk yield traits are presented in Table 1. The effects of calving year on lactation period, lactation milk yield, 305-day milk yield, and ME-305-day milk yield were significant ($p<0.001$). Effects of lactation number on ME-305 days milk yield were significant ($p<0.05$). Effects of AI Time on ME-305 days milk yield were significant ($p<0.01$).

The average of lactation length, lactation milk yield, 305 days milk yield, ME-305 days milk yield and dry period (Table 2) was estimated as 372,3 day, 9042,4 kg, 8146,2 kg, 9051,8 and 54,0 day respectively; milk yields at 305 days were lowest in 2010, at 6210,1 kg, and greatest in 2013, at 9462,8 kg. Milk yields were lowest in 4 years of age at 7834,2 kg and greatest in 6 years and older at 8620,8 kg during 305 days. Furthermore, the greatest 305-day milk yield in cows calving in the summer was 8539,3 kg, while the lowest amount in animals calving in the spring was 7948,5 kg.

Lactation length was shortest in 2014 at 314,9 days and longest in 2013 at 411,3 days. Lactation length was longest in 4 and over lactation at 383,5 days and shortest in 2nd lactation at 356,4 days.

Table 1. Least Squares Means, Significance and Multiple Comparison Test Results Belong to Milk Production Traits.

Factors	n	Lactation length (day)	Lactation milk yield (kg)	305 days milk yield (kg)	ME-305 days milk yield (kg)
		$\bar{X} \pm S\bar{x}$	$\bar{X} \pm S\bar{x}$	$\bar{X} \pm S\bar{x}$	$\bar{X} \pm S\bar{x}$
General mean	91	372,3±8,97	9042,4±287,02	8146,2±214,89	9051,8±253,12
Calving year		***	***	***	***
2010	11	326,5±11,33^{c}	6625,4±251,51^{c}	6210,1±155,79^{d}	7030,9±268,11^{c}
2011	13	348,8±27,74^{bc}	7487,2±613,85^{bc}	6938,4±419,16^{cd}	7701,1±500,22^{bc}
2012	19	392,5±23,00^{ab}	8635,3±568,32^{b}	7720,4±416,37^{bc}	8603,2±541,90^{bc}
2013	33	411,3±13,94^{a}	10866,7±502,41^{a}	9462,8±388,37^{a}	10452,4±461,00^{a}
2014	15	314,9±8,91^{c}	8665,0±317,31^{b}	8255,8±201,71^{ab}	9191,1±271,25^{ab}
Lactation No.		NS	NS	NS	*
1. Lactation	31	374,5±15,73	8753,7±484,74	7894,0±365,46	9939,5±475,29^{a}
2. Lactation	21	356,4±18,46	8945,7±536,11	8185,5±388,47	9163,1±436,93^{ab}
3. Lactation	11	368,0±22,67	8684,4±891,45	7790,8±670,52	8127,4±726,99^{b}
4. and over Lactation	28	383,5±17,08	9575,3±558,62	8534,5±420,31	8348,5±412,11^{b}
Calving season		NS	NS	NS	NS
Autumn	15	359,9±17,74	9049,6±704,39	8135,6±505,84	9076,0±658,93
Winter	39	360,2±14,55	8684,1±414,75	7959,2±308,10	9117,3±389,02
Spring	12	377,3±23,23	8835,4±729,20	7948,5±564,39	8835,3±670,29
Summer	25	396,2±17,58	9696,4±618,01	8539,3±476,18	9038,9±498,72
Calving age		NS	NS	NS	NS
2	30	377,0±16,05	8815,3±497,12	7927,9±376,31	10036,0±481,17
3	20	349,6±18,01	8849,4±554,46	8132,8±404,63	9159,3±459,34
4	13	372,3±22,23	8715,8±781,79	7834,2±579,00	8129,6±623,00
5	11	383,0±34,05	9346,9±955,10	8401,3±707,09	8301,8±699,36
6 and older	17	383,8±18,48	9723,0±703,48	8620,8±536,32	8378,8±523,54
Service Period		NS	NS	NS	NS
0-74 day	15	350,33±19,54	8613,47±678,88	7802,66±493,71	7949,87±503,06
75-100 day	7	341,71±24,30	8958,29±1041,02	8229,99±794,49	8577,14±772,11
101-125 day	4	416±53,58	10509,25±1862,54	9137,53±1400,87	10148,75±1604,80
126-150 day	5	392,00±51,14	9414,60±1588,32	8521,78±1216,62	8782,40±1130,72
151 and over	18	391,50±20,65	10050,28±583,98	8899,87±447,34	9103,00±449,71
AI Time		NS	NS	NS	**
0-12 hour	30	377,0±16,05	8815,3±497,12	7927,9±376,31	10036,0±481,17
13-24 hour	61	370,0±10,89	9154,1±353,52	8253,6±262,85	8567,7±276,57

*p<0.05; **p<0.01; ***p<0.001; NS: non-significant; a, b, c: Means without a common superscript within each variable and each factor differ (p<0.05), AI: Artificial Insemination.

Table 2. Least Squares Means, Significance and Multiple Comparison Test Results Belong to Dry Period, Day.

Factors	n	dry period (day)
		$\bar{X} \pm S\bar{x}$
General mean	60	54,0±0,93
Calving year		NS
2010	7	58,6±1,91
2011	8	53,1±2,50
2012	12	53,7±1,65
2013	22	52,8±1,72
2014	11	54,6±2,42
Lactation No.		NS
1. Lactation	-	-
2. Lactation	21	54,1± 1,69
3. Lactation	11	55,9 ± 1,66
4. and over Lactation	28	53,3 ± 1,41
Calving season		NS
Autumn	11	52,5 ± 1,66
Winter	20	54,3 ± 1,71
Spring	8	54,0 ± 1,91
Summer	21	54,6 ± 1,83
Calving age		NS
2	-	-
3	20	53,6± 1,68
4	12	56,7 ± 1,69
5	11	53,1 ± 2,53
6 and older	17	53,4 ± 1,71
Service Period (day)		NS
0-74	15	55,2±1,44
75-100	7	50,5±1,95
101-125	4	51,5±4,67
126-150	5	53,00±3,83
151 and over	18	52,7±1,84

NS: non-significant

In this study, multiple correspondence analysis was performed to visualize the effect of some factors on milk yield. The results are given in Table 3 and Figure 1.

Table 3. The results of Multiple Correspondence Analysis.

Model Summary			
Dimension	Cronbach's Alpha	Variance Accounted For	
		Total (Eigenvalue)	Inertia
1	0,838	4,203	0,382
2	0,811	3,802	0,346
Total		8,005	0,728
Mean	0,825[a]	4,003	0,364

a: Mean Cronbach's Alpha is based on the mean Eigenvalue.

As a result of the dimension reduction as seen in Table 3; the first dimension is 38.2% of the total variation, while the second dimension is 34.6%. Thus, the relationship between the properties is reduced to 2 dimensions and the total variation is 72.8%.

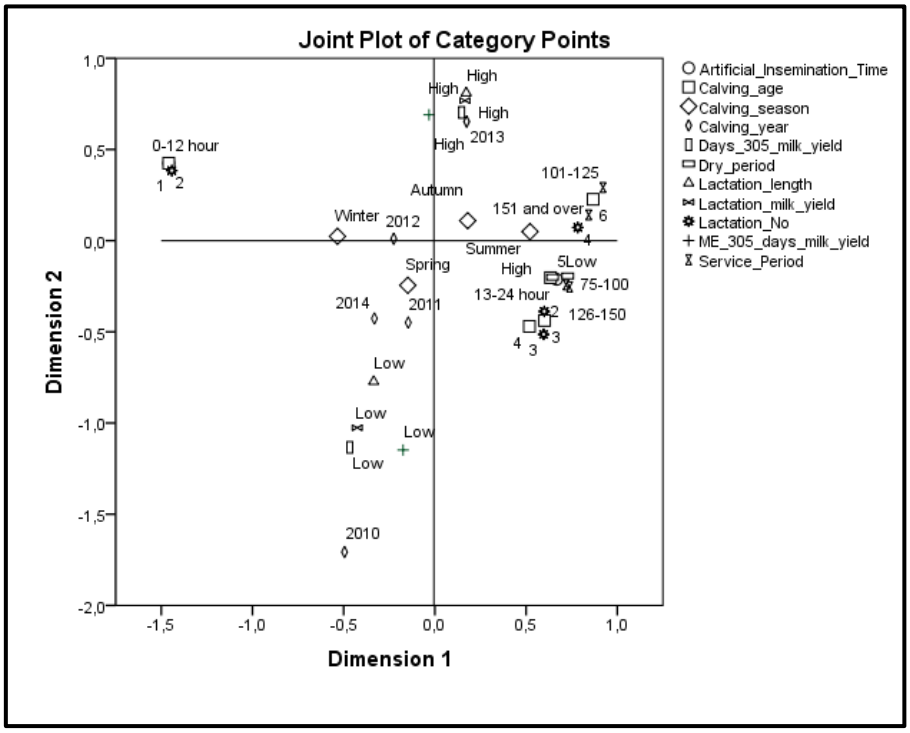


Figure 1. The graphic of Multiple Correspondence Analysis.

When the relations between the features are examined visually in Figure 1; the lactation milk yield in 2013 is high in animals that four-years old-calving cows, in autumn and summer-calving cows and service period more than 101 days-cows. On the other hand, in 2010-2012, in winter and spring seasons-calving cow's lactation milk yield is low.

When the relationships between the characteristics are examined according to the first dimension; the milk yield is low when insemination is made in the 0-12-hour period in the animals that 1-2 years old-calving. Also, insemination between 13-24 hours is positively related to high milk yield.

Discussion

In a dairy farm, fertility is also important if milk production is important. During the last fifty years passed, milk production in developed countries has greatly increased the milk yield

of cattle. But with this selection milk fertility has increased and fertility has decreased seriously. Several factors have been suggested in this regard. These are the causes, such as genetic, physiological, nutritional and managerial factors, which affect the fertile life of animals directly and indirectly.

While it is desirable to achieve high fertility in dairy farms, it is very important that the estrous is fixed at the right time. A 10% increase in the correct detection rate of oestrus time reduces the number of idle days from an average of 136 days to 119 days. In addition, the increase in correct estrus time detection rate increases the reproductive efficiency by shortening the two birth intervals. Estrus symptoms and the accurate determination of oestrus with these symptoms are very important for dairy farms, even though new methods have been developed (Daşkın 2005).

As known in dairy cattle, age and number of births are related to each other and there may be some differences according to reproductive performance among cows. In this study, the relationship between artificial insemination time and some milk yield characteristics was investigated. There are many studies investigating the relationship between artificial insemination time and some reproductive performance traits. However, the number of studies investigating the relationship between artificial insemination time and some milk yield traits is rare.

Lactation Length

In this study, the average lactation length of Holstein cows was determined to be 372,3 days. This value is seen to be about 67,3 days longer than the 305 days of which is considered as the standard lactation length. In this study, results obtained in the lactation length, compared to literature results conducted on the Holstein breed: This value is lower than that reported by Mellado et al (2011), but it is longer than Afifi, Khalil & Salem (1992), Akman et al (2001), Duru & Tuncel (2002), Atil & Khattab (2005), Bilgiç & Alıç (2005), Sehar & Özbeyaz (2005), Erdem, Atasever & Kul (2007), Javed, Babar & Abdullah (2007), Özkök & Uğur (2007), Akkas & Sahin (2008), Cilek (2009), Bayrıl & Yılmaz (2010), Şahin & Ulutaş (2010), Koç (2012), M'hamdi et al (2012), Özyürek & Tüzemen (2015) and Alkoyak (2016). The effect of calving year on lactation length were statistically significant ($p<0,001$). This study is like the reports of Erdem, Atasever & Kul (2007), Cilek (2009), Bayrıl & Yılmaz (2010) and Şahin & Ulutaş (2010).

Lactation Milk Yield

In this study, the mean lactation milk yield of Holstein cows was 9042,4 kg. This value is higher than findings of Afifi, Khalil & Salem (1992), Akman et al (2001), Duru & Tuncel (2002), Bilgiç & Alıç (2005), Erdem, Atasever & Kul (2007), Özkök & Uğur (2007), Bayrıl & Yılmaz (2010), Şahin & Ulutaş (2010), Koç (2012), Özyürek & Tüzemen (2015) and Alkoyak (2016); but is than lower findings of Mellado et al (2011).

The effects of the calving year on lactation milk yields were shown to be substantial in this study and these findings are parallel with findings of Duru & Tuncel (2002), Bilgiç & Alıç (2005), Erdem, Atasever & Kul (2007), Özkök & Uğur (2007), Bayrıl & Yılmaz (2010), Şahin & Ulutaş (2010) and Koç (2012) but is not like finding of Alkoyak (2016).

305 Days Milk Yield

This research 305-days milk yields of Holstein cows are 4639,79 kg. This value is higher than values in other studies Afifi, Khalil & Salem (1992), Akman et al (2001), Duru & Tuncel (2002), Atil & Khattab (2005), Bilgiç & Alıç (2005), Erdem, Atasever & Kul (2007), Özkök & Uğur (2007), Akkas & Sahin (2008), Cilek (2009), Bayrıl & Yılmaz (2010), Şahin & Ulutaş

(2010), Koç (2012), M'hamdi et al (2012), Alkoyak (2016) but is lower than Mellado et al (2011).

The effect of calving years on 305 days milk yield was significant. Similar results were shown by some studies on Holstein cattle Duru & Tuncel (2002), Bilgiç & Alıç (2005), Erdem, Atasever & Kul (2007), Özkök & Uğur (2007), Cilek (2009), Bayrıl & Yılmaz (2010), Şahin & Ulutaş (2010).

ME-305 days milk yield (kg)

In this study, the mean mature equivalent (ME)-305 days milk yield of cows was 9051,8 kg. This value is parallel finding of Farin et al (1994), is higher than value of Bayrıl & Yılmaz (2010) however is lower than value of ElBoshra, Ali & Hassabo (2016). Effect of calving year, lactation number and artificial insemination time on ME-305 days milk yield was shown as significant. However, effect of calving season and calving age on ME-305 days milk yield was non-significant. Effect of calving season, calving year, lactation number and calving age on ME-305 days milk yield were found to be significant at the different levels in Bayrıl & Yılmaz (2010) research. This study was partially paralleled study of Bayrıl & Yılmaz (2010).

Dry period (day)

The dry period of Holstein cows was 54,0 days. The dry period of Holstein cows was between 61 and 98,15 days in previous studies. Value of this study was lower than findings of previous studies Afifi, Khalil & Salem (1992), Akman et al (2001), Sehar & Özbeyaz (2005), Erdem, Atasever & Kul (2007), Akkas & Sahin (2008), Cilek (2009), Bayrıl & Yılmaz (2010), Şahin & Ulutaş (2010), M'hamdi et al (2012), Alkoyak (2016). Effect of calving season, calving year, lactation number and calving age on dry period were found to be non-significant. However, the effect of calving year and lactation number on dry period was reported as significant by Bayrıl & Yılmaz (2010). The Effect of calving age on dry period was reported as significant by Erdem, Atasever & Kul (2007). Effect of calving season, calving year and lactation number on dry period was reported as significant by Akkas & Sahin (2008). The Effect of lactation number on dry period was reported as significant Alkoyak (2016).

Conclusion

In this study, milk yield in cows in farm was increased periodically from the first lactation to the fourth lactation, and the highest milk yield was obtained in 4th lactation. There was a statistically significant difference in ME-305 days milk yield between 1st lactation and 2nd, 3rd and 4th lactation milk yields ($P<0.05$).

There have been many reasons for cows affecting milk yield. As experience in dairy cattle increases, it is inevitable that both milk yield and fertility will increase. As the year progresses in the study carried out, the increase in milk yield increases year by year. A significant difference ($P <0.05$) was found between 2010 and the milk yield to be obtained between 2011, 2012 and 2013. It was also found that lactation, which is increasing as lactation number, is a drop-in milk yield. There was also a statistical difference ($P> 0.05$) between the milk yields of cows in terms of the season in which they gave birth, but not statistically. A statistical significance level ($P> 0.05$) was not determined when cows had a relationship between the calving age and milk yield.

In this study, the milk yield was low when insemination was made in the 0-12-hour period in the animals that 1-2 years old-calving. Also, insemination between 13-24 hours was positively related to high milk yield.

As a result, it was determined that milk yield performance increased from lactation 1st to lactation 4th in this study, and the best results in terms of milk yield and fertility were obtained from lactating cows. For this reason, it can be said that in Holstein race cultivation, which requires good care and nourishment, cows can be easily handled during at least 4 lactations provided that environmental and management-related conditions are also noted. In addition, the number of lactations increases by at least 4th milk yields up to lactation. This might be due to improvements in breeding, nutrition, and management practices (e.g., milk production selection and herd culling). Although lactation length was determined to be about optimum, the dry period was predicted to be less than optimal. By lengthening the dry time, it may be feasible to make more profitable animals. It may be concluded that Holstein cattle are effectively produced for milk output on the Osmaniye commercial farm under Türkiye circumstances and in the South Eastern Anatolia environment.

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