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RESEARCH PAPER

Evaluation of the Relationship of Some Environmental Factors and Number of Inseminations per Pregnancy with Milk Yield in Holstein Cows

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Abstract

In order to investigate the relationship between some environmental factors and the number of artificial inseminations per pregnancy with milk yield, data of 90 healthy Holstein breed dairy cows in a private dairy farm in Karapınar district of Konya province were taken. For the utilization of the data, age, number of artificial inseminations, lactation yield, calving season and sequence of lactation records were taken from the herd management program in the enterprise and analysed. As a result of the analysis, the number of artificial inseminations per pregnancy in 2016 was 1.79 and lactation milk yield was 10079,41 kg; the number of artificial inseminations per pregnancy in 2017 was 2.16 and lactation milk yield was 9767.94 kg. There was a statistically significant relationship between the number of artificial inseminations per pregnancy and milk yield during lactation period in both years. As a result, the increase in the number of artificial inseminations per pregnancy negatively affected the average milk yield of lactation period. Genetic and environmental factors are thought to play a major role in this effect.

Introduction

There are many factors that affect the profitability of dairy cows, such as fertility and milk yield, calving interval, dry period, number of artificial inseminations per pregnancy, age at first service. The most important of these factors is the ability to produce a good milk yield and one calf per year from healthy animals, which depends on reproductive performance. Reproductive performance is measured on the basis of numerical values such as service period, number of artificial inseminations per pregnancy, calving interval (Gökcan *et al.*, 2021). These measurements are made possible by ensuring herd continuity and cow conception (Bakır and Kibar, 2019). After the calving period, the period until the formation of a new pregnancy is called the service period (Gül and Karaca, 2022). Tüzemen (2020) reported that this period should be 85 days.

The lactation period in which the cow begins to produce milk at the end of calving is accepted as a standard of 305 days (Alpan and Aksoy, 2009). Cows with a lactation period of less than 305 days are evaluated on the basis of the number of milking days if they are spontaneously dry, and if the milking period is stopped due to disability, reform, forced slaughter and disease, correction factors are applied according to 305 days. If the lactation period is longer than 305 days, it is assumed that milking takes place twice a day and correction factors are applied according to 305 days (McDaniel *et al*., 1965). The lactation period ends with the dry period, which should be 60 days If the dry period is longer than 60 days or shorter than 40 days, the yield is reduced in the next lactation period (Homan and Wattiaux, 2008)..

In dairy farms, if the conditions for resuming pregnancy are not met, the service period is extended and the number of artificial inseminations per pregnancy increases. As a result, the cost of AI per pregnancy also increases (Alkan *et al*., 2021). In addition to artificial insemination at the right time to initiate pregnancy, there are other factors that affect reproductive performance. These factors are generally expressed as temperature stress, ration, inaccurate estrus detection, foot disease, udder health and metabolic diseases (Walsh *et al*., 2011).

The number of inseminations per pregnancy refers to the number of artificial inseminations performed to get the cow pregnant again after calving. Ideally, this number should be less than 1.5 and this situation is considered successful. If the number of inseminations per pregnancy is 1.8 and above, it is considered unsuccessful (Kaya, 2013). Inchaisri *et al.* (2010) stated that the number of artificial inseminations per pregnancy should be 1.61 to ensure the profitability of the farm. In the literature review, there are different reports on the number of inseminations per pregnancy (Bilgic and Yener, 1999; Kaygısız, 1997; Yıldırım, 1999; Duru and Tuncel, 2002; Orman, 2003; Yaylak, 2003; Saglam and Ugur, 2007; Bayrıl and Yılmaz, 2010; Sahin and Ulutas, 2011; Tangorra *et al*., 2022).

Kaya *et al*. (2003) found the average lactation yield of Holstein, which are known to have the highest milk yield, to be 6232 kg of Italian origin; Yaylak and Kumlu (2005) 6341 kg; Özkök and Uğur (2007) 6729. 2 kg; Orman and Oğan (2008) 4535 kg; Şahin and Ulutaş (2010) 6976 kg; Tutkun (2015) 6198 kg; Sarar and Tapkı (2017) 6588 kg; Genç and Sosyal (2018) 6189 kg.

Looking at the data obtained by Karakçı (1990) in his study where the number of inseminations per pregnancy and the 305-day adjusted lactation milk yield average were analysed together in Holstein cows of different origins, a positive correlation can be mentioned between the number of inseminations per pregnancy and the 305-day adjusted lactation milk yield.

In this study, Holstein cattle were preferred as animal material due to the popularity of the breed and high lactation efficiency. There are studies in the literature (Erdem *et al*., 2007; Sahin and Ulutas, 2010) that have investigated the effect of number of inseminations per pregnancy on reproductive traits. However, the lack of sufficient number of studies investigating the effect of number of inseminations per pregnancy on milk yield shows that this study is original and it is believed that it will provide new information for future studies. This study was conducted to investigate the effect of some environmental factors, especially the number of inseminations per pregnancy, on the milk yield of Holstein cows in private dairy farms in Karapınar district of Konya province between 2016 and 2017.

Materials and Method

The study material was obtained from the herd management programme of a private dairy farm in Karapınar district, Konya province, by collecting data from 90 healthy Holstein breed milking cows in 2016 and 2017. Data belonging to the same animals were selected to be used in the analyses. The records during this period included age, number of inseminations per pregnancy, number of days milked, milk yield during the lactation period, calving season and sequence of lactation.

The lactation periods of cows with lactation periods shorter than 305 days were calculated based on the number of days milked, those whose lactation period was terminated due to disease were calculated by applying correction factors according to 305 days, those with lactation periods longer than 305 days were calculated according to 2 milkings per day and by applying correction factors according to 305 days.

For calving season, December, January, February were grouped as winter season, March, April, May as spring season, June, July, August as summer season and September, October, November as autumn season. The number of inseminations per pregnancy was grouped as 1-2 1; 3-4 2; 5-6 3; 7 and above 4.

The SPSS 26 package was used for statistical analysis of the data obtained. The data were normally distributed (Tabachnick and Fidell, 2013). Correlation was used to determine if there was a relationship between the variables; regression analysis was used to determine the degree of relationship between the variables ($P<0.05$ significant; $P<0.01$ highly significant). The following formula has been used in regression analyses for both years.

$$y=a+bx1+bx2+.....bxz$$

In which; y = dependent variable, a = constant, b = regression coefficient, x = independent variable

The ethics committee report required for the study was obtained with the decision of the Ethics Committee of the Experimental Animal Production and Research Centre (SUVDAMEK) of the Faculty of Veterinary Medicine, Selcuk University, dated 02.11.2023 and numbered 2023/115.

Results and Discussion

It was determined that all values for both years exhibited a normal distribution, and the mean values and standard errors for the variables are provided in Table 1.

The results of the correlation analysis (Table 2) indicated that for the year 2016, there was a significant correlation between lactation yield and both age and sequence of lactation (P<0.05). Additionally, there was a highly significant correlation between the number of inseminations per pregnancy and lactation yield adjusted to 305 days (P<0.01). Similarly, the calculations for the year 2017 also showed a highly significant correlation between lactation yield and these variables (P<0.01).

Table 1. Means and standard errors of the variables.

Variable	Mean ± Std Error	
	2016	**2017**
Lactation yield (kg)	10079.41 ± 3462.573	9767.94 ± 2467.123
Age	3.77 ± 1.374	4.94 ± 1.369
Inseminations per pregnancy	1.79 ± 0.977	2.16 ± 1.027
Number of days milked	364.41 ± 109.736	353.61 ± 69.185
305 days corrected for milk yield	8225.29 ± 1605.399	8315.06 ± 1600.389
Sequence of lactation	2.49 ± 1.603	3.52 ± 1.173

The correlations between age and the number of inseminations per pregnancy, as well as age and lactation yield adjusted to 305 days, were significant for the year 2016. Additionally, the correlation between age and sequence of lactation was found to be highly significant.

The correlation between the number of inseminations per pregnancy and the sequence of lactation was observed to be significant for both 2016 and 2017.

When examining the correlation between lactation yield adjusted to 305 days and the sequence of lactation, a significant correlation was found for 2016, whereas no correlation was found for 2017.

According to the t-test results for the significance of the regression coefficients (Table 3), the lactation yield adjusted to 305 days can be considered a significant determinant of lactation milk yield for the years 2016 and 2017.

In studies investigating the number of inseminations per pregnancy, the following values were reported: Kaygısız (1997) found 2.19; Bilgiç and Yener (1999) found 1.4; Yıldırım (1999) found 1.95; Duru and Tuncel (2002) found 1.33; Orman (2003)

Table 2. Correlation analysis of variables.

2016	**Lactation yield (kg)**	**Age**	**Inseminations per pregnancy**	**305 days corrected for milk yield**	**Calving season**
Age	0.019*				
Inseminations per pregnancy	0.000**	0.031*			
305 days corrected for milk yield	0.000**	0.040*	0.328		
Calving season	0.167	0.333	0.276	0.320	
Sequence of lactation	0.005*	0.000**	0.031*	0.003*	0.464
2017					
Age	0.491				
Inseminations per pregnancy	0.000**	0.085			
305 days corrected for milk yield	0.000**	0.493	0.421		
Calving season	0.288	0.073	0.297	0.078	
Sequence of lactation	0.354	0.000**	0.045*	0.378	0.130

*p<0.05
**p<0.01

found 1.69; Yaylak (2003) found 1.87; Sağlam and Uğur (2007) found 1.60; Bayrıl and Yılmaz (2010) found 1.47; Şahin and Ulutaş (2011) found 1.59; Tangorra *et al.* (2022) found 2.2-2.9. According to Kaya (2013), the value of 1.79 obtained for the year 2016 fell in between and did not show similarity to other studies. Similarly, according to the same statement, the value of 2.16 obtained for the year 2017 showed similarity to the values found by Kaygısız (1997) and Tangorra *et al*. (2022) but was considered unsuccessful. According to Inchaisri *et al*. (2010), the farm failed to reach the ideal number for economic profitability.

Table 3. Regression analyses for predicting variables with lactation milk yield.

Variable	Std error	β	t	P
2016				
Constant*	504.054		-16.242	0.001
Age	122.746	0.028	0.0569	0.571
Inseminations per pregnancy	144.801	-0.023	-0.567	0.572
305 days corrected for milk yield	0.047	0.535	24.322	0.001
Calving season	66.781	-0.015	-0.713	0.478
Sequence of lactation	162.880	-0.057	-1.144	0.256
2017				
Constant*	399.611		17.270	0.001
Age	81.972	-0.045	-0.993	0.323
Inseminations per pregnancy	58.329	-0.021	-0.853	0.396
305 days corrected for milk yield	0.031	0.679	33.851	0.001
Calving season	46.014	0.002	0.088	0.930
Sequence of lactation	96.392	0.019	0.418	0.677

* milk yield in lactation
(For 2016 R:982 R^2=.965 $F_{(8.90)}$=381.801 P:.001)
(For 2017 R:982 R^2=.965 $F_{(8.90)}$=381.801 P:.001)

The results of 305-day milk yield in the studies carried out by some researchers; Kaya *et al*. (2003) found 6232 kg for Italian origin Holsteins; Yaylak and Kumlu (2005) found 6341 kg; Özkök and Uğur (2007) found 6729.2 kg; Orman and Oğan (2008) found 4535 kg; Şahin and Ulutaş (2010) found 6976 kg; Tutkun (2015) found 6198 kg; Sarar and Tapkı (2017) found 6588 kg; and Genç and Sosyal (2018) found 6189 kg. The average lactation milk yield for the year 2016 in this study was 10079.41 kg, and for the year 2017, it was 9767.94 kg. These values were higher than those reported in these studies and did not show similarity. In a study by Karakçı (1990) examining both the number of inseminations per pregnancy and lactation milk yield adjusted to 305 days in cows, the values were reported as follows: for Israeli origin Holsteins, 1.83 and 5119.44 kg; for German origin Holsteins, 1.74 and 4394.17 kg; for American origin Holsteins, 1.48 and 4382.76 kg. Israeli origin Holsteins had higher average milk yields during both the pregnancy per insemination and lactation periods compared to German and American origin ones. Israeli origin Holsteins had the highest pregnancy per insemination and lactation yields. The average number of inseminations per pregnancy and lactation milk yield adjusted to 305 days in this study were 1.79 and 8225.29 kg for 2016, and 2.16 and 8315.06 kg for 2017, respectively. These values are consistent with the findings of Karakçı (1990). According to the study's findings, there is a negative correlation between the number of inseminations per pregnancy and milk yield. That is, while the number of inseminations per pregnancy increased in 2017, the lactation milk yield decreased. As a result of the regression analysis, an increase of 0.37 in the number of inseminations per pregnancy resulted in a loss of 311.47 kg in lactation milk yield, with a loss of 3.4 kg per animal. The analysis results indicate that the number of inseminations per pregnancy alone does not affect milk yield, and many genetic and environmental factors also affect milk yield.

In studies on the effect of calving season on milk yield, some have stated that it affects milk yield, while others have stated that it does not (Ozcan, 1994; Thaler *et al.,* 1996; Pelister, 1998; Reyes, 1998). It has been suggested that the effect of the season on milk yield may arise from factors such as temperature, body weight, breed, and diet (Linwill and Pardue, 1992). In this study, it was found that the effect of the season on lactation milk yield was not statistically significant (P>0.05).

There are researchers who report that sequence of lactation affects lactation milk yield (Kurt, 2001; Erdem *et al*., 2007), as well as researchers who report that there is no effect (Bakir and Cetin, 2003; Tekerli and Gündogan, 2005). While the effect of sequence of lactation was found to be significant for lactation yield in 2016, it was found to be insignificant for 2017. The results obtained in the study support both of these statements expressed by researchers.

Conclusion

In conclusion, according to the study, there is a high-level correlation between the number of inseminations per pregnancy and lactation milk yield, and the regression analysis indicates that an increase in the number of inseminations per pregnancy leads to a decrease in lactation milk yield. Furthermore, an increase in the number of inseminations per pregnancy increases labor requirements, time loss, and causes significant economic losses to the farm. Therefore, inseminations should be performed at the right time and with proper technique. Indeed, managerial errors in farms can also lead to an increase in the number of inseminations per pregnancy and a decrease in lactation milk yields. Additionally, investigating the effects of these and similar factors in subsequent studies will be beneficial for breeders.

Conflict of Interest

The authors declare there is no conflict of interest.

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