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Reproductive Traits of Holstein Cows Raised at Polatli State Farm in Turkey

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Abstract: The present research, was carried out to determine reproductive traits and effects of environmental factors on these traits in Holstein cows raised at polatli state farm located in Ankara province in Turkey. A total of 2177 reproduction records between 1997 and 2006 were constituted the research material. Environmental factors were analyzed by least squares method. The General Linear Model (GLM) was used for variance analyses of reproductive traits. Duncan's multiple range test was used for multiple comparisons between groups. The least square means of gestation duration, first servicing period service period, NIPC and calving interval were 274.97±0.52, 111.55±3.73, 149.60±4.36, 1.72±0.05 and 427.88±4.36 days, respectively. On gestation duration, effects of breeding year, breeding age, birth type and sex of calf were significant ($p<0.001$). However, effect of breeding season on gestation duration was non-significant ($p>0.05$). Effects of breeding age on all reproductive traits (service period, first servicing period, Number of Insemination for Per Conception (NIPC) and calving interval) were significant ($p<0.001$). Effect of breeding season on service period and on calving interval was significant ($p<0.05$). However, effect of breeding season on first servicing period and on NIPC was non-significant ($p>0.05$). As effect of breeding year on all reproductive traits was significant($p<0.001$), it can be said that management was the most important factor which affect on fertility of cows in this study. Long service period and first servicing period may be decreased with injection of GnRH and oestrus detection at the right time and in an appropriate way.

Key words: Cattle, holstein, postpartum anoestrus, reproductive performance, environmental factors, NIPC,

INTRODUCTION

Holstein cows were considered the most dairy cows in world. Holstein-friesians become more prevalent day by day, as is generally the case in most of the countries of the world, due to their high milk and meat production and good adaptation to different climates under good management (Grothe, 1995; Kaya *et al*., 2003). As number of Holstein cows in Turkey is more than other breeds of cattle, breeding of Holstein cows is very important in Turkey. In breeding of dairy cows, the most important aims are to obtain a calf in a year and high milk yield from cows. To obtain a calf in a year from cows dependents on some parameters in ideal limits (60-day dry period, 305-day lactation duration etc.). For these aims, good management in herd of dairy cows is very important. Profitable breeding could be achieved by keeping lactation duration, dry period and service period between optimal limits (Alpan, 1994; Kumuk *et al*., 1999; Cilek and Tekin, 2005; Kocak *et al*., 2007). Getting cows pregnant is the major goal in any dairy farm's reproductive program. There has been a lot of research done to determine the cost of number of days open after a cow's voluntary waiting period following calving. The range varies from $3.00-6.00 per day open per cow (Tahmasbi *et al*., 2004).

The yields of farm animals are the result of the combined effects of genotype and environmental conditions. In order to increase the yield level, it is necessary to optimise 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 un-measurable effects (infectious diseases, parasitic infestations, etc.). The amounts of effects of factors with measurable effects can be determined and they can be used in the planning of management in farm (Yalcin, 1975; Yaylak and Kumlu, 2005; Cilek and Tekin, 2007). In this study, reliable information regarding environmental factors effecting fertility traits of Holstein cows have been gathered.

Average gestation length of Holstein was reported between 278.5 and 280 days (Zambrano *et al*., 2006; Erdem *et al*., 2007; Kocak *et al*., 2007; Kopuzlu *et al*., 2008). It was reported that the longest gestation length in those who calves in spring and the shortest in those who calves in summer (Tilki *et al*., 2003; Cilek and Tekin, 2007).

It was reported that the gestation duration for male births was longer than famela births (Pelister, 1999; Cilek and Tekin, 2005, 2007). Twin births were reported shorter than single births (Pelister, 1999; Cilek and Tekin, 2005, 2007).

First servicing period of Holstein cows was reported between 72.8 and 90.2 days in previous researches (Berry *et al*., 2003; Ajili *et al*., 2007; Melendez and Pinedo, 2007). Service period of Holstein cows was reported between 100.7 and 163.34 days (Olds *et al*., 1979; Kumlu and Akman, 1999; Kaya *et al*., 2003; Ajili *et al*., 2007; Erdem *et al*., 2007; Kocak *et al*., 2007; Melendez and Pinedo, 2007; Kopuzlu *et al*., 2008). Effect of calving season on service period and on calving interval was reported significant (Kocak *et al*., 2007; Kopuzlu *et al*., 2008). However, it was reported non-significant (Cilek and Tekin, 2005, 2007).

Calving interval was found between 393 and 402.4 days by Kumlu and Akman (1999), Erdem *et al*. (2007), Kocak *et al*. (2007), Melendez and Pinedo (2007) and Kopuzlu *et al*. (2008). It was reported that service period and calving interval decreased till 4 years of age and then increased after this age (Inal and Alphan, 1989; Ogan, 2000; Cilek and Tekin, 2007). It was reported that effects of calving age on calving interval was significant in previous research (Özçelik and Arpacik 2000). However, Cilek and Tekin (2005), Erdem *et al*. (2007) and Kocak *et al*. (2007) reported that effect of calving age on calving interval was non-significant.

Number of Insemination for Per Conception (NIPC) was reported between 1.4 and 1.8 (Berry *et al*., 2003; Zambrano *et al*., 2006; Erdem *et al*., 2007; Melendez and Pinedo, 2007). Effects calving age and year on NIPC were reported significant in pervious study (Erdem *et al*., 2007). Effect of calving season was reported non significant by Cilek and Tekin (2005) and Erdem *et al*. (2007).

This study was conducted to determine reproductive traits and to investigate the environmental factors affecting reproductive traits of Holstein cows reared at the polatli state farm between 1997 and 2006.

MATERIALS AND METHODS

At the polatli state farm located in Ankara province, a total of 2177 reproductive records of Holstein cows raised between 1997 and 2006 were used. Seven age groups were formed beginning from 2 years and ending at 8 years and older for calving age; 4 groups for calving season (Spring, Summer, Autumn and Winter) and 10 groups for calving year, between 1997 and 2006.

All gestations ending with a live birth were used in calculation of gestation length. Environmental factors, which were effective on first servicing period, service period, NIPC, calving interval and gestation length were investigated. General Linear Model (GLM) was used for variance analyses of fertility traits. Duncan's multiple range test was used as multiple comparison test between groups.

For gestation length, the statistical model was:

$$Y_{ijklm} = \mu + A_i + B_j + C_k + D_l + F_m + E_{ijklm}$$

Where:

Y_{ijklm} = Observed gestation duration values at breeding age i, season j, calving year k and birth type l and sex of calf m
μ = Mean of total observed values
A_i = Effects of breeding age (i = 2, 3, 4, 5, 6, 7, 8 and older)
B_j = Seasonal effects (spring, summer, autumn winter)
C_k = Eeffect of calving year (k = between 1997 and 2006)
D_l = Effect of birth type (l = single, twin)
F_m = Effect of sex of calf (m = male, female)
E_{ijklm} = Random sampling effects

For first servicing period, service period, NIPC and calving interval, the statistical model was:

$$Y_{ijk} = \mu + A_i + B_j + C_k + E_{ijk}$$

Where:

Y_{ijk} = Observed reproductive values at breeding age i, season j, calving year k
μ = Mean of total observed values
A_i = Effects of breeding age (i = 2, 3, 4, 5, 6, 7, 8 and older)
B_j = Seasonal effects(spring, summer, autumn, winter)
C_k = Effect of calving year (k = between 1997 and 2006)
E_{ijk} = Random sampling effects

RESULTS AND DISCUSSION

The least square means for gestation length were presented in Table 1. Average gestation length was found as 274.97 days. Effects of sex of calf, calving age, calving year, on gestation length were found statistically significant ($p<0.001$). However, effect of calving season was non significant ($p>0.05$).

The least square means for first servicing period, service period, calving interval and NIPC were presented in Table 2. Effects of calving year and calving age on these traits were found significant ($p<0.001$). Average first

servicing period was estimated as 111.55 days. First servicing period was the shortest at 94.41 days in 2 age of year, the longest at 140.70 days in 8 and older age of years. First servicing period was the shortest at 81.44 days in 1998, the longest at 150.38 days in 2004.

Average calving interval was found as 427.88 days. Calving interval changed between 396.99 days in 1998 and 501.54 days in 2006. Calving interval was the shortest at 396.76 days in 2 age of year, the longest at 459.39 days in 7 age of years.

Average of Number of insemination for per conception (NIPC) in this holstein herd was found as 1.7. NIPC was found the shortest in 2 age of years at 1.45, the highest in 8 age of years at 1.84.

In this study, mean of gestation duration was 274.97 days. This value was nearly between limits of previous researches (Zambrano *et al*., 2006; Erdem *et al*., 2007; Kocak *et al*., 2007; Kopuzlu *et al*., 2008). That effect of breeding season was non-significant was not in agreement with literature (Tilki *et al*., 2003; Cilek and Tekin, 2007). The gestation duration for single and male births was longer than that for twins and female births, this result agreed with those of previous researches (Pelister, 1999; Cilek and Tekin, 2005, 2007). Effect of breeding year on gestation duration was significant. Gestation duration changed between 274.1 days in 2005 and 276 days in 2004. This may have influenced the nutrition quality of rations, which might have become deficient and irregular, leading to a later end of gestation as an mechanism for adjusting to adverse climatic and nutrition conditions.

In this study, average 1rst servicing period was estimated as 111.55 days. This value was higher than ideal value (60-90 days) and literature values (Berry *et al*., 2003; Ajili *et al*., 2007; Melendez and Pinedo, 2007). High first

Table 1: The least square means of gestation length (day)

Factors	n	Mean±SE
Calving age		***
2	1144	274.2±0.51d
3	386	275.3±0.56c
4	276	275.4±0.58c
5	176	276.8±0.63a
6	113	276.1±0.71b
7	51	274.1±0.91d
8 and older	31	272.9±1.10e
Calving season		ns
Spring	585	275.0±0.55
Summer	441	274.6±0.58
Autumn	552	274.9±0.57
Winter	599	275.4±0.57
Calving year		***
1997	255	274.5±0.61bc
1998	240	275.5±0.63ab
1999	50	275.0±0.94abc
2000	211	274.2±0.66c
2001	286	275.2±0.62abc
2002	245	275.6±0.62ab
2003	317	275.2±0.59abc
2004	219	276.0±0.61a
2005	298	274.1±0.58c
2006	56	274.3±0.89c
Sex of calf		***
Male	1134	274.4±0.54b
Female	1004	275.6±0.54a
Birth type		***
Single	2106	278.3±0.24a
Twin	71	271.7±0.98b
Overall mean	2177	274.97±0.52

Table 2: The least square means of service period, calving interval, first servicing period (day) and NIPC

Factors	N	First servicing period (day)	Service period (day) Mean±SE	NIPC (number) Mean±SE	Calving interval (day) Mean±SE
Breding age		***	***	***	***
2	474	94.41±4.27b	118.68±4.99d	1.45±0.05b	396.76±4.99d
3	366	95.84±4.73b	134.66±5.52d	1.70±0.06a	412.94±5.53cd
4	264	110.67±5.50b	158.04±6.42b	1.82±0.07a	436.66±6.43b
5	167	108.11±6.65b	155.94±7.76bc	1.76±0.08a	435.62±7.77b
6	107	99.27±8.27b	137.51±9.66cd	1.69±0.10a	417.10±9.67bc
7	48	131.87±1.98a	182.00±13.99a	1.78±0.15a	459.39±14.02a
8 and older	31	140.70±14.86a	160.38±17.36b	1.84±0.18a	436.70±17.38b
Breeding season		ns	*	ns	*
Spring	402	114.02±5.23	154.80±6.11ab	1.75±0.06	433.03±6.12b
Summer	316	115.51±5.59	161.81±6.53a	1.79±0.07	439.62±6.54a
Autumn	366	107.36±5.11	141.14±5.96bc	1.68±0.06	419.49±5.97c
Winter	373	109.32±5.43	140.65±6.34c	1.66±0.07	419.38±6.35c
Breeding year		***	***	***	***
1997	179	109.20±6.55bcd	131.25±7.64cde	1.57±0.08d	408.81±7.65de
1998	183	81.44±6.44e	117.87±7.52e	1.90±0.08bc	396.99±7.53e
1999	37	97.18±14.24de	134.85±16.63cde	1.76±0.17cd	413.19±16.65cde
2000	44	113.40±?12.86bcd	137.138±15.02cde	1.54±0.16d	416.09±15.04cde
2001	175	100.12±7.193cde	130.68±8.41de	1.62±0.09d	409.35±8.41de
2002	220	119.39±6.42bc	151.209±7.50cd	1.54±0.08d	429.53±7.51cd
2003	228	104.57±6.10bcd	132.62±7.13cde	1.56±0.07d	410.97±7.14de
2004	169	150.38±6.71a	155.07±7.84c	1.19±0.08e	434.08±7.85c
2005	183	116.88±6.36bcd	181.27±7.43b	2.09±0.08b	458.25±7.44b
2006	39	122.97±13.39b	224.04±15.64a	2.43±0.16a	501.54±15.66a
Overall mean	1457	111.55±3.73	149.60±4.355	1.72±0.05	427.88±4.36

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

servicing period which was found in this study may be related to postpartum anoestrus. In this farm, it can be said that oestrus detection was not performed at the right way. In this farm, accurate oestrus detection in cows will decrease in first servicing period. The most important factors were breeding age and breeding year. First servicing period in the youngest cows was shorter than value in oldest cows. Differences of first servicing period among breeding years may be related to the management differences. Oestrus detection was carefully performed early time in this farm. Furthermore, accurate techniques may be used for oestrus detection.

The average calving interval was higher than ideal value (365 days) and literature (Kumlu and Akman, 1999; Erdem *et al*., 2007; Kocak *et al*., 2007; Melendez and Pinedo, 2007; Kopuzlu *et al*., 2008). Similarly, as service period, it can be said that except for 6 years cattle, service period with age of cows increased.

Several methods are considered for oestrus detection such as, calendar method, observation method, vaginal examination, conductive meter, progestrone test of milk, measurement of vaginal pH, measurement of boby temperature, searching bull, ultrasonography (Coyan and Tekeli, 1996). These methods can be used in this farm for shorter service period. In cows with lactation, synthesis osterogene from interstitial cells stops, GnRH secretion is inhibited and increased cortisone level inhibites secretion of LH. This situation is postpartum anoestrus (Coyan and Tekeli, 1996). Postpartum anoestrus is the one of the most important reasons for long service period and calving interval.

Although, 305 days milk yields and parity (lactation number, age of cows) are generally adversely associated with fertility, service period may be significantly reduced by the use of a GnRH injection. Injection of GnRH during artificial insemination under this dairy farm conditions should improve reproductive performance (Tahmasbi *et al*., 2004).

Service period of Holstein cows was reported 149.6 days. This value is higher than ideal value (60-90 days) and at top of limits in literature (Olds *et al*., 1979; Kumlu and Akman, 1999; Kaya *et al*., 2003; Ajili *et al*., 2007; Erdem *et al*., 2007; Kocak *et al*., 2007; Melendez and Pinedo, 2007; Kopuzlu *et al*., 2008). That effect of calving season on service period was significant was in agreement with previous researches (Kocak *et al*., 2007; Kopuzlu *et al*., 2008). As reported by Cilek and Tekin (2005), the fact that the service period and NIPC were shorter in cows calving in Winter may result from the effects of temperature and humidity and the availability of green fodder during the spring, which might favour the physiological functioning of different systems. Except for 6 years cows, service period generally increased with breeding age in this study. This result was not in agreement with literature (Inal and Alphan, 1989; Ogan, 2000; Cilek and Tekin, 2007). Except for 6 years cattle, increasing of service period with age of cows may be associated with degenerative endometrial changes. Decrease in service period in 8 years and older, may result from keeping with good fertility in the herd. After 1999, rapidly increasing level in milk yield reported by Cilek (2009) in this farm may be the reason for the extension of the service period. As reported by Kaya *et al*. (2003), higher yield is associated with reduced reproductive performance in lactating cows and one of the most common causes of low fertility in dairy cows is negative energy balance in early lactation.

Number of Insemination for Per Conception (NIPC) was found as 1.72. This value was top of limits in literature (Berry *et al*., 2003; Zamrano *et al*., 2006; Erdem *et al*, 2007; Melendez and Pinedo, 2007). That effects calving age and year on NIPC were found was in agreement in previous study (Erdem *et al*., 2007). Similarly, after 1999, increasing in milk yield reported by Çilek (2009) may be reason of increasing in NIPC, in service period and calving interval. Increasing of these values may be also related to the endocrine system and postpartum anoestrus. In cows with high milk yield, injection of GnRH during artificial insemination should be done to improve reproductive performance and to avoid from postpartum anoestrus. Oestrus detection of cows with high milk yield was carefully performed. Furthermore, accurate techniques may be used for oestrus detection, for example, conductive meter, progesterone test of milk, measurement of vaginal pH, searching bull, ultrasonograpic examination.

CONCLUSION

In this study, service period and calving interval and NIPC was higher than ideal levels. As affecting factor on all reproductive traits (service period, first servicing period, Number of Insemination for Per Conception and calving interval) was breeding year, management is the most important factor in this farm. Management was done carefully in this farm. Oestrus detection and artificial insemination should be performed at the right time and in an appropriate way. Accurate techniques should be used for oestrus detection. In order to make animals more profitable, it is essential that they be made pregnant as soon as possible during the service period in order to shorten the dry period. It can be concluded that Holstein cattle are raised unsuccessfully for reproductive yield on Polatli state farm and under steppe climate conditions in

Turkey. Service period may be significantly reduced by the use of a GnRH injection. Injection of GnRH during artificial insemination may improve reproductive performance of cows with high milk yield and postpartum anoestrus. In this farm, service period and first servicing period may be decreased with injection of GnRH and oestrus detection at the right time and in an appropriate way.

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