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Research Article

Some Fertility traits of Holstein friesian cattle raised at various production scales in the Western Mediterranean Region of Turkey

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ABSTRACT

The presented study aimed to investigate the fertility traits and to determine the effect of the production scales and other environmental factors on fertility traits of the dairy enterprises in the Western Mediterranean Region of Turkey. Dairy enterprises were divided into 4 groups based on animal numbers; Group I (1-10 heads), Group II (11-50 heads), Group III (51-100 heads), and Group IV (≥101 heads), respectively. Results indicated that the relationship between the production scales of enterprises and calving intervals as well as the service period was highly significant ($p<0.001$). Group I had the highest calving interval (468.95 ± 7.93 days) and the highest service period (185.95 ± 7.93 days). Whereas, Group II had the lowest calving interval (414.06 ± 5.71 days) and service period (131.06 ± 5.71 days) values. The present study showed that the production scale of the enterprise is one of the main environmental factors influencing fertility traits. Therefore, comprehensive activities focusing on the economic efficiency of cow breeding programs, containing both milk yield and reproduction traits would be more appropriate for the implementation of profitability or productivity in the dairy industry.

Türkiye'nin Batı Akdeniz Bölgesinde farklı üretim ölçeğiyle yetiştiriciliği yapılan Holstein Friesian sığırlarda döl verimi özellikleri

ÖZ

Bu çalışmanın amacı, Türkiye'nin Batı Akdeniz Bölgesi'ndeki süt sığırcılığı işletmelerinin fertilite özelliklerini araştırmak ve üretim ölçekleri ile diğer çevresel faktörlerin fertilite özelliklerine etkisini belirlemektir. Çalışmada süt sığırcılığı işletmeleri hayvan sayısına göre Grup I (1-10 baş), Grup II (11-50 baş), Grup III (51-100 baş) ve Grup IV (≥101 baş) olmak üzere 4 gruba ayrılmıştır. Sonuçlar, işletmelerin üretim ölçekleri ile buzağılama aralıkları ve servis periyodları arasındaki ilişkinin oldukça anlamlı olduğunu göstermiştir ($p<0,001$). Grup I en yüksek buzağılama aralığına (468,95 ± 7,93 gün) ve en yüksek servis periyoduna (185,95 ± 7,93 gün) sahipken Grup II'nin en düşük buzağılama aralığı (414,06 ± 5,71 gün) ve servis periyodu (131,06 ± 5,71 gün) değerlerini taşıdığı saptanmıştır. Bu çalışma, işletmelerin üretim ölçeğinin fertilite özelliklerini etkileyen ana çevresel faktörlerden biri olduğunu göstermiştir. Bu nedenle, bölgede süt verimini artırmaya yönelik ıslah yerine, ekonomik verime odaklı süt ve döl verimini içine alan kapsamlı bir ıslah faaliyetinin daha doğru olacağına inanılmaktadır.

INTRODUCTION

Fertility is one of the main parameters commonly used for the evaluation of productivity in dairy enterprises. The sustainability and growth of the herd closely related to the fertility. The main aim of dairy farming enterprises is to obtain one healthy calf a year. As a common concept in dairy milk production, cover the expenses such as feed, veterinarian, staff salaries, etc. with milk sale and calf is the profit of enterprises (1).

Although fertility has been ignored as a parameter in the past, it has become one of the major problems for producers faced in herd management. Enterprises with low fertility scores are face expenses such as extra frozen semen, veterinary expenditures, culling costs (2). A large number of criteria are used for the definition of fertility in dairy enterprises includes; calving interval, service period, and the number of inseminations per pregnancy (3).

A number of previously conducted studies have been reported the fertility characteristics of Holstein cattle raised in Turkey and have stated that the average calving interval, service period, and the number of inseminations per pregnancy range from 364 to 438 days (4-6), 88 to 150 days (4,6,7) and 1.28 to 2.4 (7), respectively. Studies in the literature were mainly focused on defining the effects of environmental factors on fertility traits such as the number of lactations, calving season and calving year as the environmental factors (3,8,9), except a single study focused on the production scale of enterprises (10). Therefore, the present study was aimed to prove the effect of production scale on the enterprises' fertility traits.

MATERIAL and METHODS

The animals included 2,005 fertility records of 796 Holstein Friesian cows between the years of 2011 and 2017. The Cattle Breeders' Association of Turkey provided the data in the

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Table 1. Least square means for the effects of factors on some fertility traits (Mean±SE)are given in parentheses.

Factors	n	Calving interval, day	Service period, day	Number of inseminations per successful pregnancy
Production scale (head)				
Group I (1-10)	291	468.95^{a}±7.93	185.95^{a}±7.93	1.68^{ab}±0.09
Group II (11-50)	506	414.06^{c}±5.71	131.06^{c}±5.71	1.48^{b}±0.06
Group III (51-100)	571	428.58^{bc}±5.66	145.57^{bc}±5.66	1.52^{b}±0.06
Group IV (≥101)	637	437.65^{b}±4.83	154.65^{b}±4.83	1.80^{a}±0.05
P-Value		0.000***	0.000***	0.001**
Calving year				
2011	137	424.40^{ab}±10.42	141.40^{ab}±10.42	1.46^{ab}±0.12
2012	132	455.40^{a}±10.47	172.40^{a}±10.47	1.24^{b}±0.12
2013	256	446.29^{a}±7.80	163.29^{a}±7.80	1.63^{a}±0.09
2014	335	443.87^{a}±6.77	160.87^{a}±6.77	1.69^{a}±0.08
2015	380	451.75^{a}±6.20	168.75^{a}±6.20	1.69^{a}±0.07
2016	349	430.62^{ab}±6.23	147.62^{ab}±6.23	1.81^{a}±0.07
2017	416	408.85^{b}±5.58	125.85^{b}±5.58	1.73^{a}±0.06
P-Value		0.000***	0.000***	0.001**
Province				
Antalya	278	428.95±7.11	145.95±7.11	1.37^{c}±0.08
Burdur	901	441.48±4.83	158.48±4.83	1.59^{b}±0.05
Denizli	514	440.96±5.64	157.96±5.64	1.77^{a}±0.06
Isparta	312	437.84±7.41	154.84±7.41	1.70^{ab}±0.08
P		0.417	0.417	0.000***
Lactation no.				
1	603	438.74±4.64	155.74±4.64	1.35^{b}±0.05
2	527	440.65±5.15	157.65±5.15	1.67^{a}±0.06
3	372	432.67±6.24	149.66±6.24	1.77^{a}±0.07
4	240	426.93±7.76	143.93±7.76	1.58^{ab}±0.09
5	141	429.21±9.97	146.21±9.97	1.44^{ab}±0.11
≥6	122	455.66±11.07	172.66±11.07	1.81^{a}±0.12
P-Value		0.184	0.184	0.000***
Calving season				
Spring	426	438.71±6.20	155.71±6.20	1.53±0.07
Summer	472	439.51±6.00	156.51±6.00	1.62±0.07
Autumn	351	438.67±6.57	155.67±6.57	1.64±0.07
Winter	756	432.34±4.94	149.34±4.94	1.63±0.05
P-Value		0.628	0.628	0.606
Overall	2005	437.31±2.50	154.31±2.50	1.61±0.03

**:P<0.01, ***: P<0.001. abc: Means within the same column followed by different letter are statistically significant. ns: Non-significant (P>0.05)

Antalya, Burdur, Denizli, and Isparta cities of Turkey.

The dairy cattle enterprises were categorized based on their production scale, namely, Group I (1 - 10 heads), Group II (11 - 50 heads), Group III (51 - 100 heads), and Group IV (≥ 101 heads). The fertility traits were calving interval, service period, and the number of inseminations per pregnancy. Each lactation among the first and fifth lactation was grouped as an individual, and lactation number sixth, and more categorized as a separate lactation group. Calving seasons; December, January, and February months were classified as winter; March, April, and May as spring; June, July, and August as summer; and September, October, and November as autumn. Calving years were covers from 2011 to 2017.

The generalized linear model was used to determine the effects of factors such as the production scale of enterprises, differences in provinces, lactation number, calving season, and calving year on some fertility traits. Tukey's multiple comparison test was used to determine the significances of the differences between the subgroups (7). For this purpose, the statistical model below was created as;

$Yijklm= \mu + Ai+Bj+Ck+Dl+Fm+eijklm$

μ= mean of total observed values

Ai= Production scale effects of enterprises (i = 1-10, 11-50, 51-100, ≥ 101 heads)

Bj= Effects of calving year (j= 2011, 2012, 2013, 2014, 2105, 2016, 2017)

Ck= Effects of provinces (k = Antalya, Burdur, Denizli, and Isparta)

Dl= Effects of lactation number (l = 1, 2, 3, 4, 5, 6, and more)

Fm= Seasonal effects (m = spring, summer, autumn, winter)

Yijklm= Observed fertility traits at scale of enterprises (i), calving year (j), provinces (k), lactation number (l), and calving season (m)

eijklm= Random sampling effects

RESULTS

In the present study, the corrected fertility traits mean of Holstein cattle in all groups; calving interval, service period, and the number of inseminations per pregnancy were 437.31 ± 2.50 days, 154.31 ± 2.50 days, and 1.61 ± 0.03, respectively. The calving interval, service period, number of inseminations per successful pregnancy are presented in Table 1. The data indicates that there was a statistically significant relationship between the production scale of enterprises and fertility traits ($p<0.01$). Calving interval and service period values in Group I were found to be statistically higher than those of production scale categories ($p<0.001$). On the contrary, calving interval and service period values in Group II were found to be statistically the lowest than those other groups of in production scale categories ($p<0.001$). The difference between the number of inseminations per pregnancy of the enterprises and the production scale categories was statistically significant in all groups ($p<0.01$). Table 1.

The effects of calving year on fertility traits was statistically significant ($p<0.001$). The calving interval and service period values were the lowest in 2017 and significantly different from the values in all of the examined years, except 2011 and 2016 ($p<0.001$). The number of inseminations per pregnancy was the lowest in 2012, which was statistically significantly different from all years except for 2011 and was the highest in 2016 and 2017 ($p<0.01$).

The number of inseminations per pregnancy in Antalya province was the lowest ($p<0.01$). However, there was an insignificant difference between provinces in terms of calving interval and service period ($p>0.05$) (Table 1). The effect of the number of inseminations per pregnancy on the number of lactations is statistically significant ($p<0.001$), but calving interval and service period are not significant effect on this value ($p>0.05$). Moreover, the effect of calving season on fertility traits was statistically insignificant ($p>0.05$).

DISCUSSION

In this study, the effect of production scales on fertility traits besides the effect of other environmental factors on fertility parameters were investigated. The originality of the presented study was that the production scale of the enterprise was effective on the some fertility traits ($p<0.001$). Group II had the lower calving interval and service period values than other groups. This particular success of medium - scale enterprises should be associated with the fact that they are usually serviced by experienced field veterinarians. In contrast, in large - scale enterprises usually choose young veterinarians due to their low veterinary service fee charge. Additionally, herd control and tracing of oestrus were effective in the cows in medium - scale enterprises (Group II) compared to the large - scale enterprises. The calving interval and service period values in Group I were higher than those of medium - scale enterprises and were similar to large - scale enterprises. Enterprises at the small - scales usually have limited financial resources. Therefore, they are unable to follow technological developments in animal caring and feeding. Although the organization and management of cattle seem easier in small - scale enterprises, they had a higher fertility value compared to those of the enterprises in other groups. The underlying reason for these results would be the lack of access to financial resources and innovation opportunities. A single study of reported that the calving interval was the shortest in enterprises with 6-10 heads of dairy cows, and they stated that calving interval was close to each other and had the highest values in enterprises with 1-6 heads of dairy cows (10). As observed in present work they suggested that growth in animal numbers was closely related with calving interval.

The effect of calving year on calving interval, service period and the number of inseminations per pregnancy was statistically significant ($p<0.001$), and our results supported by previously conducted studies as well (3,4,7,11); however, some studies were unable to find such a statistical relationship

(8,9,12,13).

Despite optimum calving interval and optimum service period were reported as 365 days and 60 - 90 days in the literature (14), which were quite lower than our results. The reason for these differences in milk yields in the region is more likely to be the fact that the milk yield is above the average value reported in Turkey. Besides, high milk yields adversely affect fertility as well. As stated in the previous studies, there is a negative phenotypic correlation between calving interval and milk production in high-yielding dairy cattle (15-18). Our values on fertility traits were much higher than previous study (8) carried out in the same provinces from 2004 to 2005. The breeding aimed at increasing milk yield over the recent years resulted in lowered fertility. In the present study, the service period changed 150 days, which is far above the accepted value (60-90 days). The longer service period indicates the ineffectiveness of oestrus tracing and insemination periods in dairy cow units.

Although the optimum value of the number of inseminations per pregnancy is 1.0, it is quite difficult to achieve this level for many reasons in practice. Therefore, values up to 1.5 are acceptable within the standard (14,19). In the present study, 1.65 ratio was in parallel to the references (20,21) somewhat higher than (3,22,23) and were lower than those of previously published reports (13,24).

The effect of the lactation number on calving interval and service period was statistically insignificant ($p>0.05$) (Table 1). The results were supported by the previous studies (3,8,11,13). On the other hand, some of the studies suggested the effect of the lactation number on calving interval (9,12) and service period (9,12,21,25) was important.

Effects of the number of inseminations per successful pregnancy on the lactation number was statistically significant ($p<0.05$). The value was the lowest in the cows in the first lactation (1.35 ± 0.05) and the highest in the cows at the sixth lactation and onwards (1.81 ± 0.12) ($p<0.001$). The number of inseminations per successful pregnancy rises rapidly following the first lactation. The incidences of repeat breeding problems increase with lactation numbers for a successful conception in dairy cows. Although, our results related to the number of inseminations per successful pregnancy and lactation number was significant ($p<0.05$) that was supported by previous studies (3), some studies suggested the effect of lactation number on the number of inseminations per pregnancy was insignificant (11,13,24).

In the present study, there was no statistical difference between the effects of calving season on fertility ($p>0.05$). These findings were supported by previous studies (3,8,913), but some studies suggested the presence of a significant relationship between season and fertility parameters (4,11,12,23).

CONCLUSION

The results indicated that the values of the calving interval, service period, and the number of inseminations per pregnancy in the Holstein cows in the Western Mediterranean Region of Turkey were higher than those of the globally accepted optimum values for Holstein cows. The breeding of cows based on the high milk yield negative effects on fertility. Thus, more attention should be paid to the tracing of oestrus to regularly obtain a calf every year in the high - yield cattle enterprises. According to our study, there was a significant relationship between production scale and fertility parameters. Also, the difference in management and organization might affect negatively and positively on fertility. As suggested previously, the genetic selection of dairy cows may result in an improvement in the fertility characteristics of dairy cows because the hereditary coefficient of reproduction is low but the coefficient of variation is very high. In this case, Scandinavian breeding programs that address the problem of genetic correlation between fertility and milk yield could serve as a better model. The features that make the Scandinavian dairy cattle breeding program from other milk-based programs are the addition of fertility and mastitis resistance characteristics of cows into milk yield. Although the program has a disadvantage in increasing milk yield, it may have an advantage of better economic efficiency. As a result, comprehensive breeding focusing on economic efficiency, including both milk yield and reproduction traits would be more appropriate rather than breeding on exclusively increasing milk yield in dairy enterprises.

DECLARATIONS

Ethics Approval

This study was approved by Non-Clinical Research Ethics Committee of the Burdur Mehmet Akif Ersoy University (No: GO 2018/103), Burdur.

Conflict of Interest

The authors declare that they have no competing interests.

Author Contribution

Idea, concept and design: Y Öztürk,

Data collection and analysis: Y Öztürk, C Sipahi

Drafting of the manuscript: Y Öztürk, C Sipahi

Critical review: Y Öztürk, C Sipahi

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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