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Calving season affects reproductive performance of high yielding but not low yielding Jersey cows

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Abstract

Days from calving to first insemination, days open and calving interval in Jersey cows with low (1522-2476 kg) and high (3917-7116) lactation milk yield were determined to evaluate the effect of calving season on the reproductive performance of Jersey cows. A total of 1269 lactation milk yield record of 462 Jersey cows were analysed and data were classified according to calving season into four different climatic seasons (winter, spring, summer and autumn). Days from calving to first insemination in high producing cows (104.0±3.4 d) was 44 days longer ($P<0.001$) compared to low producing cows (59.5±3.3 d), while this period in high producing cows calving in summer months (128.4±7.4 d) was found to be 42 days longer ($P<0.001$) than those calving in winter months (86.0±5.7 d). Days open in high producing cows calving in summer months (151.2±8.7 d) were 35 days longer ($P<0.001$) than those calving in winter months (116.4±6.7 d). Calving interval was 18 days longer ($P<0.05$) in high producing cows calving in spring (388.1±7.7 d) compared to high producing cows calving in winter months (367.9±6.9 d). These results show that reproductive performance of high producing Jersey cows are adversely affected by the high environmental temperature and/or vegetation in summer months compared to the low producing Jersey cows.

Introduction

Genetic selection has resulted in a dramatic increase in milk yield in dairy cows over the years. This has been reported to be associated with an increase in the incidence of reproductive disorders and infertility of dairy cows in the USA (Butler, 2000; Rajala-Schultz and Fraser, 2003). The decline in fertility in modern dairy cows is of major concern (Lucy, 2001). It has been reported that the rate of decline in fertility parameters was around 0.5% in the USA (Butler and Smith, 1989) and 1% in the UK (Royal et al, 2000) per annum. Equivalent decreases in reproductive efficiency in dairy cattle have been reported in Ireland (Roche et al., 2000), Australia (Macmillan et al., 1996), Spain (Lopez-Gatius, 2003) and South Africa (Muller at al., 2000). Genetic correlations between milk yield and reproductive measures in dairy cattle are unfavourable (Pyrce and Veerkamp, 2001). This suggests that successful selection for higher yields may have lead to a decline in fertility. The reason for a reduced reproductive efficiency in high yielding dairy cows may be due to an imbalance of nutrients, high genetic merit for production, or diets not matched to performance (Pryce et al., 2004).

The decrease in reproductive efficiency in dairy cows worldwide is not solely due to increase in milk yield. There are equally important other factors contributing to the problem. These may include negative energy balance of the cow, increasing herd size and global warming. Seasonal changes on the reproductive performance of dairy cows have been reported and the effect of season has been attributed to the heat stress rather than changes in vegetation (De Rensis and Scaramuzzi, 2003). The impacts of heat stress on reproductive efficiency have been well documented (Hansen and Arechiga, 1999; Wolfenson et al., 2000; Kadzere et al., 2002; Jordan, 2003; De Rensis and Scaramuzzi, 2003). The adverse effect of heat stress on the reproductive performance of high yielding dairy cows may be more dramatic due to not only high milk yield but also metabolic heat increment in high yielding cows. Therefore in the present study, seasonal changes on the reproductive performance of Jersey cows differing in lactation milk yield were investigated.

Materials and methods

Data of 1269 lactation record of 462 Jersey cows raised in a farm between the years 1984 and 2000 in Samsun at the sea level on the Black Sea region of Turkey were used in the study. Data for reproductive performance of cows were also collected. Data for cows between 1st and 5th were used. The mean lactation milk yield of the herd was 3195.7±20.2 kg. Means of the herd for calving interval, open days, interval from calving to first insemination, lactation period, gestation length and dry period were 366.6±1.7 d, 92.9±1.6 d, 78.0±1.3 d, 301.7±1.1 d, 275.2±0.2 d and 69.3±0.8 d, respectively. During the studied period, the maximum environmental temperatures above 25°C on the farm were observed in all months except December and January. Temperatures above 30°C were observed between March and October. The observed maximum humidity was almost 100% in all months.

Lactation milk yield of cows were classified into 3 levels; cows with the milk yield of 1 standard deviation above the herd mean was considered as high yielding cows, those of 1 standard deviation below the herd mean was considered as low yielding cows, and cows with the milk yield between these limits were considered as average yielding cows (Table 1). Then, reproductive performance data for each milk yield level were classified into four different calving seasons, namely as winter, spring, summer and autumn calvers. Means of milk yield for these calving seasons are summarised in Table 1.

Table 1. Classification of the data into calving months and lactation milk yield groups.

Calving season	Months	n	Lactation milk yield (kg)
Winter	December-February	380	3275.4 ± 36.2
Spring	March-May	319	3236.3 ± 44.0
Summer	June-August	287	3104.3 ± 40.2
Autumn	September-November	283	3135.5 ± 40.2
Level of milk yield	Range (kg)	n	
Low	1522 – 2478	188	2158.5 ± 18.5
Average	2479 – 3914	893	3160.3 ± 12.3
High	3915 - 7116	188	4401.0 ± 35.6

Data were subjected to analysis of variance, and calving seasons and milk yield levels were used as main factors, calving age (month) was used as covariant and calving year was used as dummy factor in the model under the GLM model of SPSS. The differences between the means were compared by LSD test and the means were presented as mean±s.e.m.

Results

Days from calving to first insemination in Jersey cows with different milk yields calving in different seasons are presented in Table 2. Days from calving to first insemination increased with the increase in milk yield (P<0.001). Days from calving to first insemination in high producing cows (104.0±3.4 d) was 44 days longer (P<0.001) compared to low producing cows (59.5±3.3 d), while this period in high producing cows calving in summer months (128.4±7.4 d) was found to be 42 days longer (P<0.001) than those calving in winter months (86.0±5.7 d). Similar results were observed for cows with average milk yield (P<0.001). However there were no effects of calving season on the days from calving to first insemination of cows with low milk yield (P>0.05).

Days open in Jersey cows with different milk yields calving in different seasons are presented in Table 3. Days open increased with the increased in milk yield (P<0.001). Days open in high producing cows (132.4±4.0 d) were 63 days longer (P<0.001) compared to low producing cows (68.9±3.9 d). Days open in high producing cows calving in summer months (151.2±8.7 d) were 35 days longer (P<0.001) than those calving in winter months (116.4±6.7 d). Similar results were observed for cows with average milk yield (P<0.01). However there were no effects of calving season on the days open of cows with low milk yield (P>0.05).

Calving interval increased (P<0.001) with the increase in milk yield (Table 4). Calving interval was 26 days longer in high yielding cows (377.6±4.5 d) compared to that in low producing cows (351.1±4.7). There was no effect of calving season on calving interval (P>0.05). However, calving interval was 18 days longer (P<0.05) in high producing cows calving in spring (388.1±7.7 d) compared to high producing cows calving in winter months (367.9±6.9 d).

Table 2. Days from calving to first insemination in Jersey cows with different milk yields calving in different seasons (days).

Calving season	Level of milk yield			
	Low	Average	High	Overall
Winter	59.4±6.0	67.1±2.6 b	86.0±5.7 b	70.8±2.9 a
Spring	52.0±6.6	80.0±3.0 a	101.8±5.9 b	77.9±3.1 ab
Summer	64.1±6.7	79.8±3.0 a	128.4±7.4 a	90.8±3.5 c
Autumn	62.4±6.7	84.4±3.2 a	99.7±7.5 b	82.2±3.5 bc
Overall	59.5±3.3 A	77.8±1.5 B	104.0±3.4 C	

a, b: Values in the same column not sharing a common superscript differ significantly; A, B, C: Values within row with different letters differ significantly (P<0.001).

Discussions

The results presented in this study show that reproductive performance of Jersey cows decreases with the increase in milk yield, and seasonal changes in the reproductive performance of cows indicate that high yielding Jersey cows, but not low yielding cows, are adversely affected by the seasonal changes which may reflect the adverse effect of heat stress. Observations in the present study are in agreement with the previous reports that increase in milk yield causes a decrease in reproductive performance (Royal et al., 2000; Pyrce and Veerkamp, 2001; Pryce et al., 2004).

Table 3. Days open in Jersey cows with different milk yields calving in different seasons (days).

Calving season	Level of milk yield			
	Low	Average	High	Overall
Winter	67.5±7.0	82.5±3.1 b	116.4±6.7 b	88.8±3.4 c
Spring	68.8±7.7	97.3±3.5 a	132.1±6.8 ab	99.4±3.6 d
Summer	69.3±7.9	88.7±3.5 ab	151.2±8.7 a	103.1±4.1 d
Autumn	70.1±7.9	93.8±3.8 a	129.8±8.8 ab	97.9±4.1 cd
Overall	68.9±3.9 A	90.6±1.7 B	132.4±4.0 C	

Values in the same row not sharing a common superscript differ significantly, a, b: (P<0.001); c, d: (P<0.05); A, B, C: Values in the same row not sharing a common superscript differ significantly (P<0.001).

Table 4. Calving interval in Jersey cows with different milk yields calving in different seasons (days).

Calving season	Level of milk yield			
	Low	Average	High	Overall
Winter	347.0±9.8	369.1±3.5 ab	369.7±6.9 b	362.0±4.2
Spring	352.5±10.5	361.0±4.4 b	388.1±7.7 a	367.2±4.6
Summer	355.4±8.7	373.2±3.9 a	382.9±11.8 ab	370.5±5.1
Autumn	349.6±8.1	363.6±3.9 ab	369.6±8.4 ab	360.9±4.1
Overall	351.1±4.7 A	366.7±2.0 B	377.6±4.5 C	

a, b; Values within column with different letters differ significantly; A, B, C: Values within row with different letters differ significantly (P<0.001).

Days from calving to the first insemination, days open and calving interval in high yielding Jersey cows were longer in summer calvers than winter calvers in the present study. The effect of calving season on these reproductive performance parameters indicate that such effects may be due to the adverse effect of heat stress. The decrease in conception rate during the hot season can range between 20 and 30 % compared to the winter season (De Rensis and Scaramuzzi, 2003). Heat stress has been shown to alter the duration of oestrus, conception rate, uterine function, endocrine status, follicular growth and development, luteolytic mechanism, early embryonic development and fetal growth (Badinga et al., 1993; Roth et al., 1997; Barash et al., 2001; Jordan, 2003). The effects of heat stress on fertility can appear to carry into the autumn (Roth et al., 1997; Wolfenson et al., 2000). These effects of heat stress on fertility may explain the decreased reproductive performance of high yielding Jersey cows calving during summer months in the present study. Another factor contributing this effect of heat stress on reduced reproductive performance of high yielding but not low yielding cows may be the fact that increase in milk yield results in an increase in metabolic heat due to the increase in food intake (Kadzere et al., 2002) and also negative energy balance of high yielding cows (Butler, 2000).

In conclusion, the results presented here demonstrate that high yielding dairy cows are more vulnerable to the heat stress compared to low yielding Jersey cows in terms of reproductive performance.

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