Factors Affecting Calving Interval in Italian Holstein-Friesian Heifers

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ABSTRACT

Effect of rump conformation on calving interval of 520 Italian Holstein Friesian heifers was evaluated with simultaneous adjustment for herd, year of birth, calving month, age at first parturition, and milk production. All factors, except age at first parturition, were important sources of variation. Heifers with narrow rumps at the pins had the longest calving interval. There were significant differences among the herds. Cows born between 1979 and 1981 had shorter calving intervals, probably resulting from a national plan against bovine infertility initiated in 1981. Cows calving in July had better reproductive performance. There was positive relationship between milk production and calving interval.

INTRODUCTION

Lifetime profitability of cows is a function of production per lactation, length of productive life, age at first calving, calving interval, and input and output prices (2). In recent years intensive selection for milk yield has depressed reproductive performance of cows (27). Fertility problems account for about 28% of disposals in Western Europe and for 16% in the US (13). The economic loss resulting from low fertility is due mainly to a prolonged calving interval and reduction in milk production (16, 17) and accounts for 40% of health costs (21). Optimal calving interval is 13 mo for primiparous and 12 mo for multiparous cows (4, 13). Although many parameters that influence reproductive performance are well defined, relationship of reproduction to type components has been less studied. Van Vleck and Norman (26), in a survey on reasons for disposal of dairy cows, observed that cows with sloping rumps had a lower incidence of culling than animals with level rumps. Honnette et al. (12) found a relationship between first calving interval and rump score of Friesian heifers with first calving interval for cows with sloping rumps being shorter than average. Tigges et al. (25) demonstrated that in Holstein cows the descriptive type codes deemed most desirable for stature, rump, and feet resulted in least total profit.

Our study was conducted to evaluate a possible relationship between cow rump conformation, milk production, calving month, herd, year of birth, and calving interval.

MATERIALS AND METHODS

Data on rump score, first calving interval, milk production during first lactation, and age at first calving were obtained from 12 herds of Italian Holstein-Friesian cattle in northern Italy. All the herds utilized freestall housing and artificial insemination. Only animals having a first calving interval from 270 to 600 d were considered. Milk production was measured as the deviation of 305-d lactation, twice daily milking, mature equivalent (ME) milk record from the adjusted herdmate average. Incomplete records were extended to 305 d. The initial data consisted of 770 heifers born between 1974 and 1981. The analysis was carried out on 520 animals for lack of complete data for some heifers.

Rump appraisal of the heifers was completed by the Italian Holstein Friesian National Association. The rump scores were: 1) long and wide, nearly level; 2) medium width, length, levelness; 3) pins higher than hips or high tail head; 4) narrow, especially at pins; and, 5) sloping. In the analysis, score of 1 was not

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TABLE 1. Analysis of variance of calving interval.

Variance sources	df	Mean squares
Rump score	3	11,299*
Herd	11	7200*
Year of birth	7	8239*
Calving month	11	6997*
First calving age	1	5568
Milk production	1	42,047***
Residual	485	3600

*$P<.05$.

***$P<.001$.

considered because it was assigned to 4 cows only.

A nonsequential least squares analysis of variance and covariance was carried out on calving interval by using the GLM procedure from SAS (10). The general model was:

$$Y_{ijklm} = m + R_i + H_j + Y_k + M_l + b_1x_1 + b_2x_2 + e_{ijklm}$$

where:

y_{ijklm} = calving interval;
m = overall mean;
R_i = effect of the i^{th} rump score ($i = 2,...,5$);
H_j = effect of the j^{th} herd ($j = 1,...,12$);
Y_k = effect of the k^{th} year of birth ($k = 1,...,8$);
M_l = effect of the l^{th} calving month ($l = 1,...,12$);
b_1, b_2 = independent variables: age at first calving in months (x_1) and ME milk production (x_2);
e_{ijklm} = random error term with zero mean and variance.

All the effects were considered as fixed.

Months of calving were pooled in three season classes. A model with this factor was fitted as well as models with interactions among herd, year of birth, and calving month or season. Seasonal effects and interactions were not significant and therefore were not considered. Significant differences between means were determined by nonorthogonal contrasts (10).

RESULTS AND DISCUSSION

The analysis of variance for effects of rump code, herd, year of birth, calving month, age at first calving, and milk production is in Table 1. Calving interval was affected by all factors, except age at first calving.

Animals with rump score 4 had the longest calving interval (Table 2). Even though not statistically significant, calving interval was shortest in heifers with sloping rumps (score = 5). Rump width and direction are related to reproductive performance. Ali et al. (1) observed easier calving in cows with low pins, probably resulting from an increase of the vertical dimension of the pelvis and consequent increase of pelvic opening. Dadati et al. (5) found a genetic correlation between rump conformation and calving ease, principally a positive relationship between width at pins and calving ease. Because difficult parturitions cause days open to lengthen (6, 15, 18, 24), the longer calving interval in heifers with rump code 4 may be due to an increase in calving difficulty. Cows with sloping rump have less trouble in conceiving after calving, probably because of better draining of uterine fluids (19). Sieber (22) has argued that dairy cows with a slope from hooks to pins are kept in the herd longer, probably because of a direct effect of rump angle on reproductive performance.

TABLE 2. Least squares means and standard errors of calving interval for the rump scores.[1]

Rump score	Frequency	$\overline{X}$	SE
2	245	390.9[b]	5.4
3	120	393.0[b]	7.0
4	58	413.7[a]	9.2
5	97	382.4[b]	7.3

[a,b]Means with different letters are different ($P<.05$).

[1]Least squares means were adjusted for differences among herds, years of birth, calving month, age at first calving, and milk production.

TABLE 3. Least squares means and standard errors of calving interval for the herds.[1]

Herd	Frequency	$\bar{X}$	SE
1	47	392.6[bc]	9.8
2	36	408.9[bc]	11.7
3	36	380.8[ac]	11.2
4	42	388.3[bc]	10.4
5	65	399.5[bc]	9.0
6	67	396.8[bc]	7.9
7	21	351.4[a]	15.1
8	10	409.9[bc]	20.3
9	46	408.1[b]	10.1
10	42	386.9[bc]	10.4
11	67	409.6[b]	8.6
12	41	407.3[bc]	11.0

[a,b,c]Means with different letters are different ($P<.05$).

[1]Least squares means were adjusted for differences among rump scores, years of birth, calving month, age at first calving, and milk production.

TABLE 5. Least squares means and standard errors of calving interval for parturition months.[1]

Calving month	Frequency	$\bar{X}$	SE
January	46	409.9[bc]	10.1
February	41	381.2[ae]	10.6
March	48	402.3[bef]	9.8
April	53	409.1[b]	9.4
May	36	384.4[acde]	11.2
June	43	391.3[acde]	10.4
July	32	369.8[a]	11.5
August	38	406.1[be]	11.0
September	35	410.0[bd]	10.8
October	45	402.3[beg]	10.0
November	46	379.9[afg]	10.2
December	57	393.8[acdf]	9.5

[a,b,c,d,e,f,g]Means with different letters are different ($P<.05$).

[1]Least squares means were adjusted for differences among rump scores, herds, years of birth, age at first calving, and milk production.

The effect of herd on calving interval was significant (Table 3). There are several environmental factors that may influence reproductive efficiency (23). In this study, climatic differences among herds can be eliminated as all herds were from the same region. It is difficult to ascertain the influence of feeding and other management factors.

There was a significant relationship between calving interval and year of birth. Heifers born in later years had shorter calving intervals (Table 4). This may be attributed to better management conditions. Since 1981 these herds were influenced by a governmental plan to improve fertility. Veterinarians and technicians periodically examine the animals for reproductive performances by detecting pregnancies and checking genital health status.

TABLE 4. Least squares means and standard errors of calving interval for the heifers year of birth.[1]

Year of birth	Frequency	$\bar{X}$	SE
1974	13	415.8[b]	17.3
1975	44	415.8[b]	10.0
1976	40	399.0[bc]	10.3
1977	83	401.9[b]	7.5
1978	145	407.7[b]	5.6
1979	140	395.5[bc]	5.6
1980	46	376.9[ac]	9.9
1981	9	347.4[a]	21.9

[a,b,c]Means with different letters are different ($P<.05$).

[1]Least squares means were adjusted for differences among rump scores, herds, calving month, age at first calving, and milk production.

Some authors (8, 9, 20) have reported an optimum environmental temperature for a high conception rate, but others (11, 14) have not found an influence of month of mating on fertility. Our data do not suggest a close relationship between calving month and reproductive performance, although cows calving in July showed the shortest calving interval (Table 5). These animals were thus mated in the previous October. During this month, in Italy, the environmental temperature is near optimum for good fertility (8, 9, 20).

The lack of significance of the effect of age at first calving on calving interval may be due to the fact that most heifers calved at about 3 yr of age. Generally, the heifers were bred according to size, regardless of age.

There was a positive relationship ($P<.001$) between calving interval and milk production, the regression coefficient being .0071 kg of milk. It is difficult to ascertain if higher milk production lengthens calving interval or if cows open more days show higher production because the depressing effect of gestation on lactation is delayed. For some (16) the highest producers have longer calving interval because the strong negative energy balance in early lactation prevents early return to estrus (3). However, better reproductive management of high producing herds may overcome fertility depression (7, 13, 14). In our research the herd with the shortest calving interval (herd 7) had the highest milk production, thus indicating that better management may influence positively production and fertility.

CONCLUSION

Rump conformation is related to reproductive performance. Animals narrow at pins had longest calving intervals; cows with sloping rumps had the shortest calving intervals. Selection against narrow pins and for hips higher than pins may improve reproductive performance.

It is possible that linear scoring with higher accuracy in determining differences in body measurements may allow a better definition of the relationship between appraisal traits and performance. The influence of milk production on calving interval in dairy cattle may be due to intensive selection for high yields, resulting in a physiological imbalance and consequent reproductive failure. Good management can overcome these reproductive problems.

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