CALVING DIFFICULTY IN TWO GENETIC LINES OF HOLSTEIN-FRIESIAN COWS DIFFERING IN MATURE LIVE WEIGHT

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SUMMARY

Calving difficulty (CD) records (0 = no difficulty, 1 = difficult calving) were collected over a 10-year period from 1987 to 1996 from a dairy herd used to develop two genetic lines of Holstein-Friesian (F) cows differing in mature live weight (LW). Cows from the base herd (B, n = 157), the heavy (H, n = 53), and light (L, n = 49) LW selection lines provided 508, 110, and 101 calving records, respectively. Nationally evaluated across breeds, the average breeding values (BV's) for LW were 41.3 kg (B), 18.5 kg (L), and 92.5 kg (H), for maternal grandsires (MGS), and 47.4 kg (B), 32.1 kg (L), and 87.3 kg (H) for sires. Stepwise logistic regression was used for variable selection and to estimate the regression coefficients and odds ratio (OR) of variables related to CD. Variables considered were calf sex, parity, age, genetic line, sire of calf breed, an index for farm profitability termed "Breeding Worth" (BW), and the BV's for production traits and traits other than production (TOP) for sires and MGS. Primiparous (n = 229 calvings) and multiparous (n = 490 calvings) cows were analysed separately. There was no effect of genetic line (H or L) on CD of primiparous or multiparous cows. For primiparous cows, calves were more difficult to deliver if i) sired by F than by Jersey (J) bulls ($P < 0.05$; OR = 2.3), ii) if they were males ($P < 0.005$; OR = 2.7), or iii) if their MGS BV for rump angle was one standard deviation (SD) below average ($P < 0.005$; OR = 1.5). For multiparous cows, males were only marginally ($P < 0.11$; OR = 1.7) more difficult to deliver than females. Calves were more difficult to deliver if calved by younger cows ($P < 0.005$; OR = 1.6), sired by bulls with BW one SD below average ($P < 0.05$; OR = 1.5), or if from bulls with BV for rump width one SD above average ($P < 0.01$; OR = 1.4).

Keywords: calving difficulty, traits other than production, New Zealand dairy cattle.

INTRODUCTION

Simulation studies have shown that heavier LW affects dairy farm profitability through its effects on extra dietary energy requirements for maintenance and growth and extra income from culled cattle (Dempfle 1986; Visscher *et al.* 1994); therefore LW has a negative economic value in the breeding objective of New Zealand dairy cattle. Experimental evidence is scarce on the effect of selection for lighter or heavier LW on the pattern of growth and onset of puberty of the replacement heifer, the productive and reproductive efficiency of the lactating cow, and the incidence of difficult calvings. CD is particularly important due to its effects on calf mortality, subsequent cow reproductive performance, and extra labour required from the farmer and veterinary assistance (Meijering 1984). This paper reports on the association between cow CD and the BV's for production traits and TOP for sires and MGS of F cows selected for heavy or light mature LW.

MATERIALS AND METHODS

Source of data. Calving records were analysed from 1987 to 1996 for the F herd at the Dairy Cattle Research Unit, Massey University, New Zealand. Calves born from artificial insemination (AI) during the first three years from 1987 to 1989 inclusive were sired by bulls selected on the basis of an index (Total Breeding Index) combining fat (kg), protein (kg), and volume (*l*), with no selection on LW. For the following seven years, bulls with similar BV's for fat (kg), and protein (kg) but with BV's for LW ranging from 0-50 kg (L) or from 60-122 kg (H) were used to generate the L and H lines, respectively. AI bulls also had estimates of: a) BV's for other production traits such as milk volume (*l*), survival (%), fat (%), protein (%); b) BW ($), and c) BV's for TOP evaluated on a 1 to 9 scale, where 1 and 9 represent the biological extremes. TOP included were adaptability to milking, shed temperament, milking speed, farmer's overall opinion, stature, dairy capacity, rump angle, rump width, legs, udder support, front udder attachment, rear udder attachment, front teat placement, rear teat placement, udder overall, and dairy conformation (Livestock Improvement Corporation 1997).

Animals and management. Each year multiparous cows were submitted to AI for a period of seven weeks from October to December, followed by four weeks of natural mating (NM) with F or J bulls. High genetic merit B cows were stratified by age and live weight; heavier cows were allocated to H bulls and lighter cows to L bulls. B cows not selected for the project were mated to B bulls. All heifer calves with a H or L sire were reared as replacements, and naturally mated at 14-15 months to F (years 1987-89, and 1993-96) or J (years 1990-92) bulls. In the subsequent years L-sired and H-sired cows were mated to L or H bulls, respectively. In total, 32 B, 16 H, and 17 L sires and 53 B, 12 H, and 12 L MGS had offspring with CD records during the 10-years analysed. Cows calved outdoors, and diagnosis of CD and determination of need for assistance was at the discretion of the herd manager. Calvings were observed and given a numerical score where 1 represented an assisted calving (from slight manual assistance to veterinary assistance) and zero represented no difficulty or assistance required. Twins, deformed calves, and calves from multiparous cows pregnant to a NM bull were excluded from the analysis.

Statistical procedures. Independent variables were selected to build a multiple logistic regression model for calving difficulty. Stepwise variable selection was employed and significance levels of $P < 0.25$ and $P < 0.05$ were required for variables to enter and to remain in the model, respectively (Hosmer and Lemeshow 1989). The LOGISTIC procedure (SAS 1990) was used to obtain maximum likelihood estimates of the regression coefficients, odds ratio and 95% confidence intervals (CI). Primiparous and multiparous cows were analysed separately. For primiparous cows the probability of CD was modelled by including their sire's BV's for production traits and TOP, age at calving (days), calf sex, sire of calf breed, and genetic line. For multiparous cows the variables included were production traits and TOP from both the sire of calf and the MGS of calf, parity, calf sex, and genetic line. In both cases, genetic line and sex of calf were first forced into the model to avoid variables entering the model merely because of differences in genetic line or calf sex.

RESULTS AND DISCUSSION

Average calving difficulty was 23% for primiparous and 8.8% for multiparous cows. The figure for multiparous cows is in agreement with the 9.5% reported by Elliot (1992) for New Zealand F cows. The high incidence of difficult calvings for primiparous cows, however, contrasts with the relatively low estimate of 5.9% reported by Ahlborn-Breier (1989) for New Zealand F heifers mated to F bulls. Tables 1 and 2 show the parameter estimates and OR with their respective 95% CI for the stepwise logistic regression of primiparous and multiparous cows, respectively. There was no effect of genetic line on the probability of CD of primiparous cows. However, calves were more difficult to deliver ($P < 0.05$; OR = 2.3) if sired by F than by J bulls, if they were males ($P < 0.005$; OR = 2.7), or if their MGS BV for rump angle was one SD below average ($P < 0.005$; OR = 1.5). Thus, primiparous cows with high pin bones appeared to be more likely to face CD than those with low pin bones; this difference was apparent regardless of the sex and genotype of their calves (Figure 1).

Table 1. Parameter estimates, odds ratios, and 95% CI from stepwise logistic regression analysis for calving difficulty of primiparous cows (n = 229 calvings)

	Parameter		Odds ratio[1]			
Variable	estimate	SD	Discrete	Continuous	95% CI	P
Cow genetic line						
Light	0.233		1.3		0.6 - 2.7	0.560
Heavy	-0.510		0.6		0.2 - 1.4	0.262
Calf sex						
Male	0.982		2.7		1.4 - 5.3	0.004
Sire of calf breed						
Holstein-Friesian	0.831		2.3		1.1 - 5.2	0.030
MGS of calf BV for rump angle	-1.852	0.22		1.5	1.1 - 2.0	0.005

[1] Odds ratio for continuous independent variables were calculated for one SD of change.

For multiparous cows (Table 2) there was also no effect of genetic line on the probability of CD. Males were only marginally ($P < 0.11$; OR = 1.7) more difficult to deliver than females. Also, calves were more difficult to deliver if calved by younger cows ($P < 0.005$; OR = 1.6), sired by bulls with BW one SD below average ($P < 0.05$; OR = 1.5), or if sired by bulls with BV for rump width one SD above average ($P < 0.01$; OR = 1.4). Pooled over parity number, CD was 11.6, 15.0, and 16.4% for B, H and L cows, respectively ($\chi^2 = 2.9$; $P < 0.23$).

These results suggest higher CD will be expected from daughters of less profitable sires, or sires with lower than average BV for rump angle, and from cows mated to bulls with higher than average BV for rump width. Up to this point, selection for heavier or lighter mature LW has had no effect on CD of grazing F cows.

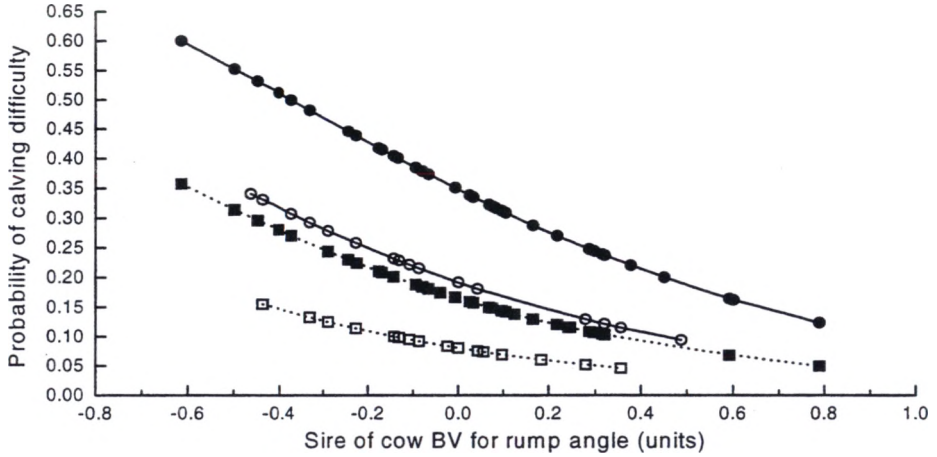

Figure 1. Probability of calving difficulty of primiparous F cows delivering F (male, —●—; female, ···■···) calves or FxJ (male, —○—; female, ···□···) calves.

Table 2. Parameter estimates, odds ratios, and 95% CI from stepwise logistic regression analysis for calving difficulty of multiparous cows (n = 490 calvings)

Variable	Parameter estimate	SD	Odds ratio[1] Discrete	Odds ratio[1] Continuous	95% CI	P
Cow genetic line						
Light	-0.461		0.6		0.1 - 2.1	0.494
Heavy	-0.162		0.9		0.3 - 2.2	0.752
Calf sex						
Male	0.543		1.7		0.9 - 3.3	0.106
Parity, *number*	-0.440		1.6		1.2 - 2.0	0.002
MGS of calf breeding worth	-0.012	31.70		1.5	1.1 - 2.0	0.019
Sire of calf BV for rump width	1.358	0.27		1.4	1.1 - 1.9	0.009

[1] Odds ratio for continuous independent variables were calculated for one SD of change.

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