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Genetic Evaluation of Calving Ease for Brown Swiss and Jersey Bulls from Purebred and Crossbred Calvings

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ABSTRACT

The objective of this study was to examine the feasibility of implementing routine national calving ease (CE) genetic evaluations of Brown Swiss (BS) and Jersey (JE) sires that include records of crossbred calvings. Records were available for 11,793 BS calvings, 3431 BS-sired crosses, 65,293 JE calvings, and 7090 JE-sired crosses. Evaluations were performed for each breed using only purebred calvings and using both purebred and crossbred calvings. In the latter evaluations, the sire-maternal grandsire model used for the routine evaluation of Holstein (HO) CE was modified to include a fixed breed composition effect to account for differences between purebred and crossbred calvings. Jersey cows had very little calving difficulty (0.5 to 0.7%) and JE bulls had a very small range of evaluations, suggesting that a routine JE evaluation would be of little value. Results from the BS evaluations suggest a routine evaluation would provide BS breeders with a useful tool for genetic improvement. Further examination of data showed that many BS calvings were in mixed herds with HO calvings. As a result, a joint evaluation for BS and HO bulls was developed. The BS data showed that there is similar genetic variability as found in the HO population, which suggests implementation of a routine evaluation including BS CE would be of value. It appears BS bulls may produce daughters with superior maternal calving ability compared with HO. Validation of the joint evaluation was performed by comparing results with the routine HO evaluation. Holstein solutions from the joint evaluation were comparable to results from the routine HO-only evaluation. Correlations among solutions and evaluations showed HO evaluations were not adversely affected by BS data and BS sires were reranked as compared with the BS-only evaluation.
(**Key words:** calving ease, crossbred, genetic evaluation, purebred)

Abbreviation key: BH = dataset with BS-sired purebred calvings, HO-sired purebred calvings, and BS-sired calvings from HO dams, **BS** = Brown Swiss, $\mathbf{BS_c}$ = dataset with all calvings in BS_p plus BS-sired crossbred calvings, $\mathbf{BS_p}$ = dataset with BS-sired purebred calvings, **CE** = calving ease, **%DBH** = percentage of difficult births in heifers, **DCE** = daughter calving ease, **HO** = Holstein, **JE** = Jersey, $\mathbf{JE_c}$ = dataset with all calvings in JE_p plus JE-sired crossbred calvings, $\mathbf{JE_p}$ = dataset with JE-sired purebred calvings, **MGS** = maternal grandsire, **SCE** = service-sire calving ease, **S-MGS** = sire-maternal grandsire.

INTRODUCTION

The Animal Improvement Programs Laboratory of USDA-ARS performs national genetic evaluations for calving ease (**CE**) twice a year and maintains the associated database. In 2003, a sire-maternal grandsire (**S-MGS**) threshold model (Van Tassell et al., 2003) replaced the sire threshold model (Berger, 1994) used since 1988. Genetic evaluations of calving ease have been provided for US Holsteins (**HO**) since 1978 (Berger, 1994).

Dairy producers are increasingly interested in crossbreeding. In a recent survey of US dairy producers using crossbreeding, almost all respondents indicated a desire to improve calving ease as well as health, fertility, and longevity (Weigel and Barlass, 2003). Holstein-Brown Swiss (**BS**) and HO-Jersey (**JE**) F_1 both outperformed purebred HO for Net Merit and Cheese Merit, although no cross outperformed HO for Fluid Merit (VanRaden and Sanders, 2003). The authors also reported a small, favorable (1.2%) heterotic benefit for productive life. Heins et al. (2003b) reported that JE-HO crossbred heifers and cows had significantly lower phenotypic dystocia scores than purebred HO contemporaries, 1.32 vs. 1.94. A related study (Heins et al., 2003a) reported that JE-sired calves were born with significantly lower dystocia scores than BS-sired calves, and BS-sired calves had significantly lower dystocia scores than HO-sired calves in a population of HO, HO-JE, and HO-Normande cows. McClintock et al. (2004) presented further evidence that JE-HO crossbreds have a lower inci-

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dence of dystocia than purebred HO. No difference for dystocia was found between HO-JE and JE-HO calvings (Cassell et al., 2004), although the sample size was very small. Heins et al. (2004) reported that HO-sired calvings had significantly more dystocia than JE-sired calvings; HO cows also had higher rates of dystocia than Normande-HO, Montbeliarde-HO, and Scandinavian-HO cows. These results suggest that the use of sires from several non-HO breeds in a crossbreeding program may result in reduced incidence of dystocia.

In response to interest in calving ease from the Brown Swiss Association and the announcement of an Interbull pilot study of CE for breeds other than HO, the Animal Improvement Programs Laboratory studied CE in the BS and JE breeds. The objectives of this research were: 1) to determine the extent to which CE data are recorded in the BS and JE breeds; 2) to characterize the available CE data for BS and JE, as well as for BS- and JE-sired crosses; 3) to perform preliminary prediction of PTA for these breeds, as well as for BS- and JE-sired crosses, using the available data; and 4) to develop a procedure for routine national evaluations for the BS and JE breeds, if appropriate.

MATERIALS AND METHODS

Data

Calving ease records for BS- and JE-sired pure- and crossbred calvings were extracted from the Animal Improvement Programs Laboratory database. Purebred calvings were defined as calvings with matching sire and dam breed codes; sire and dam breed codes differed for crossbred calvings. All records were subjected to a series of data quality edits (Van Tassell et al., 2003). Four datasets were created for use in breeding value estimation: BS-sired purebred calvings (**BS_p**); all calvings in BS_p plus BS-sired crossbred calvings (**BS_c**); JE-sired purebred calvings (**JE_p**); and all calvings in JE_p plus JE-sired crossbred calvings (**JE_c**). A fifth dataset was created for use in the routine BS evaluation; it was formed by combining BS-sired purebred calvings, HO-sired purebred calvings, and BS-sired calvings from HO dams (**BH**). In addition, results of the routine HO evaluation were used to validate the results from the BH evaluation.

Difficult births, indicated by a CE score of 4 or 5, were combined into a single category for the JE_p and JE_c evaluations to attain convergence. Records from herds with only difficult calvings, or with only one calving record in the database, were omitted from the BS and JE datasets.

Genetic Evaluation Models

Purebred and crossbred evaluation. The same S-MGS model as used for the routine HO genetic evaluation (Van Tassell et al., 2003) was used to analyze BS_p and JE_p datasets:

$$y_{ijklnopr} = hy_i + YS_j + PS_k + SB_l + BM_n + s_{lo} + m_{np} + e_{ijklnopr} \quad [1]$$

where $y_{ijklnopr}$ = CE score, hy_i = random effect of herd-year i, YS_j = fixed effect of year-season j, PS_k = fixed effect of parity-sex k, SB_l = fixed effect of sire birth year l, BM_n = fixed effect of maternal grandsire (**MGS**) birth year n, s_{lo} = random effect of sire o in birth-year group l, m_{np} = random effect of MGS n in birth-year group p, and $e_{ijklnopr}$ = random residual effect.

Parities were first, second, and third and later. Year-season groups begin in October and May. The model used to analyze BS_c, JE_c, and BH datasets was similar to [1] but included a fixed effect to account for breed composition (BC_q). The breed composition effect had 2 levels in the BS_c(JE_c) data set to differentiate between births of purebred and crossbred calves. There were 3 levels of breed composition in the BH data set to differentiate between breeds of MGS (BS, HO, and all other). The (co)variance components estimated by Wiggans et al. (2003) were used for all analyses.

The same sire birth-year groups were defined for the BS_p(JE_p) and BS_c(JE_c) datasets: ≤1990, 1991 to 1995, and 1996, 1997, ..., 2003. Identical MGS birth-year group definitions were used for the BS_p(JE_p) datasets. Maternal grandsire birth years ranged from 1964 to 2001 for BS and 1958 to 2001 for JE. Different MGS groupings for animals with known MGS ID and with unknown MGS ID were used. For animals with known MGS ID, MGS birth years were ≤1985, 1986 to 1990, 1991 to 1995, and 1996, and 1997 for BS_c and ≤1990, 1991 to 1995, and 1996 to 2000 for JE_c. Records without valid MGS ID were assigned to birth-year groups based on dam birth year. When dam birth years were not recorded, they were approximated as calving year − parity − 1. Maternal grandsire birth-year groups for bulls without valid ID were: ≤1995 and >1995.

Genetic bases for service-sire CE (**SCE**) and daughter CE (**DCE**) were defined by bulls born in 1995 and in 1990, respectively. Sire and MGS solutions on the underlying scale were adjusted such that the mean of the base bulls on the observed scale was approximately equal to the mean percentage of difficult births in heifers (**%DBH**; CE scores of 4 or 5 for first-calf heifers giving birth to male calves) observed in the appropriate offspring (Van Tassell et al., 2003). Mean %DBH was estimated separately for each data set. The BH evalua-