Fertility and Survival of Pure Holsteins Versus Crossbreds of Holstein with Normande, Montbeliarde, and Scandinavian Red

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ABSTRACT

First-calf pure Holsteins and Normande/Holstein, Montbeliarde/Holstein, and Scandinavian Red/Holstein crossbreds were compared for days to first breeding, first-service conception rate, days open, and survival. First-calf heifers were in 7 commercial dairies in California and calved from June 2002 to October 2004. Holsteins were required to have a recorded sire with a National Association of American Breeders code to assure they were sired by artificially inseminated bulls. Normande-, Montbeliarde-, and Scandinavian Red-sired crossbreds were all daughters of artificially inseminated bulls via imported semen. For days open, first-calf heifers were required to be at least 250 d in milk and those with greater than 250 d open were truncated to 250 d. Least squares means for days to first breeding were 69 d for Holsteins, 62 d for Normande/Holstein, 65 d for Montbeliarde/Holstein, and 66 d for Scandinavian Red/Holstein crossbreds, and differed significantly from pure Holsteins for Normande/Holstein and Montbeliarde/Holstein crossbreds. First-service conception rates were 22% for Holsteins, 35% for Normande/Holstein, 31% for Montbeliarde/Holstein, and 30% for Scandinavian Red/Holstein crossbreds and, again, differences from Holstein were significant for the Normande/Holstein and Montbeliarde/Holstein crossbreds. Least squares means for days open were 150 ± 4.1 d for pure Holsteins, 123 ± 3.8 d for Normande/Holstein, 131 ± 4.4 d for Montbeliarde/Holstein, and 129 ± 4.6 d for Scandinavian Red/Holstein crossbreds, and all 3 crossbred groups had significantly fewer days open than pure Holsteins. Three measures of survival were to 30, 150, and 305 d postpartum, and all crossbred groups survived significantly longer than pure Holsteins during first lactation for all 3 measures of survival. Least squares means for survival to 30 d postpartum were significantly different for pure Holsteins (95%) vs. all crossbred groups (98%), were significantly different for survival to 150 d postpartum for pure Holsteins (91%)

vs. all crossbred groups (96%), and were significantly different for survival to 305 d postpartum for pure Holsteins (86%) vs. all crossbred groups (92 or 93%).

Key words: crossbreeding, days open, heterosis, survival

INTRODUCTION

The decline in fertility of Holsteins is of major concern internationally and might be caused by a combination of physiological and management factors. Higher milk production, larger herd sizes, reduced cow health, and increased inbreeding might be contributing to reproductive decline in Holsteins (Lucy, 2001). Washburn et al. (2002) reported an increase of days to first breeding (DFB) from 84 to 100 d between 1985 and 1999 in 532 Holstein dairy herds in 10 southeastern US states and an increase in days open (DO) from 124 d in 1976 to 168 d in 1999. de Vries and Risco (2005) documented an increase in DFB from 84 d in 1983 to 104 d in 2001 and an increase in DO from 121 d in 1982 to 167 d in 1998 for Florida and Georgia dairy herds. Weigel and Rekaya (2000) found an average of 70.5 d for DFB in California Holstein cows in 1998. For New York herds, Butler (1998) reported a decline of first-service conception rate (FSCR) from 65% in 1951 to 40% in 1996. In central California commercial dairy herds, Ettema and Santos (2004) reported FSCR of 25 to 42% in first-calf Holstein heifers.

McDowell (1982) stated, "Reproductive traits and survival rate, which demonstrate the greatest heterosis, have been overlooked in comparisons between purebreds and crossbreds." Studies with dairy cattle suggest that the possible advantages of crossbreds over purebreds lie in a shorter breeding period, fewer DO, a larger proportion of females that complete one or more lactations and a higher percentage that conceive during any breeding period (McDowell et al., 1974).

In a study at the USDA Animal Husbandry Research Division, McDowell et al. (1970) reported fewer DO in crossbreds of Ayrshire (106 d) and Brown Swiss (126 d) with Holstein than in pure Holsteins (144 d) during first lactation. Ayrshire/Holstein (78%) and Brown Swiss/Holstein (86%) crossbreds had a higher proportion of cows pregnant 145 d following calving across

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lactations than pure Holsteins (64%), and the percentage that conceived by 305-d postpartum favored the crossbreds (93 vs. 90%). In a similar study, Rincon et al. (1982) reported that crosses of Ayrshire and Brown Swiss with Holstein had 24 d fewer DO than pure Holsteins. The Southern Regional Cooperative Research Project S-49 (McDowell, 1982) reported that crossbreds averaged 3 to 17% fewer DO than purebreds at 3 institutional locations, but the differences between crossbreds and purebreds did not consistently favor the crossbreds at a fourth location. Conversely, Touchberry (1992) reported more services per conception for crossbreds of Guernsey and Holstein (1.77) than for pure Holsteins (1.72), and crossbreds had average DO of 113 vs. 110 d for pure Holsteins.

Crossbreeding has been shown to increase herd life; Dickinson and Touchberry (1961), reporting on survival of pure Holsteins and crosses of Guernsey and Holstein, found that during first lactation, 31% of Holstein cows were removed from the herd compared with only 15% of crossbreds of Guernsey and Holstein. Furthermore, in a more complete analysis, 85.1% of crossbreds of Guernsey and Holstein calved once, and 80.3% calved twice (Touchberry, 1992), whereas 71.9% of purebred Guernseys and Holsteins calved at least once, and only 64.5% calved twice. Over all lactations, more purebreds died on farm than crossbreds, suggesting that crossbreds were less susceptible to disease, sickness, and reproductive difficulties than were purebreds (Touchberry, 1992).

Using a censored data analysis, Hocking et al. (1988) reported that crossbred females had a 21-wk longer estimated median herd life than purebred Ayrshires and Holsteins at 308 d postpartum. However, Vesely et al. (1986) reported that the percentage of cows leaving the herd from first to second lactation was similar for pure Holsteins (26.5%) and crossbreds of Ayrshire and Holstein (25.6%). The Animal Improvement Programs Laboratory of USDA studied productive life of purebreds and crossbreds (VanRaden and Sanders, 2003), and the average productive life for first-generation (F_1) crosses of 2 breeds was 24.3 mo compared with 23.8 mo for pure Holsteins. Estimates of heterosis for productive life were small (1.2%), but the authors stated, "matings among Jersey, Brown Swiss, and Holsteins can produce crossbred progeny that on average will stay in the herd as long or longer than pure Holsteins."

A survey of 50 dairy producers conducted by Weigel and Barlass (2003) indicated that Brown Swiss/Holstein and Jersey/Holstein crossbreds had an advantage in longevity compared with pure Holsteins. Dairy producers responded that crossbreeding programs of Holstein cows with either Brown Swiss or Jersey bulls

achieved higher conception rates than matings involving pure Holsteins. Nearly all producers indicated they observed improvements in fertility from crossbreeding.

The objectives of this study were to determine differences among pure Holsteins and Normande/Holstein, Montbeliarde/Holstein, and Scandinavian Red (SR)/Holstein crossbreds during first lactation for DFB, FSCR, DO, and survival in 7 commercial dairies in California.

MATERIALS AND METHODS

Genetic Groups

The decline in fertility and survival of pure Holsteins led the managers of 7 large dairies in California to mate Holstein heifers and cows with imported semen of the Normande and Montbeliarde breeds from France, as well as the Swedish Red and the Norwegian Red breeds. The Swedish Red and Norwegian Red breeds share similar ancestry, mostly Ayrshire and Shorthorn, and exchange sires of sons; therefore, the breeds were collectively regarded as SR for this study. Production of cows in these dairies is provided in Heins et al. (2006a), and pure Holsteins had significantly greater fat (kg) plus protein (kg) production than Normande/Holstein (−8.6%) and Montbeliarde/Holstein (−3.8%) crossbreds. However, first-calf pure Holsteins and SR/Holstein crossbreds were not significantly different for fat (kg) plus protein (kg) production.

The 7 dairies in this study typically bred many cows on any given day and breeding was by a professional AI technician; therefore, no attempt was made to correctively mate the Holstein dams of cows in this study to sires from one breed group vs. another breed group or specific sires within breed group. The only exception was that SR sires were used with greater frequency on Holstein dams that were virgin heifers because of perceived advantages of SR sires for calving ease; therefore, breed groups of cows in this study did not differ for age at calving of dams, except for the SR/Holstein crossbreds. The mean age at calving of Holstein dams of SR/Holstein crossbreds was 32 mo, which was 17 mo younger than the other breed groups. Consequently, the mean of maternal grandsires by breed group for PTA for daughter pregnancy rate and productive life were very similar, except the maternal grandsires for SR/Holstein crossbreds were somewhat lower for mean PTA for daughter pregnancy rate (−0.25) and productive life (−0.42) compared with the other breed groups. Therefore, the SR/Holstein crossbreds had a very slight disadvantage for fertility and survival compared with pure Holsteins and the other crossbred groups in this study.

Table 1. Pure Holstein and crossbred cows remaining after each step of data editing

Trait and edit	Range of calving dates (mo/yr)	Pure Holstein	Crossbreds		
			Normande/Holstein	Montbeliarde/Holstein	Scandinavian Red/Holstein
30-d survival					
Only first-lactation cows	6/2002 to 11/2004	1,265	513	694	457
Required sire identification	6/2002 to 11/2004	726	474	680	447
Opportunity to survive to 30 d in milk	6/2002 to 10/2004	692	465	655	434
Opportunity to survive to 150 d in milk	6/2002 to 5/2004	592	426	515	347
Opportunity to survive to 305 d in milk	6/2002 to 12/2003	523	363	229	190
Days to first breeding and first service conception rate					
Cow bred at least once	6/2002 to 3/2004	536	379	375	261
Days open					
Required 250 d in milk	6/2002 to 3/2004	520	375	371	257

Data

Calving dates, breeding dates, disposal dates, reasons for disposal, and results of pregnancy palpation of cows were provided by 7 commercial dairies in central California. Three of the 7 dairies in this study included data for cows that calved but did not enter the milking string; however, data for such cows were not provided for the other 4 dairies. The DFB, FSCR, DO, and survival were calculated using data from dairy herd management programs used by each of the 7 dairies.

Holsteins were required to be sired by AI bulls and have a National Association of Animal Breeders (NAAB) sire code. All sires for the European breed crosses had frozen semen imported into the United States. This edit removed all first-calf heifers from the study that had natural-service Holstein sires.

The numbers of cows remaining in the data following successive steps of editing are provided in Table 1. The Montbeliarde/Holstein and SR/Holstein crossbreds tended to calve later within the time interval of the study compared with the pure Holsteins and Normande/Holstein crossbreds; therefore, fewer of the Montbeliarde/Holstein and SR/Holstein crossbreds had the opportunity to survive to 150 and 305 d postpartum compared with the pure Holsteins and Normande/Holstein crossbreds.

DFB and FSCR

Data for the analyses of DFB and FSCR were collected for first calvings from June 2002 to March 2004. The DFB were calculated as the day of first service minus the calving date. The FSCR was recorded in a binary manner as either conceived or not conceived at first service.

Herd-year of calving was included in the analysis, and herd-years were from June 2002 to May 2003 and June 2003 to March 2004. Preliminary analysis indicated that seasons did not significantly account for vari-

ation. Each herd-year was required to have calvings from more than a single breed group. Following this edit, 14 herd-years remained for the analyses of DFB and FSCR, and 536 first-calf pure Holsteins were compared with 379 Normande/Holstein, 375 Montbeliarde/Holstein, and 261 SR/Holstein crossbreds. The pure Holsteins and Normande/Holstein, Montbeliarde/Holstein, and SR/Holstein crossbreds were daughters of 76, 24, 22, and 10 bulls, respectively.

Independent variables for statistical analyses of DFB and FSCR were the fixed effects of herd-year and breed group. For the analysis of FSCR, DFB was added as a covariable in the model. For both DFB and FSCR, the GLM procedure of SAS (SAS Institute, 2004) was used to obtain solutions. However, logistic regression (SAS Institute, 2004) was used to determine statistical significance for FSCR, which was a binary trait. Significance of contrasts between breed groups for FSCR were from the logistic regression analysis.

DO

The DO of pure Holsteins and Normande/Holstein, Montbeliarde/Holstein, and SR/Holstein crossbreds were measured as actual DO for first-calf heifers that had a subsequent calving or had pregnancy status confirmed by a veterinarian. If no inseminations were recorded, the date of conception was calculated by subtracting a mean gestation length of 280 d from the date of second calving. To be included in the analysis, first-calf heifers were required to have had at least 250 d in milk. A lower limit of 35 d for DO was applied, and those with more than 250 d for DO had DO set to 250 d. The maximum of 250 d for DO is used by the Animal Improvement Programs Laboratory of USDA for routine genetic evaluations for cow fertility in the United States (VanRaden et al., 2004). However, because DO were truncated at 250 d, potential breed group differences using this measure of fertility are possibly diminished.

Table 2. Number of first-calf heifers that survived at least 250 d postpartum by herd and breed group for analysis of days open

Herd	Pure Holstein	Crossbreds		
		Normande/Holstein	Montbeliarde/Holstein	Scandinavian Red/Holstein
1	108	24	63	30
2	78	95	105	48
3	57	58	51	48
4	61	66	77	44
5	202	17	6	31
6	10	43	24	12
7	4	72	45	44
Total	520	375	371	257

Data for the analysis of DO were for first calvings from June 2002 to March 2004. Herd-years of calving were the same as those for DFB and FSCR, and herd-years were required to have calvings from more than a single breed group. Following this edit, 1,523 first-calf heifers remained and included 520 pure Holsteins and 375 Normande/Holstein, 371 Montbeliarde/Holstein, and 257 SR/Holstein crossbreds.

The number of first-calf heifers that survived at least 250 d postpartum by herd and breed group are in Table 2. The 7 dairies were variable in herd size and in extent of use of crossbreeding. The edit for NAAB-coded sire removed many pure Holsteins from the data file, especially for some dairies. Only 14 pure Holsteins passed edits from herds 6 and 7 for the analysis of DO. Eliminating the data from these 2 dairies from analysis had no meaningful impact on the results for pure Holsteins; however, data from these 2 dairies provided additional information for comparison of the crossbred breed groups.

Independent variables for statistical analysis of DO were the fixed effects of herd-year and breed group. For DO, the GLM procedure of SAS (SAS Institute, 2004) was used to obtain solutions and for the ANOVA.

Survival

First-calf heifers were compared for calving dates from June 2002 to October 2004 for survival to 30 d, from June 2002 to May 2004 for survival to 150 d, and from June 2002 to December 2003 for survival to 305 d postpartum. Survival to 30 d, 150 d, and 305 d were recorded in a binary manner as remained in the herd or left the herd. First-calf heifers coded as leaving herds for dairy purposes were not included in the analysis for survival. Percentage of first-calf heifers within breed group leaving for dairy purposes were 1.0% for pure Holsteins, 1.1% for Normande/Holstein crossbreds, 2.1% for Montbeliarde/Holstein crossbreds, and 2.1% for SR/Holstein crossbreds. Herd-years of calving

were the same as those for the fertility traits, and each herd-year was required to have calvings from more than a single breed group.

Following edits, 2,246 first-calf heifers remained for the analysis for 30-d survival, 1,880 remained for the analysis for 150-d survival, and 1,305 remained for the analysis for 305-d survival. The number of first-calf heifers by herd and breed group for survival to 30 d postpartum are in Table 3, and 692 pure Holsteins were compared with 465 Normande/Holstein, 655 Montbeliarde/Holstein, and 434 SR/Holstein crossbreds.

Independent variables for statistical analysis of survival were the fixed effects of herd-year and breed group. For the analysis of survival, the GLM procedure of SAS (SAS Institute, 2004) was used to obtain solutions. Logistic regression (SAS Institute, 2004) was used to determine statistical significance for survival, which was a binary trait. Significance of contrasts between breed groups were from the logistic regression analysis.

RESULTS AND DISCUSSION

DFB

Number of observations, least squares means, and standard errors for DFB during first lactation are in Table 4. Normande/Holstein (62 ± 1.2 d) and Montbeliarde/Holstein (65 ± 1.3 d) crossbreds had significantly fewer DFB than pure Holsteins (69 ± 1.2 d). Some of the dairies in this study used synchronization programs as a reproductive aid; potentially, breed group differences could have been greater without the aid of synchronization programs.

Weigel and Rekaya (2000) reported similar results of 70.5 d for DFB of Holsteins in California. Touchberry (1992) reported pure Holsteins had more DFB than crossbreds of Guernsey and Holstein, and estimates of heterosis for DFB were small (1%). However, Vesely et al. (1986) found no difference between pure Holsteins and crossbreds of Ayrshire and Holstein for DFB.

Table 3. Number of first-calf heifers by herd and breed group for opportunity to survive until 30 d postpartum

Herd	Pure Holstein	Crossbreds		
		Normande/Holstein	Montbeliarde/Holstein	Scandinavian Red/Holstein
1	125	36	102	55
2	87	124	195	87
3	61	59	88	76
4	67	76	118	62
5	331	17	7	57
6	15	64	55	23
7	6	89	90	74
Total	692	465	655	434

FSCR

Table 4 also has the number of observations, least squares means, and standard errors for FSCR. The DFB, as a covariable, did not significantly explain variation of FSCR. Both Normande/Holstein (35%) and Montbeliarde/Holstein (31%) crossbreds had significantly higher FSCR (30%) than pure Holsteins (22%). The SR/Holstein crossbreds tended to have higher FSCR than pure Holsteins, although the difference was not statistically significant ($P = 0.06$). The results of this study agree with those of Donald and Russell (1968), who documented that F_1 crossbreds of Ayrshire, Holstein, or Jersey had higher FSCR (58%) than purebreds (47%) of those breeds; however, Touchberry (1992) and McDowell (1982) reported no difference between crossbreds and purebreds for conception rates. The pure Holsteins in this study had slightly lower FSCR than reported by Ettema and Santos (2004), who reported FSCR of 25 to 42% across various calving seasons for first-calf Holsteins in California.

Studies have documented an antagonistic relationship of FSCR and milk production (Faust et al., 1988; Bagnato and Oltenacu, 1994). Furthermore, Weigel and

Rekaya (2000) reported increases in calving difficulty resulted in reduced conception rates in California dairies, and Dematawewa and Berger (1997) found first-calf heifers with greater calving difficulty required 0.22 more services to conceive than those with no calving difficulty. The pure Holsteins in this study had more calving difficulty than the crossbreds (Heins et al., 2006b).

Increases in inbreeding might have lowered conception rates of pure Holsteins in this study because average inbreeding in US Holsteins has increased from 2.5% in 1990 to 5.1% in 2005 (<http://aipl.arsusda.gov/dynamic/inbrd/current/kindx.html>). Conversely, heterosis might have enhanced conception rates for crossbreds in this study; estimates of heterosis for conception rates are reported to range from -1.3 to 13.9% (McDowell, 1982; Touchberry, 1992).

DO

The number of first-calf heifers by breed group and stratification for DO is in Table 5; 38% of the pure Holsteins had 35 to 99 d for DO vs. 52% of the Normande/Holstein, 43% of the Montbeliarde/Holstein, and 44% of the SR/Holstein crossbreds. Furthermore, 21% of the pure Holsteins had at least 250 d for DO vs. only 14% of the Normande/Holstein and SR/Holstein crossbreds. A χ^2 analysis (SAS Institute, 2004) indicated that fewer pure Holsteins had <100 d for DO and more pure Holsteins had ≥ 250 d for DO compared with cows in the crossbred groups ($P < 0.01$).

Number of observations, least squares means, and standard errors for DO are in Table 6. The 520 pure Holsteins had mean DO of 150 ± 4.1 d, and all of the crossbred groups had significantly ($P < 0.01$) fewer DO than the pure Holsteins. The Normande/Holstein crossbreds had the fewest DO (123 ± 3.8 d) of the crossbred groups, with the SR/Holstein and Montbeliarde/Holstein crossbreds following at 129 ± 4.6 d and 131 ± 4.4 d for DO, respectively.

Table 4. Number of observations, least squares means (LSM), and standard errors of means for days to first breeding and first-service conception rate of first-calf heifers for breed groups

Breed group	n	Days to first breeding		First-service conception rate, ¹ %	
		LSM	SE	LSM	SE
Pure Holstein	536	69	1.2	22	3.0
Normande/Holstein	379	62**	1.2	35*	3.0
Montbeliarde/Holstein	375	65*	1.3	31**	3.0
Scandinavian Red/Holstein ²	261	66	1.4	30	3.0

¹Paired contrasts were used to compare non-Holstein breed groups with pure Holsteins from the logistical regression statistical test.

²For contrast of difference from pure Holstein, $P = 0.10$ for days to first breeding, and $P = 0.06$ for first-service conception rate.

* $P < 0.05$ for contrast of difference from pure Holstein; ** $P < 0.01$ for contrast of difference from pure Holstein.

Table 5. Number of first-calf heifers by breed group and stratification for days open

Days open	Pure Holstein	Crossbreds		
		Normande/Holstein	Montbeliarde/Holstein	Scandinavian Red/Holstein
		(%)		
35 to 99 d	38	52	43	44
100 to 174 d	28	22	29	32
175 to 249 d	13	12	9	11
≥250 d	21	14	20	14

McDowell et al. (1970) and Rincon et al. (1982) reported that Ayrshire/Holstein and Brown Swiss/Holstein crossbreds had fewer DO than pure Holsteins. Brandt et al. (1974) also reported fewer DO for crossbreds of Brown Swiss and Holstein compared with pure Holsteins. However, Touchberry (1992) reported that crossbreds of Guernsey and Holstein had 3 d more DO than purebred Guernseys and Holsteins. In another study with data from central California, first-calf Holstein heifers averaged 155 d for DO (Ettema and Santos, 2004), which is comparable to the DO for first-calf pure Holsteins found in the 7 California dairies in this study.

Antagonism of DO and milk production is well documented, and research has reported substantial genetic correlation (0.30 to 0.35) between DO and milk production (Hansen et al., 1983; VanRaden et al., 2004); however, even higher genetic correlations (0.55) have been reported (Dematawewa and Berger, 1998). In many studies, cows with higher milk production had increased DO (Laben et al., 1982; Hageman et al., 1991; Marti and Funk, 1994; Abdallah and McDaniel, 2000). The higher milk production of pure Holsteins compared with Normande/Holstein and Montbeliarde/Holstein crossbreds in this study (Heins et al., 2006a) might have contributed to increased DO.

Survival

Table 7 has least squares means, odds ratios, and significance from the logistical regression statistical test for breed groups for survival to 30, 150, and 305 d

Table 6. Number of observations, least squares means (LSM), and standard errors of means for days open of first-calf heifers for breed groups

Breed group	n	Days open	
		LSM	SE
Pure Holstein	520	150	4.1
Normande/Holstein	375	123**	3.8
Montbeliarde/Holstein	371	131**	4.4
Scandinavian Red/Holstein	257	129**	4.6

** $P < 0.01$ for contrast of difference from pure Holstein.

postpartum. For 30-d survival, all of the crossbred groups (98%) were significantly greater than pure Holsteins (95%). Normande/Holstein (96%), Montbeliarde/Holstein (96%), and SR/Holstein (96%) crossbreds were significantly different from pure Holsteins (91%) for 150-d survival. For 305-d survival, pure Holsteins (86%) were significantly different from Normande/Holstein (93%), Montbeliarde/Holstein (92%), and SR/Holstein (93%) crossbreds. The apparent contradiction of sample size and level of significance for the Normande/Holstein and Montbeliarde/Holstein crossbreds is likely due to a more uniform distribution of Montbeliarde/Holstein crossbreds than Normande/Holstein crossbreds across herd-years (Table 3).

Odds ratios were used to compare the probability that survival occurred in one breed group relative to it occurring in another breed group. If the odds ratio was 1, then survival was equally likely in both groups; if the odds ratio was >1 then survival was more likely in the crossbred group, and if the odds ratio was <1 then survival was less likely in the crossbred group. The logistic regression analysis indicated higher odds ratios for 30-, 150-, and 305-d survival for Normande/Holstein, Montbeliarde/Holstein, and Scandinavian Red/Holstein crossbred cows vs. pure Holsteins.

Hocking et al. (1988) reported that crossbreds of Ayrshire and Holstein had longer herd life than pure Holsteins. Also, Dickinson and Touchberry (1961) and Touchberry (1992) found crossbreds of Guernsey and Holstein had higher survival rates than pure Guernseys and Holsteins and, across all generations, crossbreds had a 15.6% greater survival rate than pure Guernseys and Holsteins. However, Vesely et al. (1986) reported no difference between crossbreds of Ayrshire and Holstein and pure Holsteins for percentage of cows leaving the herd from first to second lactation.

Factors that might have contributed to lower survival rates of the pure Holsteins in comparison to crossbreds in this study include decreased fertility, greater calving difficulty, and increased inbreeding of pure Holsteins. In a survey conducted by Bascom and Young (1998), dairy producers indicated that poor reproduction is the main reason for cows having lower survival rates across

Table 7. Least squares means, odds ratios, and significance from the logistical regression statistical test¹ of breed groups for survival to 30, 150, and 305 d postpartum during first lactations²

Breed group	Days postpartum					
	30		150		305	
	Survival (%)	Odds ratio	Survival (%)	Odds ratio	Survival (%)	Odds ratio
Pure Holstein	95	—	91	—	86	—
Normande/Holstein	98*	2.65	96*	2.70	93*	2.70
Montbeliarde/Holstein	98*	3.18	96**	2.53	92**	2.10
Scandinavian Red/Holstein	98*	3.06	96**	3.31	93*	2.57

¹Paired contrasts were used to compare non-Holstein breed groups with pure Holsteins.

²Number of observations contributing to estimates are in Table 1.

* $P < 0.05$ for contrast of difference from pure Holstein; ** $P < 0.01$ for contrast of difference from pure Holstein.

lactations. Smith et al. (1998) and Thompson et al. (2000) reported that survival decreased across lactations with increasing levels of inbreeding. All crossbred groups in this study had higher survival rates during first lactation than pure Holsteins.

CONCLUSIONS

Decline of fertility and survival of pure Holstein cows in the United States has led some dairy producers to use crossbreeding to help alleviate these problems. For the 7 dairies in this study, Normande/Holstein and Montbeliarde/Holstein crossbreds had significantly fewer DFB and higher FSCR than pure Holsteins. Furthermore, Normande/Holstein, Montbeliarde/Holstein, and SR/Holstein crossbreds had significantly fewer DO than pure Holsteins. Advantages in cow fertility for crossbreds compared with pure Holsteins in this study should have substantial impact on profitability of milk production.

All crossbred groups in this study survived longer than pure Holsteins during first lactation. Pure Holsteins left these dairies earlier than crossbreds; 98% of crossbreds survived to 30 d postpartum compared with 95% of pure Holsteins; and 96% of crossbreds survived to 150 d postpartum compared with 91% of pure Holsteins. Moreover, 92 to 93% of crossbreds survived to 305 d postpartum compared with 86% of pure Holsteins. The higher survival rates for crossbreds compared with pure Holsteins in this study should have large economic implications.

The results of this study suggest that dairy producers could improve fertility and survival of cows by crossing pure Holstein cows with bulls of some other breeds of dairy cattle. This study also suggests that the resulting crossbred females will tend to have higher FSCR, fewer DO, and higher survival rates at first calving than pure Holsteins. Additional research should help to determine

if the economics of dairying justify the use of crossbreeding as a tool to enhance fertility and survival of dairy cattle.

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