Survival, Fertility, And Production Of Normande×Holstein, Montbeliarde×Holstein, And Scandinavian Red×Holstein Crossbred Cows Compared To Pure Holstein Cows

B. J. Heins and L. B. Hansen

Introduction

The decline in survival and fertility of Holsteins over the past decade is a major concern and may be caused by a combination of physiological and managerial factors, including higher milk production, larger herd sizes, reduced cow health, and increased inbreeding. Concerns regarding survival and fertility of pure Holsteins led the managers of six 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 Breed (SRB) and the Norwegian Red Breed (NRF). The SRB and NRF breeds share similar ancestry; therefore, the two breeds were collectively regarded as Scandinavian Red for this study. The objectives of the study were to determine differences between Normande×Holstein, Montbeliarde×Holstein, and Scandinavian Red×Holstein crossbred cows and pure Holstein cows for survival, days open, and 305-day fat plus protein production in six dairies in California.

Material and methods

Background and data. All six dairies used artificial insemination (AI) for the majority of matings. Sires for AI were selected amongst highest ranking sires with the Net Merit index for Holsteins and similar indices for the other breeds. Herd sizes range from approximately 500 to 2000 cows. Calving dates, breeding dates, disposal dates, and results of pregnancy palpation for cows calving for the first time from June 2002 to January 2005 were provided by all six dairies. Test day production information was also provided by the dairies.

Statistical analysis. Normande×Holstein cows (n = 251), Montbeliarde×Holstein cows (n = 503), and Scandinavian Red×Holstein cows (n = 321) were compared to pure Holstein cows (n = 416) for survival to second, third, fourth, or fifth parity, provided they had an opportunity to survive to each of these thresholds. All cows had the opportunity to calve at least three times at the end of the trial period. Four cows (2 Holstein and 2 Scandinavian Red×Holstein) did not have the opportunity to calve a fourth time, and 71 cows (10 Holstein, 4 Normande×Holstein, 33 Montbeliarde×Holstein, and 24 Scandinavian Red×Holstein) did not have the opportunity to calve a fifth time. Survival was recorded in a binary manner, and a chi-square test was conducted for all survival traits.

Days open was measured as actual days open for cows that had a subsequent calving or had pregnancy status confirmed by a veterinarian. To be included in the analysis, cows were required to have had at least 250 days in milk. A lower limit of 35 days open was applied, and those with more than 250 days open had days open set to 250 days. The maximum of 250 days open is used by the Animal Improvement Programs Laboratory of USDA for routine genetic evaluations for fertility in the USA (VanRaden *et. al*., 2004).

University of Minnesota, 1364 Eckles Avenue, Saint Paul 55108, USA

Normande×Holstein cows (n = 245), Montbeliarde×Holstein cows (n = 494), and Scandinavian Red×Holstein cows (n = 328) were compared to pure Holstein cows (n = 380) for 305-day fat plus protein production during their first five lactations. Best Prediction (Cole *et al.*, 2009) was used to calculate actual production (milk, fat, and protein) for 305-day lactations. Adjustment was made for age at calving and milking frequency, and records less than 305 days were projected to 305 days.

Independent variables for statistical analysis of days open and fat plus protein production were the fixed effects of parity, herd-year-season (4-month seasons within the six herds) nested within parity, genetic group, parity nested within genetic group, and cow nested within genetic group, which was a random effect. Each herd-year was required to have calvings from more than a single genetic group. For production, the genetic level of the Holstein maternal grandsire was included in the model for analysis. The MIXED procedure of SAS (SAS Institute, 2004) was used to obtain solutions and for the analysis of variance.

Results and discussion

Survival. Table 1 has survival rates for crossbred cows versus pure Holstein cows, and all crossbred groups had significantly ($P < 0.01$) higher percentages of cows that calved a second, third, fourth, and fifth time than pure Holstein cows. The main difference in survival of crossbred cows compared to pure Holstein cows was prior to second calving. Twenty-three percent of pure Holstein cows did not calve a second time, whereas only 12% to 14% of crossbred cows did not calve a second time. Survival rates to second, third, and fourth calving for pure Holstein cows in this study were higher than those of Hare et al. (2006), who reported survival to second, third, and fourth calving of 73%, 50%, and 32%, respectively. Factors that could potentially contribute to lower survival rates of pure Holsteins include increased inbreeding, greater calving difficulty, decreased fertility, and increased health problems.

Table 1. Mean survival rate to subsequent parturition for crossbred cows and pure Holstein cows.

	Holstein	Normande× Holstein	Montbeliarde× Holstein	Scandinavian Red×Holstein
Parturition	(n = 416)	(n = 251)	(n = 503)	(n = 321)
2	77	88**	88**	86**
3	59	70**	70**	69**
4	35	51**	52**	50**
5	19	28**	32**	28**

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

Days open. Table 2 has means and standard errors for days open. During first lactation, pure Holstein cows had mean days open of 147 days, and all of the crossbred groups had significantly ($P < 0.05$) fewer days open than pure Holstein cows during first lactation. Although not statistically significant, all crossbred groups had numerically fewer days open during second and third lactation. During fourth and fifth lactation, Montbeliarde×Holstein cows had significantly ($P < 0.05$) fewer days open than pure Holstein cows. In another study with data from central California, first-calf Holstein heifers averaged 155 days open (Ettema and Santos, 2004), which is comparable to the days open for first-calf pure Holsteins found

in the six California herds in this study. Antagonism of days open and milk production is well documented, and research has reported substantial genetic correlation (0.30 to 0.35) between days open and milk production (VanRaden *et al*., 2004). The crossbred groups in this study had fewer days open than pure Holstein cows; therefore, crossbred cows had an advantage in reducing income losses because of days open.

Table 2. Least squares means and standard errors for days open by lactation for crossbred cows and pure Holstein cows.

	Holstein		Normande×Holstein[1]		Montbeliarde×Holstein[1]		Scandinavian Red×Holstein[1]	
Parity	Mean	s.e.	Mean	s.e.	Mean	s.e.	Mean	s.e.
1	147	5.5	-23**	5.0	-22**	4.1	-17*	4.4
2	139	6.1	-7	5.7	-14†	4.7	-3	5.0
3	140	7.5	-9	6.5	-13	5.1	-9	5.8
4	148	9.4	-10	8.2	-27*	6.6	+2	7.1
5	162	15.9	-25	12.2	-50*	10.9	-12	13.5

[1]Means for crossbred cows are expressed as a difference from pure Holsteins.
** $P < 0.01$ for contrast of difference from pure Holstein.
* $P < 0.05$ for contrast of difference from pure Holstein.
† $P < 0.10$ for contrast of difference from pure Holstein.

Production. Table 3 has results for fat plus protein production. During first lactation, Scandinavian Red×Holstein cows were not significantly different from pure Holsteins for fat plus protein; however, Normande×Holstein cows and Montbeliarde×Holstein cows had significantly lower fat plus protein production than pure Holstein cows. Although pure Holstein cows had significantly ($P < 0.01$) higher fat plus protein production during second and third lactation, the differences between crossbred cows and pure Holstein cows were minimal. Only the Normande×Holstein cows and Scandinavian Red×Holstein cows were lower for fat plus protein than pure Holstein cows during fourth lactation. The Montbeliarde×Holstein cows and Scandinavian Red×Holstein cows were not significantly different from pure Holstein cows for fat plus protein during fifth lactation.

Table 3. Least squares means for fat plus protein by lactation for crossbred cows and pure Holstein cows.

	Holstein		Normande×Holstein[1]		Montbeliarde×Holstein[1]		Scandinavian Red×Holstein[1]	
Parity	Mean	s.e.	Mean	s.e.	Mean	s.e.	Mean	s.e.
1	649	7.5	-49**	6.7	-22*	5.6	-9	6.0
2	788	8.0	-92**	7.5	-47**	6.2	-40**	6.7
3	811	9.2	-82**	8.3	-39**	6.6	-39**	7.3
4	808	11.1	-85**	9.4	-19	7.5	-34*	8.4
5	801	14.2	-59**	12.5	-11	10.0	-27	11.2

[1]Means for crossbred cows are expressed as a difference from pure Holsteins.
** $P < 0.01$ for contrast of difference from pure Holstein.
* $P < 0.05$ for contrast of difference from pure Holstein.

Table 4 has the change of fat plus protein for crossbred cows and pure Holstein cows from parity to parity. Production of pure Holstein cows increased substantially from first to second lactation, and the three crossbred groups also increased in fat plus protein, but not at the rate of the pure Holstein cows. Pure Holstein cows increased from second to third lactation, but at a reduced rate compared to the increase from first to second lactation, and all three crossbred groups had a greater increase in fat plus protein than pure Holstein cows from second to third lactation. Production was reduced for pure Holstein cows from third through fifth lactation; however, the crossbred cows increased in fat plus protein from third through fifth lactation.

Table 4. Change of fat plus protein production for crossbred cows and pure Holstein cows from parity to parity.

Change	Holstein	Normande× Holstein	Montbeliarde× Holstein	Scandinavian Red×Holstein
1st to 2nd parity	+139	+95	+114	+109
2nd to 3rd parity	+23	+33	+31	+23
3rd to 4th parity	-3	-5	+18	+3
4th to 5th parity	-7	+19	+1	+1

Conclusions

Reproductive performance and survival rates have been overlooked by many when comparing purebreds and crossbreds. For the six dairies in this study, Normande×Holstein, Montbeliarde×Holstein, and Scandinavian Red×Holstein crossbred cows had significantly higher survival rates, fewer days open in first lactation, and minimal reduction in fat plus protein production than pure Holstein cows, and these advantages for crossbreds should have substantial impact on profitability of dairying. The results of this study suggest dairy producers can improve survival rates of cows, decrease days open, while maintaining high levels of production by crossing pure Holstein cows with sires of some other breeds of dairy cattle.

References

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