PROS AND CONS OF CROSSBREEDING: OLD IDEA WITH NEW RESEARCH

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The observed decline in fertility and survival of pure Holsteins led owners of seven large dairies in California to mate Holstein heifers and cows with imported semen of the Normande and Montbeliarde breeds from France and of the Norwegian Red and Swedish Red breeds. Because the Norwegian Red (NRF) and Swedish Red (SRB) breeds share similar ancestry and freely exchange sires of sons, we have regarded the two breeds collectively as "Scandinavian Red". Crossbred cows began calving in June 2002 in the seven California dairies, and all early crossbreds were Normande-Holstein. Montbeliarde-Holstein and Scandinavian Red-Holstein crossbreds began calving about one year later than the Normande-Holstein crossbreds. Some cows in the California dairies remained pure Holstein, which has permitted the comparison of pure Holsteins and crossbreds.

PRODUCTION

All cows calved from June 2002 to December 2003 for a study of the production of crossbreds versus pure Holsteins. Sires of all cows were A.I. sires with assigned sire codes. Furthermore, the Holstein maternal grandsires of all cows (both purebred and crossbred) were likewise required to be A.I. sires with assigned NAAB sire codes. These edits removed all cows from the study that had natural service Holstein sires and/or maternal grandsires and provided for fairer comparisons.

The analysis of daily production data from milk recording adjusted for stage of lactation within breed (five 30-day intervals from calving to 150 days postpartum), age at calving, herd-year-season of calving (3-month seasons), milking frequency (2X or 3X), and PTA of each cow's Holstein maternal grandsire. Effects of breed composition, sire, and cow (within breed and sire) were key factors in the statistical analysis. Table 1 has a summary of the number of daily observations from DHI, cows, and sires represented in the production data.

Table 1. Number of observations for production.

Breed	Monthly DHI tests	Cows	Sires
Holstein	1248	294	61
Normande-Holstein	758	171	20
Montbeliarde-Holstein	611	174	20
Scandinavian Red-Holstein	470	120	8

Results for production during the first 150 days of lactation of first lactation cows are provided in Table 2. Only results for the first 150 days of lactation are reported to date, because 305-day lactational production of cows will need to be adjusted for differences in reproductive status. Cows with very short days open are penalized for 305-day production, and cows with long days open or do not become pregnant have inflated 305-day production. Results for 305-day production adjusted for days open will be published in early 2005.

Table 2. Average daily production during the first 150 days of first lactation.

	Holstein	Normande-Holstein	Montbeliarde-Holstein	Scandinavian Red-Holstein
Milk (lb)	70.5	63.1	69.4	73.3
Fat (lb)	2.42	2.24	2.46	2.58
Protein (lb)	2.09	1.97	2.12	2.23
Fat + Protein (lb)	4.51[a]	4.20[b]	4.58[a]	4.81[c]
% of Holstein		–6%	+2%	+7%

The pure Holsteins and crossbreds were comparable for daily production, which was gauged as fat plus protein (lb). The Montbeliarde-Holstein crossbreds and pure Holsteins were not significantly different for production; however, there was a tendency for the Montbeliarde-Holstein crossbreds to have higher production (+2%). The Normande-Holstein crossbreds had 6% less production and the Scandinavian Red-Holstein crossbreds had 7% more production than pure Holsteins, and these differences were statistically significant.

Some have questioned the genetic level of the sires of the pure Holsteins in this study; however, the seven California dairy producers have always used high-ranking A.I. sires. The current average PTA's of the sires of the pure Holstein cows in this study are +1219 lb milk, +33 lb fat, +37 lb protein, despite the fact that the cows were born several years ago.

The somatic cell scores for the pure Holsteins were compared to those for the crossbreds; however, averages were uniformly low for each group, and averages for somatic cell counts were all less than 65,500 for each breed combination. The data were first-lactation cows during the first 150 days of lactation; therefore, meaningful differences in somatic cells will probably require information for more cows later in first lactation as well as during subsequent lactations.

CALVING DIFFICULTY AND STILLBIRTHS

Number of observations for births was much greater than for production. Calving difficulty was measured on a 1 to 5 scale, with 1 representing a quick and easy birth without assistance and 5 representing an extremely difficult birth that required a mechanical puller. Stillbirths were

recorded as alive or dead within 24 hours of birth. It is important to keep in mind that calving difficulty and stillbirth are traits of both the sire and the dam.

For analyzing effects of breed of sire, dams of calves were limited to first-calving pure Holsteins. Adjustments were made for sex of calf and herd-year-season of calving. Across breed of sire, calving difficulty averaged 1.74 for bull calves and 1.38 for heifer calves, and stillbirth rates were 15% for bull calves and 4% for heifer calves. Clearly, the bulk of calving difficulty and stillbirths were for bull calves. Table 3 provides the number of births, average calving difficulty score, and average stillbirth rate by breed of sire. A total of 1,711 births were included in the analysis; however, the number of births by Jersey (51) and Normande (30) sires were modest during the period of time from June 2001 to December 2003.

Table 3. Average for calving difficulty and stillbirths for breed of sire.

Breed of sire	Number of births	Calving difficulty	Stillbirth rate
Holstein	339	1.76[a]	15%[a]
Normande	30	1.68[a,b]	8%[a,b]
Montbeliarde	160	1.67[a]	11%[a,b]
Brown Swiss	209	1.57[a,b]	11%[a,b]
Scandinavian Red	922	1.46[b]	7%[b]
Jersey	51	1.22[b]	4%[b]

All dams were first-lactation Holsteins.

Average score for calving difficulty was significantly less for Scandinavian Red sires (1.46) and Jersey sires (1.22) than Holstein sires (1.76); however, all breeds of sire tended to have less calving difficulty than Holstein sires. Furthermore, Scandinavian Red sires (7%) and Jersey sires (4%) had significantly fewer stillbirths than Holstein sires (15%); however, all breeds of sire tended to have fewer stillbirths than Holstein sires. It is important to remember that all dams of calves were first-calving Holsteins, so calves sired by Holstein sires were purebreds, whereas calves sired by bulls from the other breeds were crossbreds. Therefore, inbreeding within breed could have influenced the higher rate of stillbirth for Holstein-sired calves.

To estimate differences in breed composition of dam for calving difficulty and stillbirths, breed of sire was limited to Brown Swiss, Montbeliarde, and Scandinavian Red sires, because numbers of births by sires of other breeds were small and not well distributed across breed composition of dam. Therefore, all births analyzed for breed of dam were for crossbred calves. Adjustments were made for breed of sire, sex of calf, and herd-year-season of calving. Across breed composition of dam, calving difficulty was 1.67 for bull calves and 1.31 for heifer calves, and stillbirth rates were 12% for bull calves and 2% for heifer calves. Again, bull calves caused more problems than heifer calves. Table 4 has results for 1,809 births by breed composition of dam.

Table 4. Average for calving difficulty and stillbirths for breed of dam.

Breed of dam	Number of births	Calving difficulty	Stillbirth rate
Holstein	1291	1.61[a]	10%
Normande-Holstein	227	1.52[a,b]	7%
Montbeliarde-Holstein	170	1.50[a,b]	7%
Scandinavian Red-Holstein	121	1.32[b]	5%

Scandinavian Red-Holstein crossbreds (1.32) had significantly less calving difficulty than pure Holsteins (1.61), and the Normande-Holstein dams (1.52) and Montbeliarde-Holstein dams (1.50) tended to be intermediate between Scandinavian Red-Holstein dams and pure Holstein dams for calving difficulty. None of the averages for stillbirth rate were statistically different from one another; however, the stillbirth rates tended to follow the averages for calving difficulty respective to breed composition of dam, and Scandinavian Red-Holstein dams had a stillbirth rate that tended to be half that of pure Holstein dams.

SURVIVAL AND FERTILITY

Only Normande-Holstein crossbreds were compared to pure Holsteins for survival and fertility. In early 2005, adequate numbers of Montbeliarde-Holstein and Scandinavian Red crossbreds will be far enough along in first lactation to provide for comparisons with pure Holsteins. First-lactation cows in the seven California dairies that calved from June 2002 to May 2003 were compared for survival to first DHI test, to 150 days postpartum, and to 305 days postpartum. Survival rates were adjusted for age of cow at calving within breed and herd-season of calving. Table 5 has the survival rates for pure Holsteins and Normande-Holstein crossbreds. The 305-day survival rate for Holsteins is in general agreement with national statistics in the U.S., and the 305-day survival rate of the Normande-Holstein crossbreds is nothing short of amazing. These survival rates are for 787 pure Holsteins and 315 Normande-Holstein crossbreds, and it will be interesting to see if the huge difference in survival rate holds as more Normande-Holstein crossbreds become available for analysis.

Table 5. Survival during first lactation.

Measure	Holstein	Normande-Holstein	Difference
First DHI test	96%	100%	4%
150 days	86%	99%	13%
305 days	78%	95%	17%

Breed difference was significant in all cases.

Fertility of the pure Holsteins and Normande-Holstein crossbreds 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 at least 250 days in lactation. Therefore, the Holsteins were actually a more highly-selected group compared to the Normande-Holstein crossbreds, because fewer of them survived to 250 days postpartum. Cows with more than 250 days open had days open set to 250. Adjustment was made for herd-season of calving, and 547 pure Holsteins and 298 Normande-Holstein crossbreds were compared.

The distribution of days open for cows indicated 41% of the pure Holsteins versus 52% of the Normande-Holstein crossbreds had 35 to 99 days open. Furthermore, 23% of the pure Holsteins versus 10% of the Normande-Holstein crossbreds had at least 250 days open. The 547 pure Holsteins had average days open of 143, and the 298 Normande-Holstein crossbreds had average days open of 126. The difference of 17 days open was statistically significant. A difference of this magnitude for fertility, coupled with the difference for survival, more than compensates, economically, for the 6% lower production of Normande-Holstein crossbreds than pure Holsteins.

TAKE HOME MESSAGES

- **Crossbreeding is NOT genetic improvement.** The continuous use of top progeny-tested A.I. sires is what brings about genetic improvement in a breed or a herd.

- **Production of some breed crosses might exceed the production of pure Holsteins.** This is because of the bonus provided by hybrid vigor. The assumption in the past has been that no breed combination of crossbred could compete with pure Holsteins for production. However, new research is suggesting this assumption might be incorrect.

- **Hybrid vigor is a bonus that dairy producers can expect from crossbreeding.** Hybrid vigor is measured as a percentage above the average of the parental breeds. This bonus from hybrid vigor appears to be about 6.5% for production.

- **Fertility, health, and survival of cows should benefit most from crossbreeding.** The bonus from hybrid vigor appears to be at least 10% for fertility, health, and survival.

- **Crossbreeding systems should make use of more than two breeds.** This allows greater impact of hybrid vigor over generations. First crosses ("F1's") that are bred back to one of the two parental breeds results in offspring with only one half the hybrid vigor of F1's.

- **Select breeds carefully for crossbreeding.** Many dairy producers have turned to Jersey sires to breed their virgin heifers, which virtually eliminates calving difficulty in first-calf pure Holstein heifers. This one-time gain in calving ease might seem wise; however, the contribution of the Jersey breed in a continuous crossbreeding system needs to be gauged carefully. All purebreds and crossbreds (even those that are part Holstein) are expected to calve more easily than pure Holsteins. Including Jersey in a crossbreeding system will result in variation in cow size over generations that might be undesirable in some situations.