

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

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ABSTRACT

Pure Holsteins ($n = 380$) were compared to Normande/Holstein crossbreds ($n = 245$), Montbeliarde/Holstein crossbreds ($n = 494$), and Scandinavian Red/Holstein crossbreds ($n = 328$) for 305-d milk, fat, and protein production during first lactation. Scandinavian Red was a mixture of Swedish Red and Norwegian Red. Cows were housed at 7 commercial dairies in California and calved from June 2002 to January 2005. All Holstein sires and all Holstein maternal grandsires were required to have a code assigned by the National Association of Animal Breeders to assure they were sired by artificial insemination bulls. Daughters of Normande, Montbeliarde, and Scandinavian Red sires were artificial insemination bulls via imported semen. Best prediction was used to calculate actual production (milk, fat, and protein) for 305-d lactations. Adjustment was made for age at calving and milking frequency, and records less than 305 d were projected to 305 d. Herd-year-season (4-mo seasons) and the genetic level of each cow's Holstein maternal grandsire were included in the model for statistical analysis. Pure Holsteins had significantly higher milk (9,757 kg) and protein (305 kg) production than all crossbred groups, but pure Holsteins (346 kg) were not significantly different from Scandinavian Red/Holstein (340 kg) crossbreds for fat production. Fat plus protein production was used to gauge the overall productivity of pure Holsteins vs. crossbreds. The Scandinavian Red/Holstein (637 kg) crossbreds were not significantly different from the pure Holstein (651 kg) for fat plus protein production; however, the Normande/Holstein (596 kg) and the Montbeliarde/Holstein crossbreds (627 kg) had significantly lower fat plus protein production than pure Holsteins. **Key words:** crossbreeding, heterosis, production

INTRODUCTION

Interest in crossbreeding has been growing among dairy producers over the past 5 yr; however, crossbreed-

ing of dairy cattle has seldom been practiced over the past 75 yr. McAllister (2002) indicated that more than 95% of US dairy cattle are purebred or grade Holsteins. The superiority of Holsteins for milk production has contributed to a growing global domination of the Holstein breed over time. During recent years, however, milk pricing in most markets has placed greater emphasis on the solids in milk rather than fluid, which resulted in the Holstein breed having less of a competitive advantage compared with other breeds. In a recent survey by Weigel and Barlass (2003), dairy producers cited improvements in fertility, calving ease, longevity, and milk composition as reasons for crossbreeding.

Numerous research studies have documented the potential role of crossbreeding in the dairy industry, but most studies are dated (Fohrman, 1946; Fohrman et al., 1954; Bereskin and Touchberry, 1966; Brandt et al., 1974; Rincon et al., 1982; Touchberry, 1992). A USDA crossbreeding study was initiated in 1939 at Beltsville, MD (Fohrman et al., 1954). Holstein, Jersey, Red Dane, and Guernsey foundation females were bred to Holstein, Jersey, and Red Dane sires to produce 3 generations of crossbreds. Crossbred groups averaged about 30% more than foundation purebred cows for milk production and about 35% more for fat production. Using results of Fohrman et al. (1954), Touchberry (1992) estimated heterosis for milk production (21.6%) and fat production (18.8%). Fohrman et al. (1954) concluded "there is sufficient evidence presented here to indicate that female progeny of crossbred cows when sired by production proved bulls will develop into very satisfactory dairy animals."

From 1949 to 1969, a study of crossbreeding of Holsteins and Guernseys was conducted at the University of Illinois. Pure Holsteins were superior to crossbreds for milk production, but crossbreds had an advantage for income per lactation. Income produced per cow per year was 11.4% greater for crossbreds than the average of the purebreds (Touchberry, 1992).

McAllister et al. (1994) reported greater than 20% heterosis for lifetime performance in crossbreds of Holstein and Ayrshire. They also reported that moderate heterosis was observed during first lactation for milk, fat, and protein production. In the same crossbreeding

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study at Agriculture Canada, McAllister (1986) indicated that first-lactation crossbreds of Holstein and Ayrshire were not significantly different from pure Holsteins for milk production, but the crossbreds were significantly higher for fat production.

The Animal Improvement Programs Laboratory (AIPL) of USDA conducted an analysis of DHI data to determine breed differences in herds containing both purebred and crossbred cows (VanRaden and Sanders, 2003). In this study, protein production of Brown Swiss/Holstein crossbreds equaled protein production of pure Holsteins. Fat production was slightly greater for crossbreds of Jersey and Holstein, as well as crossbreds of Brown Swiss and Holstein, than for pure Holsteins. With the milk pricing scenarios Net Merit\$ and Cheese Merit\$ from USDA, they concluded that first-generation crosses of 2 pure breeds (F_1), Brown Swiss and Jersey with Holstein, were more profitable than pure Holsteins. In another study with DHI data, Lesmeister et al. (2000) showed Holstein crossbreds could be more profitable than pure Holsteins under commercial conditions.

In New Zealand, crossbreeding has grown substantially in popularity, and numerous studies have been performed to assess the benefits of crossbreeding in pastoral production systems. Ahlborn-Breier and Hohenboken (1991) reported heterosis of 6% for fat production and 7% for protein production of crossbreds of Holstein and Jersey compared to the 2 pure breeds. They also noted that F_1 crossbreds of Holstein and Jersey were superior to pure Holsteins for fat production. Lopez-Villalobos et al. (2000) evaluated the profitability of alternative breeding systems under New Zealand pastoral conditions. The aim of the study was to evaluate the profitability of dairying under 3 mating systems involving the Holstein-Friesian, Jersey, and Ayrshire breeds. The results suggested that rotational crossbreeding could increase profitability under New Zealand conditions.

A Swedish study (Ericson et al., 1988) determined the effects of crossbreeding the Swedish Red Breed (SRB) and the Swedish Holstein Breed (SLB) on several traits. The F_1 offspring of SRB and SLB were superior to pure SRB or SLB for all production traits except lactational milk production.

Crossbreeding might become more advantageous in the future for commercial milk production to avoid the consequences of inbreeding depression as the genetic relationships of the global Holstein population continue to increase. Increase of relationships within dairy breeds is inevitable with continuous selection, especially with BLUP methods for prediction of genetic worth.

Background

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 AI semen of the Normande and Montbeliarde breeds from France, as well as the SRB and Norwegian Red Breed (NRF). The SRB and NRF breeds share similar ancestry, mostly Ayrshire and Shorthorn, and exchange sires of sons; therefore, the breeds are collectively regarded as Scandinavian Red (SR) for this study. Crossbred cows began calving in June 2002, and some cows in the 7 dairies continued to be pure Holstein, which permitted comparison of pure Holsteins and crossbreds. Holstein cows were randomly assigned to breed of service sire.

The objectives of this study were to determine differences between pure Holsteins and crossbreds of Normande/Holstein, Montbeliarde/Holstein, and SR/Holstein during first lactation for actual 305-d production of milk, fat, protein, and combined fat plus protein in the 7 commercial dairies in California.

MATERIALS AND METHODS

Data

Pure Holstein and crossbred heifers calved from June 2002 to January 2005. Holstein cows were required to be sired by AI sires 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. In addition, the dams of all animals were required to have a Holstein NAAB sire code, which permitted adjustment for production potential of cows according to the genetic merit of their dams. This adjustment should alleviate concerns about nonrandom mating of breeds of sire with individual dams of cows. This edit removed all cows from the study that had natural-service Holstein sires or maternal grandsires.

The number of cows remaining in the data following successive steps of editing is provided in Table 1. Edits were made to test-day observations, and they were similar to those used by the USDA for routine genetic evaluation. Lactations of cows were required to be at least 40 d in milk. If a cow left the herd, the lactation had to be at least 15 d. A first test day by 90 d in milk was required. For individual test days, days in milk were required to be from 5 to 365 d. Test days after 305 d are used to improve prediction of 305-d production (Schaeffer and Jamrozik, 1996). The first test after 305 d, but not beyond 365 d, was included in the data file. Each test day was required to have an observation for milk, fat, and protein production. Fat percentage was required to be at least 1.0%, but no more than 9.9%. Protein percentage was required to be at least 1.0%,

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