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Fertility, survival, and conformation of Montbéliarde × Holstein and Viking Red × Holstein crossbred cows compared with pure Holstein cows during first lactation in 8 commercial dairy herds

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ABSTRACT

Montbéliarde (MO) × Holstein (HO) and Viking Red (VR) × HO crossbred cows were compared with pure HO cows in 8 large, high-performance dairy herds in Minnesota. All cows calved for the first time from December 2010 to April 2014. Fertility and survival traits were calculated from records of insemination, pregnancy diagnosis, calving, and disposal that were recorded via management software. Body condition score and conformation were subjectively scored once during early lactation by trained evaluators. The analysis of survival to 60 d in milk included 536 MO × HO, 560 VR × HO, and 1,033 HO cows during first lactation. Cows analyzed for other fertility, survival, and conformation traits had up to 13% fewer cows available for analysis. The first service conception rate of the crossbred cows (both types combined) increased 7%, as did the conception rate across the first 5 inseminations, compared with the HO cows during first lactation. Furthermore, the combined crossbred cows (2.11 ± 0.05) had fewer times bred than HO cows (2.30 ± 0.05) and 10 fewer d open compared with their HO herdmates. Across the 8 herds, breed groups did not differ for survival to 60 d in milk; however, the superior fertility of the crossbred cows allowed an increased proportion of the combined crossbreds (71 ± 1.5%) to calve a second time within 14 mo compared with the HO cows (63 ± 1.5%). For survival to second calving, the combined crossbred cows had 4% superior survival compared with the HO cows. The MO × HO and VR × HO crossbred cows both had increased body condition score (+0.50 ± 0.02 and +0.25 ± 0.02, respectively) but shorter stature and less body depth than HO cows. The MO × HO cows had less set to the hock and a steeper foot angle than the HO cows, and the VR × HO cows had more set to the hock with a similar foot angle to the HO cows. The combined crossbred cows had less udder clearance from the hock than HO cows, more width between both front and rear teats, and longer teat length than the HO cows; however, the frequency of first-lactation cows culled for udder conformation was uniformly low (<1%) across the breed groups.
Key words: crossbreeding, Montbéliarde, Viking Red, fertility

INTRODUCTION

Breeding goals of dairy cattle throughout the world have heavily emphasized production traits. However, a negative genetic correlation between production and fertility has been documented (Philipsson et al., 1994; Berry et al., 2014). Phenotypically, Holstein (**HO**) cows have deteriorated in fertility commensurate with increases in production (Walsh et al., 2011). Therefore, fertility and longevity have gradually received more emphasis over time in selection indices around the world (Miglior et al., 2005).

A steep decline in phenotypic fertility for HO cows may have plateaued at a low level during the early 2000s (Berry et al., 2014), but the plateau may be mostly attributable to environmental intervention rather than a reversal of the genetic trend for HO cows (VanRaden et al., 2014). Norman et al. (2015) reported decreases in days open (**DO**) and calving interval from 2004 to 2014 among pure HO cows in the United States; however, the results were not caused by increased conception rate (**CR**), which was only 34% for first services in 2014. Also, a continual increase of the mean inbreeding coefficient may have impeded phenotypic improvement for fertility because inbreeding is more detrimental for functional traits, such as fertility, health, and survival, than other traits (Falconer and Mackay, 1996). The average inbreeding coefficient of HO calves born early in 2017 in the United States was 7.11% (Council on Dairy Cattle Breeding, 2017). Heterosis results when distinct breeds of cattle are crossed; therefore, some

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commercial dairy producers have turned to crossbreeding to improve fertility (Walsh et al., 2008). Sørensen et al. (2008) summarized the heterosis for fertility traits of 2-breed crosses including HO and concluded that about 10% heterosis should be expected for fertility traits when other breeds are crossed with HO cows. Furthermore, the marked advantage in fertility for crossbred cows over HO cows may be attributable to additive genetic effects of non-HO breeds (Sørensen, 2007; Norman et al., 2009; Dezetter et al., 2015) in addition to heterosis.

Culling decisions for individual cows are heavily affected by production, fertility status, age, health status, stage of lactation, cull value of cows, value of replacements, or a combination of these factors (Gröhn et al., 2003). Diseases of cows have a major effect on longevity, and Kyntäjä (2013) documented fewer health treatments for Viking Red (**VR**) cows than for HO cows in Finland. Dairy producers in European countries have recorded health treatments, including lameness, for many years in France (Bourrigan et al., 2016) and the Nordic countries (Emanuelson, 2013). Therefore, selection for improved health was possible for the Montbéliarde (**MO**) and VR breeds, and, as a result, these breeds may be well suited for crossbreeding with the HO breed.

Montbéliarde cows in France had approximately 13% less mortality than French HO cows in 2005 (Raboisson et al., 2011), and VR cows had 22% less mortality than HO cows in Sweden (Alvåsen et al., 2012). Advantages for additive genetic effects of the MO and VR breeds for mortality combined with 10 to 15% heterosis for longevity from crossbreeding (Sørensen et al., 2008) has resulted in interest in 3-breed rotational crossbreeding using the MO, VR, and HO breeds. Despite the global prominence of the HO breed over the past 30 yr, pure HO cows rank poorly for survival compared with other dairy breeds (Hare et al., 2006), and this has generated interest by dairy producers in crossbreeding. Cow survival is a growing concern of the general public for animal welfare.

The HO breed has been heavily selected for large frame size over time, and the genetic trend for increased stature, strength, and body depth of HO cows continues (VanRaden et al., 2014) despite a negative weight on frame size since 2000 in the US net merit index (VanRaden and Cole, 2014). The continuous increase in mean body size of HO cows is concerning because larger body size of cows results in increased costs for health treatments (Becker et al., 2012), reduced feed efficiency because of increased maintenance requirements of large-framed cows (VandeHaar et al., 2016), and reduced survival of cows (Hansen et al., 1999; VanRaden and Cole, 2014). Selection for angularity of HO cows via selection for final score type has resulted in reduction of BCS (Hansen, 2000), and the phenotypic relationship of low BCS and poor fertility and health in HO cows is well documented (Roche et al., 2009; Walsh et al., 2011).

The MO and VR breeds may complement the HO breed for crossbreeding because the selection goals of these 2 breeds have included fertility and health alongside production of milk solids; however, the HO breed focused more on production at the expense of fertility and health. The VR breed ignored body condition, and the MO breed selected for greater body condition in their selection programs over time. The MO × HO crossbred cows evaluated by Hazel et al. (2013, 2014) had similar stature to their pure HO herdmates. Also, VR × HO cows may have reduced body size compared with HO cows because pure VR cows are 6.5 cm shorter than HO cows in Denmark, Finland, and Sweden (H. Stålhammar, VikingGenetics, Skara, Sweden; personal communication). Advantages of crossbred cows over HO cows for fertility and survival may have resulted from the increased BCS of crossbreds (Pryce and Harris, 2006; Walsh et al., 2008; Hazel et al., 2014). Studies of pure HO cows have found negligible relationships between rump, leg, and udder conformation with metabolic and reproductive diseases (Zwald et al., 2004), but HO cows with shallow udders are superior for udder health (Zwald et al., 2004; Carlström et al., 2016a).

The objective of this study was to compare phenotypes of fertility, survival, and conformation from first lactations of MO × HO and VR × HO crossbred cows with pure HO cows in a designed study. The same 2-breed crossbreds were previously compared with pure HO cows for production and calving traits during first lactation (Hazel et al., 2017).

MATERIALS AND METHODS

Experimental Design

Descriptions of Herds and Cows Enrolled. A 10-yr designed study of crossbreeding was initiated between March and September of 2008 in 8 high-performance dairy herds in Minnesota. A total of 3,550 pure HO virgin heifers as well as mostly first- or second-lactation cows were offered by the herd owners as foundation females to initiate the study. Cows in all herds were housed in 4- or 6-row freestall confinement facilities and fed a TMR during lactation. The mean herd size in May 2016 was 791 cows, and the herds had a weighted mean production level of 13,918 kg of milk, 510 kg of fat, and 430 kg of protein from Minnesota