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Short communication: Use of young bulls in the United States

J. L. Hutchison,[1] J. B. Cole, and D. M. Bickhart
Animal Improvement Programs Laboratory, Agricultural Research Service, USDA, Beltsville, MD 20705-2350

ABSTRACT

The availability of genomic evaluations since 2008 has resulted in many changes to dairy cattle breeding programs. One such change has been the increased contribution of young bulls (0.8 to 3.9 yr old) to those programs. The increased use of young bulls was investigated using pedigree data and breeding records obtained from the US national dairy database (Beltsville, MD). The adoption of genotyping was so rapid that by 2009, >90% of all Holstein artificial insemination (AI) service sires and 86% of Jersey AI service sires were genotyped, regardless of age. The percentage of sons sired by young bulls increased by 49 percentage points (10% in 2008 compared with 59% in 2012) due to the onset of genomic evaluations for Holsteins and by 46 percentage points for Jerseys (11 and 57%, respectively). When limiting these data to sons retained for breeding purposes through AI, the increase was even more dramatic, increasing approximately 80 percentage points from 2008 to 2012 for both Holsteins and Jerseys (1, 5, 28, 52, and 81% for Holsteins and 3, 4, 43, 46, and 82% for Jerseys from 2008 through 2012). From US breeding records from 2007 through 2012, 24,580,793 Holstein and 1,494,095 Jersey breedings were examined. Young bulls accounted for 28% and 25% of Holstein and Jersey breedings in 2007, respectively. These percentages increased to 51% of Holstein and 52% of Jersey breedings in 2012, representing 23- and 27-percentage-unit increases, respectively. Matings to genotyped young bulls have rapidly increased while the use of nongenotyped bulls has diminished since the onset of genomics. Mean sire age for Holstein male progeny born in 2012 was 2.7 yr younger than males born in 2006, and 1.3 yr younger for females; corresponding values for Jerseys were 2.3 and 0.9 yr. Holstein male offspring had an increase of 281 kg between 2006 and 2012, compared with 197 kg between 2000 and 2006 for parent averages (PA) for milk, an increase of 84 kg between the 2 periods. Jersey male offspring had an increase of 49 kg between the 2 periods. To demonstrate the economic impact of the differential use of young bulls, herds were grouped by the frequency of their use of young bulls, and average PTA for milk and net merit for cows that were bred in 2003 through 2012 were calculated. In 2012, herds using >75% young bulls created offspring that had a PA of +52 kg for milk and +$58 net merit compared with herds using no young bulls. Jersey herds using >75% young bulls created offspring that had a PA of +142 kg for milk and +$63 for net merit compared with herds using no young bulls. Use of young bulls has greatly reduced the generation interval and improved the rate of genetic gain since the implementation of genomic evaluations.

Key words: young bull, breeding, genomics

Short Communication

The implementation of genomic evaluations in 2008 has revolutionized dairy cattle breeding by greatly increasing the accuracy of genetic predictions for young animals. Genomic evaluations use information from genotypes that are extensively checked for call quality and parental conflicts (Wiggans et al., 2011), although their accuracy is highly dependent on the number of animals that are in the predictor population. All young bulls purchased by major AI organizations now are selected based on genomic evaluations, which allows breeders to identify genetically superior animals at a much younger age (Schefers and Weigel, 2012). In fact, bulls that have been genotyped can be evaluated for superior traits before they reach sexual maturity rather than waiting for evaluations on their resultant progeny. This greatly reduces the time and cost to identify bulls that are genetically superior. The use of young bulls (bulls <4 yr old when their semen was used) was investigated by looking at the percentage of young bulls genotyped and the percentage of young bulls used in US breeding records. Generation intervals and herd usage of young bulls were also examined to determine if a higher rate of genetic gain was achieved by using young bulls.

Pedigree data and breeding records were obtained from the US national dairy database (Beltsville, MD). In total, 24,580,793 Holstein and 1,494,095 Jersey breeding records were distributed among17,519 Holstein and

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[1]Corresponding author: Jana.Hutchison@ars.usda.gov

4,044 Jersey herds. The age of service sires from those records was categorized into 3 groups: young bulls (0.8 to 3.9 yr), first-crop sires (4.0 to 7.9 yr), and older sires (≥8.0 yr), as in Olson et al. (2011).

Rapid Adoption of Genotyping and Young Bull Predictions

Genotyping provides the opportunity to screen thousands of candidate young sires for AI service by selecting the best possible candidate bulls. Accurate genomic predictions have allowed breeders to identify genetically superior animals at a much younger age, both male and female. The adoption of genotyping was so rapid that by 2009, >90% of Holstein AI service sires and 86% of Jersey AI service sires were genotyped, regardless of the age of the bull. Currently, 100% of Holstein and Jersey young AI bulls are genotyped. Several factors contributed to this rapid adoption, including an economic benefit, an earlier accurate prediction for young bulls, and an increase in prediction reliabilities.

Earlier predictions allow young bulls to be used as sires of sons at a higher percentage than they were previously. To investigate this, the percentage of sons sired by young bulls was examined. On average, 31,777 Holstein sons were born each year from 2008 through 2012, with 31,394 sons born in 2008 and 32,310 born in 2012. An increasing number of progeny were sired by young bulls in these years with 3,205, 3,039, 6,596, 10,618, and 19,026 sons sired by young bulls in 2008, 2009, 2010, 2011, and 2012, respectively. The numbers of Jersey sons sired by young bulls were 322, 392, 831, 1,101, and 1,942 for the same years, out of an average of 3,242 Jersey sons born for each of those 5 yr (2,836 and 3,431 sons born in 2008 and 2012, respectively). The percentage of all sons sired by young bulls increased by 49 percentage points (10% in 2008 compared with 59% in 2012) due to the onset of genomic evaluations for Holsteins and by 46 percentage points for Jerseys (11 and 57%, respectively), as shown in Table 1.

When limiting these data to sons retained for breeding purposes through AI, 12, 94, 578, 912, and 869 Holsteins sons were sired by young bulls born in 2008 through 2012, with 1,625, 1,764, 2,072, 1,749, and 1,067 total Holstein bulls sampled over the same period.

For Jersey sons, 7, 8, 125, 99, and 137 were sired by young bulls and 202, 206, 289, 216, and 168 were sampled. Therefore, the percentage of AI sons sired by young bulls was 1, 5, 28, 52, and 81% for Holsteins and 3, 4, 43, 46, and 82% for Jerseys (Table 1), which approximately equates to an 80-percentage-point increase from 2008 to 2012 for both Holsteins and Jerseys.

Table 1. Percentage of Holstein and Jersey sons sired by young bulls (ages: 0.8 to 3.9 yr) by birth year of all sons and sons retained for breeding purposes through AI

Birth year of sons	Holstein		Jersey	
	All sons	AI sons	All sons	AI sons
2008	10	1	11	3
2009	10	5	13	4
2010	20	28	25	43
2011	35	52	32	46
2012	59	81	57	82

Young Bulls as Service Sires

One of the implications of the accuracy of genomic predictions is that more young bulls could be used in US selection programs. We investigated the adoption of young bulls as service sires by analyzing the percentage of inseminations by breeding year, service sire age, and genotyped status for breeding records of Holstein and Jersey bulls (Table 2). Age of service sires was categorized into the same 3 groups as before: young (0.8 to 3.9 yr), first-crop (4.0 to 7.9 yr), and old (≥8.0 yr). We observed increased use of young bulls (regardless of genotyped status) between 2007 and 2012 for Holstein and Jersey. Young bulls accounted for 28 and 25% of Holstein and Jersey breedings in 2007, respectively. These percentages increased to 51% of Holstein and 52% of Jersey breedings in 2012, representing 23- and 27-percentage-unit increases, respectively. Genotyped young bulls accounted for 0, 26, 92, 98, 99, and 100% of breedings of young Holstein bulls annually from 2007 through 2012; corresponding percentages for Jersey young bulls were 0, <1, 72, 98, 99, and 100%. This means that in 2007 and 2008, a large proportion of young Holstein and Jersey bulls were used in matings before being genotyped. Matings to nongenotyped sires, regardless of age, have diminished since the onset of genomics, decreasing from 28, 54, and 15% in 2007 for young, first-crop, and old Holstein sires and 25, 55, and 18% for Jersey sires to ≤1% in 2012 for all age groups and breeds (Table 2). First-crop sire usage, regardless of genotype status, decreased for Holstein matings by 16 percentage units (from 56% in 2007 to 40% in 2013) and for Jersey matings by 17 percentage units (from 55% in 2007 to 38% in 2013). Matings to genotyped young bulls have rapidly increased and the use of nongenotyped bulls has waned since the onset of genomics.

Generation Interval

The shift from the time-consuming method of progeny testing to genomic predictions of young bulls has greatly reduced the generation interval in the dairy cattle breeding programs that use genotyped young