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Evaluations for service-sire conception rate for heifer and cow inseminations with conventional and sexed semen

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ABSTRACT

Service-sire conception rate (SCR), a phenotypic fertility evaluation based on conventional (nonsexed) inseminations from parities 1 through 5, was implemented for the United States in August 2008. The SCR model contains the categorical fixed effects of parity for lactations 1 to 5; state-year-month of insemination group; 6 standardized milk yield groups; service number for inseminations 1 to 7; cow age; and herd-year-season-parity-registry status class. Covariate effects for service-sire and mating inbreeding coefficients were linear regressions fit as deviations from the overall mean. Random effects included service-sire age group; AI organization-insemination year group; individual service sire; cow's genetic ability to conceive; cow's permanent environmental effect; and residual. Using insemination data from 2005 through 2009, the SCR procedure was applied separately for nulliparous heifer inseminations with conventional semen $\left(SCR_{H_{conv}}\right)$, cow inseminations with conventional semen $\left(SCR_{C_{conv}}\right)$, nulliparous heifer inseminations with sexed semen $\left(SCR_{H_{sexed}}\right)$, and cow inseminations with sexed semen $\left(SCR_{C_{sexed}}\right)$. Holstein and Jersey bulls with ≥300 and ≥200 artificial inseminations, respectively, in ≥10 herds and with ≥100 breedings during the 12 mo before evaluation were examined. The number of bulls evaluated for SCR in January 2010 was 270 Holsteins and 16 Jerseys for $SCR_{H_{conv}}$, 2,309 Holsteins and 214 Jerseys for $SCR_{C_{conv}}$, 114 Holsteins and 6 Jerseys for $SCR_{H_{sexed}}$, and 25 Holsteins and 7 Jerseys for $SCR_{C_{sexed}}$. The mean SCR for each evaluation category was set to 0; Holstein standard deviations were 2.55% for $SCR_{H_{conv}}$, 2.21% for $SCR_{C_{conv}}$, 4.29% for $SCR_{H_{sexed}}$, and 2.39% for $SCR_{C_{sexed}}$. The mean Holstein reliabilities were 82, 79, 75, and 73%, respectively. Correlations for Holstein SCR between conventional and sexed semen averaged near zero (−0.21 to 0.18). Predicted correlations between true SCR were −0.27 to 0.24. In contrast, correlations between Holstein heifers and cows were high (0.66 to 0.76), and predicted true correlations averaged near 1.0 (0.82 to 1.03). Correlations for Jerseys were often larger, although based on fewer inseminations and service sires compared with Holsteins. Some rankings for SCR could benefit from combining cow and heifer data but should be kept separate for conventional and sexed semen inseminations.

Key words: service sire, conception rate, sexed semen, bull fertility

INTRODUCTION

Dairy producer interest in sexed semen has been based largely on a desire to obtain more heifer calves for herd growth while maintaining a closed herd, supply herd replacements for other producers, or accelerate genetic improvement within the herd. Norman et al. (2010) documented the rapid acceptance of sexed semen technology in DHI herds in the United States. They also reported differences in conception rate, dystocia, stillbirth, and calf sex from using female-designated sexed semen versus conventional (nonsexed) semen for breeding heifers and cows. Compared with conventional semen, the conception rate for sexed semen was 70% as high for heifer breedings and 83% as high for cow breedings. Those national findings were similar to earlier results from field trials (Seidel and Schenk, 2002; DeJarnette et al., 2009; Schenk et al., 2009). For female-designated sexed semen, female calves resulted from 91% of heifer inseminations and 89% of cow inseminations; corresponding percentages for conventional semen were 51 and 48 (Norman et al., 2010). The slightly higher percentage of female than male calves for nulliparous heifers bred with conventional semen could be the result of incorrect coding of some sexed semen or an underlying physiological circumstance (Skjervold and James, 1979). Norman et al. (2010) also reported that dystocia was decreased by 28% for heifers and 64% for cows through the use of female-designated sexed semen. In contrast, they reported that stillbirths were more prevalent for heifers from sexed than from conventional semen (9%) but

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less prevalent for cows (25%). The surprising frequency in stillbirths for heifers from female-designated sexed semen resulted primarily from a 44% higher stillbirth incidence for single male calves than for single female calves, but stillbirth incidence also was 11% higher for single female calves. DeJarnette et al. (2009) first reported an unusually high incidence of stillbirths with male calves when female-designated sexed semen was used.

Field trials with sexed semen have shown unpredictable bull differences in fertility after sperm is sex sorted compared with the fertility before sorting (Seidel and Schenk, 2002; i.e., the sperm of some bulls tolerates the stress of sex sorting better than that of other bulls). DeJarnette et al. (2009) and Abdel-Azim (2010) reported that separate conception rates for conventional and sexed semen were essential for bull rankings.

Service-sire differences in fertility of conventional semen have been documented and bull rankings for nonreturn rate made available from 1986 through 2005 by North Carolina State University and Dairy Records Management Systems (Raleigh, NC; Clay, 1987). The Western Fertility Analysis, a service-sire ranking based on conception rates for confirmed pregnancies from conventional semen, was initiated in 2000 through AgriTech Analytics (Visalia, CA; Weigel, 2006).

A national evaluation for service-sire conception rate (**SCR**) was implemented in August 2008 by the USDA Animal Improvement Programs Laboratory (Beltsville, MD; Norman et al., 2008a). This phenotypic bull fertility evaluation based on inseminations with conventional semen was the culmination of research reported by Kuhn et al. (2006, 2008) and Kuhn and Hutchison (2008). An SCR evaluation is the difference in probability that a unit of semen from a specific bull will result in a pregnancy compared with the mean of all other bulls that could have been used. In developing SCR Kuhn and Hutchison (2008) compared results from both the categorical and linear model and found linear models were as effective as threshold models in determining the usefulness of multiple services and expanded service sire terms. Linear models were used to avoid the substantial computing time required to obtain categorical evaluations and minimize the complexity of results.

Only AI inseminations from the first 7 breedings with known outcomes (success or failure) are included in SCR. All information reported subsequently, such as additional inseminations, future calving dates, pregnancy check reports, do-not-breed designations, and termination codes, were used in determining pregnancy status for each insemination. These edits are the reason that SCR is considered a conception rate evaluation rather than an evaluation based on nonreturn rate. To date, the official SCR evaluations have not been expanded to include results from sorted semen because commercial use of the technology only started in 2006.

The objective of this study was to compare separate SCR evaluations for cow and heifer inseminations with conventional or sexed semen to determine whether dairy producers can be provided more accurate predictions of bull fertility in different breeding situations.

MATERIALS AND METHODS

Holstein and Jersey records for AI breedings with conventional or sexed semen were extracted from the US national dairy database (Beltsville, MD). Sexed semen use was determined from coding in reproductive records (format 5; Animal Improvement Programs Laboratory, 2009) supplied to the USDA by dairy records processing centers: either AI breeding with gender-selected semen (code G) for type of reproductive event or a semen-processing organization code from the National Association of Animal Breeders (Columbia, MO), generally in the 500 series (semen marketing codes). The reproductive records were supplied to the national database primarily from AgSource Cooperative Services (Verona, WI), AgriTech Analytics (Visalia, CA), and Dairy Records Management Systems (Raleigh, NC, and Ames, IA). Those 3 dairy records processing centers provided >1.5 million breeding records for heifers and >13.1 million breeding records for cows. Records with a semen marketing code of 514 were excluded from analysis because the technology used by Accelerated Genetics (Baraboo, WI) differed from that used by other AI organizations.

The Council on Dairy Cattle Breeding oversees a quality certification program for the US dairy industry and, through an agreement with the USDA Animal Improvement Programs Laboratory, agrees to provide data so that accurate genetic evaluations will be provided to the dairy industry on a routine basis. Using the US procedure designed for official SCR evaluations (Norman et al., 2008a), 4 separate SCR evaluations were calculated based on independent sources of input data. The 4 separate SCR categories were nulliparous heifer inseminations with conventional semen $\left(\mathbf{SCR}_{\mathbf{H}_{\mathbf{conv}}}\right)$, cow inseminations with conventional semen $\left(\mathbf{SCR}_{\mathbf{C}_{\mathbf{conv}}}\right)$, nulliparous heifer inseminations with sexed semen $\left(\mathbf{SCR}_{\mathbf{H}_{\mathbf{sexed}}}\right)$, and cow inseminations with sexed semen $\left(\mathbf{SCR}_{\mathbf{C}_{\mathbf{sexed}}}\right)$. The $\mathrm{SCR}_{\mathrm{C}_{\mathrm{conv}}}$ evaluation was identical to the US official SCR evaluation that is released to the dairy industry. Data edits were primarily the same as for US official SCR evaluations (Kuhn et al., 2008; Norman et al., 2008a). Age at breeding was restricted to ≥12 and <27 mo for nulliparous heifers and ≥22 mo