Sire Conception Rate (SCR): A Measure of Sire Fertility

What does it mean and how should it be interpreted?

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Summary

Sire Conception Rate (SCR) is an indicator of the semen fertility of bulls used for Artificial Insemination (AI) and is the only national fertility evaluation in the US. The SCR evaluation model uses data from all four US Dairy Record Processing Centers, including data from all 50 states plus Puerto Rico and Mexico. From its extensive database of 57 million breedings, the Council on Dairy Cattle Breeding (CDCB) used over 18 million breedings from over 5 million cows to calculate the December 2015 SCR. The evaluation model is reviewed and re-examined to ensure its relevance and correctness, giving producers an accurate measurement of sire fertility.

Producers have long been interested in sire fertility of bulls they are using in AI service. Sire Conception Rate (SCR) is the only national fertility evaluation in the US. SCR's are calculated and distributed by CDCB, the same organization that is responsible for genetic and genomic evaluations in the US.

Origin of Sire Conception Rate

Sire fertility evaluations date back 30 years to 1986 when Estimated Relative Conception Rate (ERCR) evaluations were first conducted by Dairy Records Management Systems (DRMS). ERCR's were phenotypic (physical characteristics) evaluations based upon 70-day Non-Return Rate (NRR) to first breeding, which measures the success or failure of first service. NRR's were reported through DHI from participating herds primarily located in the Eastern and Midwestern US (Clay, 1987).

In 2003, AgriTech Analytics (ATA) began calculating and distributing the Western Bull Fertility Analysis, now called Service Sire Fertility Summary (SSFS). These evaluations are based on 75-day confirmed pregnancy rather than on NRR that was used in ERCR. SSFS includes up to five services per cow per lactation (Weigel, 2006). SSFS now restricts breedings to the last 60 months, as reported through DHI from participating herds in 20 states across the US. The December 2015 analysis was based on 2 million breedings from 930,000 cows and included 6,924 Holstein service sires, of which 808 meet the minimum requirements for publication (Weigel, 2015).

In May 2006, USDA's Animal Improvement Programs Laboratory (AIPL) took over calculation and distribution of the phenotypic ERCR evaluations for sire fertility (Kuhn et. al., 2006).

Initially, there were no changes made by AIPL to the ERCR evaluation methodology; they employed the same methodology used by DRMS.

In the same year, AIPL launched an intense research effort. This extensive research continued until August 2008 and resulted in a new evaluation called Sire Conception Rate (SCR) (Kuhn et. al. 2008 a). The evaluation model used for SCR is very complex and includes a number of individual effects (Kuhn et. al. 2008 b).

SCR Evaluation Model

The SCR evaluation model takes into account the inbreeding percentage of the bull being used (service sire) as well as the percent inbreeding of the offspring resulting from the mating. The age of the bull, the AI organization collecting the semen, and the year the semen was used are also accounted for. Many variables relating to the fertility potential of the ~~female~~ cow being bred are included in the model in order to accurately partition the effect of both bull and cow on the ability to create a pregnancy.

Data from all four Dairy Record Processing Centers in the US (ATA, AgSource Cooperative Service, DRMS, and DHI Computing Services, Inc.) contribute information to the database used to calculate SCR. Data is included from all 50 states plus Puerto Rico and Mexico.

Data editing is very extensive for the SCR evaluation. Only AI breedings with known outcomes are used in SCR evaluations. Any information provided such as additional breedings, subsequent calving dates, pregnancy check results, “Do Not Breed” designations and termination codes are used to confirm pregnancy status for each breeding. Up to seven breedings per cow per lactation are used through their first 5 lactations. Heifer breedings are excluded. In addition, no crossbreed data is used. The breed of the service sire must match the breed of the cow and her sire (Norman et. al, 2008).

The CDCB’s massive edited dataset contains 57 million breedings from January 2004 to December 2015. No other dataset in the world comes close to having the number of inseminations and accuracy that is provided by the CDCB dataset used in calculating SCR evaluations. (Weigel, 2015).

The data used in the December 2015 SCR evaluations was limited to the latest 48 months of breedings, which contains over 18 million breeding records from over 5 million cows. In order to keep the SCR evaluations current and more relevant, the last 24 months of data receives more weight in the SCR evaluations than the breedings from 25-48 months earlier. There were 20,760 service sires included in the December 2015 SCR analysis, of which 2,730 bulls from six breeds meet the minimum requirements for publication.

An SCR evaluation is released for active-AI or genomic Holstein bulls that have a minimum of 300 breedings in the last 48 months (at least 100 breedings in the last 12 months) in at least 10 herds. The average number of breedings for the 2,273 Holstein bulls in the December 2015 SCR run was 4,314. Fewer minimum breedings are required for release of the SCR evaluations for the other five breeds (Ayrshire, Brown Swiss, Guernsey, Jersey and Milking Shorthorn). SCR

evaluations are calculated three times a year (April, August and December) by the CDCB in conjunction with the genetic and genomic evaluations.

Interpreting SCR Values

SCR is a phenotypic prediction of bull fertility and is most appropriately used to select higher fertility bulls regardless of source. SCR is expressed as a relative conception rate (CR) and is reported as a percentage to the nearest .1 %. SCR's are reported on a within breed basis. The average of all bulls, for each of the six dairy breeds, has an average SCR of 0.0 %. The Holstein breed standard deviation for December 2015 was 2.1 %.

A bull with an SCR of +2.0 % is expected to have a 2.0 % higher CR than an average bull and a 4.0 % higher CR than a bull with an SCR of -2.0 % (Norman et. al., 2008). A bull with an SCR of +2.0 % is *expected* to have a CR of 32 % in a herd that normally averages 30 % and historically has used bulls with average SCR. The reason the term *expected* is used is that it indicates what the results would be if based on large numbers of breedings. (Norman et. al., 2008). Any prediction of the conception rate from just a few breedings is seldom reliable, which is a weakness of smaller datasets from in-house evaluations.

Examining SCR Model

SCR evaluations have been calculated and distributed by the CDCB for 7 years now. Since some of the assumptions could have changed over time, the National Association of Animal Breeders (NAAB) Sire Fertility Evaluation Committee asked the CDCB to do a re-examination of the SCR model used in the US. The committee is made up of one representative from each of the six major US AI companies plus Dr. Kent Weigel, genetics consultant to NAAB and a professor and leading genetics researcher at University of Wisconsin Madison.

The results of the re-examination were reported at the Interbull meeting in Orlando, Florida July 2015 (Norman et. al., 2015). The re-evaluation study confirmed that the model currently being used is still valid for predicting SCR's. The NAAB Sire Fertility Evaluation Committee continues to meet with CDCB scientists, exploring ways to ensure SCR's are even more accurate predictions of sire fertility that help dairy producers meet their reproductive goals. Along with SCR's, producers have several genetic evaluation measures of fertility, such as daughter pregnancy rate and productive life, to help them achieve greater reproductive success.

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