

How Genomics May Influence Fertility

Making improvements in dairy cattle reproduction is being done in a myriad of ways. Research has shown that synchronization programs, nutrition and management factors can all benefit dairy cattle reproductive performance. But one new way to improve reproduction is emerging—genomics.

The low heritability of reproduction

The new genomic technology comes on the heels of poor dairy cattle reproduction and low heritability of reproductive traits, as the adjacent chart illustrates. These values on a bull proof are commonly consulted when making mating decisions, even though heritability and reliability is very low.

Because reproductive traits are low in heritability, improvements must be made in both genetic progress and on-farm management practices. As the illustration depicts, producers can often compensate for poor genetics with very good management practices, because management and genetic improvement support each other. Likewise, producers can see exponential improvements in fertility by focusing on genetics and management.

Enter: Genomic Mapping

Researchers moved closer to improving reproduction and selection for reproductive traits when the mapped bovine genome was released in 2004, says Dr. Brian Kirkpatrick of the University of Wisconsin-Madison. The bovine genome now provides researchers and geneticists with a roadmap to better understand an animal's genotype and its ability to perform in a myriad of economically relevant traits, including reproduction.

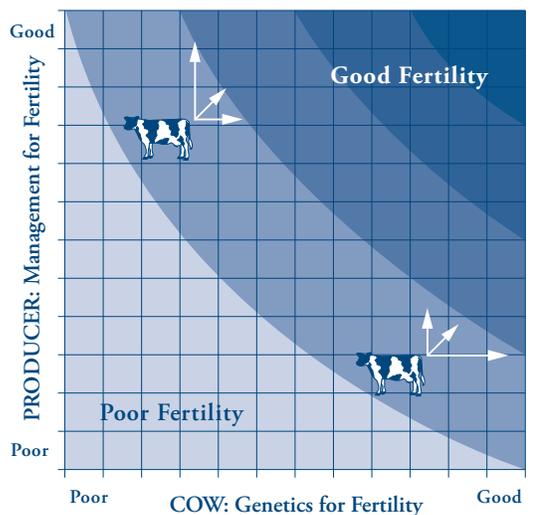
With the inclusion of new genomic data into traditional pedigree parent averages, reliabilities for all traits will improve, ultimately providing the dairy producer with more reliable information prior to bull selection.

Just how much information will new genomic data provide? Geneticists predict that by using the DNA test, the enhanced reliability will be equivalent to adding four to

Mean heritability for fertility traits estimated in 17 studies¹

Fertility Scores	Heritability (%)
Non-return after first insemination	1.9
Conception to first service	2.7
Number of services per conception	2.6
Interval Traits	
Calving Interval	3.4
Days Open	2.4
Days to first service	5.0
Interval from first to last insemination	1.7

Interaction of Management vs. Genetic Improvements





five lactations worth of phenotypic production data for daughters and nine to 10 daughters to a bull's proof. For young sires, a genetic test will help enhance the current data and increase the reliability of the information to levels similar to a proven sire.

The DNA test that is available today uses a DNA chip that can read more than 54,000 single-nucleotide polymorphisms (SNPs). SNPs represent the change of one nucleotide in a sequence of DNA and may or may not cause physical change, while the genotype, or genetic make-up, of the animal is altered. These SNPs are what make each animal unique and what researchers use to identify animals with superior genetics.

Identifying traits that are associated with reproduction is no easy feat. Such traits, like fertility, are complicated in expression because multiple mechanisms are involved. Hundreds of genes may control the expression of one trait, which makes additional research to improve reliability necessary. Researchers are continually identifying additional DNA markers on the bovine genome that are associated with reproduction.

With the variations identified in the genome DNA sequences, more information becomes available and accuracy can be improved more rapidly, says Dr. Kirkpatrick. The adjacent chart

Initial reliabilities for selected traits¹

Trait	Parent Average	Genomic Test	Combined Reliabilities
Productive life (PL)	28	19	47
Daughter pregnancy rate (DPR)	25	15	40
Sire calving easy (SCE)	31	5	36
Daughter calving	31	5	36

shows the initial reliabilities for selected traits related to reproduction. As you will see, adding the genomic test to the already identified parent average can help these traits reach much higher reliabilities and provide producers with additional information that will improve decision-making.

Using genomics for decision-making

Although this science is highly complex, dairy producers will be able to use the information to make improvements to their herd's reproductive performance. Dr. Kirkpatrick notes that the new genotyping information will help producers make even more informed mating decisions without even knowing it because they will consult the same numbers on the sire proof, but those numbers will be more reliable.

More reliable information will make economic sense for the producer, says Dr. Kirkpatrick. If producers choose bulls with improved reproductive traits, a chain of improvements can be realized at the farm level.



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Improved decision-making for reproduction. More information on how a bull's genes transmit can improve the quality of animals in the herd and their genetic ability to get bred in future lactations. By choosing bulls on traits such as daughter pregnancy rate (DPR), improvements in reproductive performance can be realized.



Additional pregnancies. Coupled with the appropriate management practices, using more reliable information to choose bulls can boost conception and pregnancy rates. These bulls will have significantly improved reliability, which means reproductive performance numbers will be more accurate.



Appropriate average days in milk. Increased conception at the most appropriate times in the lactation means cows can be dried off and freshened in a timely manner to maintain the herd's average days in milk. Rather than keeping cows in the milking string far beyond the 305-day lactation, producers can use genomics as an additional management tool to ensure cows rejoin the milking string in a timely manner.



Increased financial gains. Improved repro stats and appropriate time of rebreeding can mean more calves are born and more cows are in the milking string in the appropriate stage of lactation. This can also allow producers to be more flexible in their culling decisions as more genetically superior animals join the milking string in a timely fashion.

The DNA-marker technology and DNA tests available today only scratch the surface; additional DNA markers that influence economically relevant traits will help improve current reliability and provide producers with additional information about the bulls they select. Even in its infancy, genomics will have a direct influence on sire reliability and may be a successful new tool that can be used to improve herd reproduction.

¹ "Code busters just made top genetics easier to find." *Hoard's Dairyman*. April 25, 2008.