



DAIRY CATTLE REPRODUCTION COUNCIL

## Genomics uncover genes related to fertility and reproductive longevity

*Researcher Dr. Hein van der Steen provides insight on implication of research findings.*

Genomic tools continue to provide new information for dairy producers, and how genomic test results will impact reproductive performance continues to be uncovered. New research findings have uncovered more than 50 genes that could directly impact reproductive traits.

To learn more about these genomic findings, we talked with Dr. van der Steen about the implications of the research and how it will influence the future of on-farm reproductive decision-making.

### **Tell us a little bit about the latest genomic breakthrough you've found related to improving reproductive performance.**

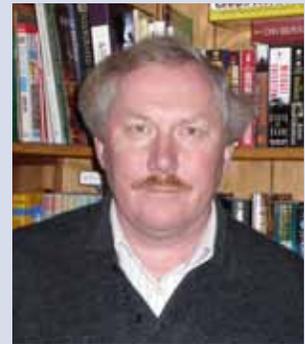
The basis for our research, and the source of its considerable competitive advantage, is a genetically superior mouse colony that has been selectively bred for reproductive longevity for more than 25 years, representing more than 30 generations. The selected lines reproduce almost twice as long as the control line and live through 100 percent more pregnancies. This is the result of a gradual accumulation of favorable versions of the relevant genes for reproductive longevity in the selection lines. Using this mouse model, we recently completed a whole genome scan, which identified genes and pathways related to reproductive longevity in mice.

The DNA of an individual is like a large library: the information you are looking for is in some of the books, but it takes a lot of time to read them all. The mouse model has pointed principal investigator Dr. Benkel and his research team in the right direction, so now they only need to read a few "chapters" from a few "books" to find the information they are looking for.

They evaluated 25 genes and found 140 DNA markers that are potentially relevant for the prediction of herd life and fertility in Holstein cows. A second set of 25 genes is being evaluated now. The most promising markers will be further validated in large-scale studies using the DNA from Canadian bulls and from dairy cows from herds in Quebec and Nova Scotia.

### **What impact will this genomic breakthrough have on future reproductive performance of the dairy cow?**

Replacement heifers are the second largest cost for commercial dairy producers, so fertility and reproductive longevity have a very significant impact on profitability. Improving this complex of traits offers a highly attractive opportunity to increase productive efficiency and economic returns for producers. A DNA test for Holstein cattle is being developed using our



Dr. Hein van der Steen has a diverse background in academia, serving as an associate professor at Wageningen Agricultural University in the United Kingdom, as well as time in industry, working on pig and shrimp breeding. Today he runs a UK-based consulting company with activities in Canada (Performance Genomics, Inc.), Indonesia and Europe.

Performance Genomics, Inc. (PGI) is a Canadian-based genetic research and product development company formed to develop and commercialize reproductive technology products derived from research on fertility and reproductive longevity in mice and other species. They are currently developing a predictive DNA test for fertility and herd life for Holstein dairy cows and bulls.



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knowledge about fertility and reproductive longevity genes, as well as information on the gene *STATA5*, which affects embryo survival. The final test, based on a panel of markers, will be able to identify animals with superior breeding values for fertility and herd life at an early age on the basis of a simple laboratory test.

The test results will enable dairy farmers to make decisions on whether to keep or sell heifers, whether to use a cow for the production of replacements, whether to use sexed semen or embryo transfer, and from which bull to buy semen. This knowledge will help them directly improve milk production and reduce herd replacement costs. Selection for fertility and reproductive longevity traits will, over time, increase the overall genetic profile of the herd, leading to additional productivity gains. An improvement in herd replacement rate of 5 percent (for instance, from 45 to 40 percent) has a value of about \$150 per cow per year. For a herd with 500 cows, this adds \$75,000 per year to the bottom line.

### **What do you foresee as potential opportunities related to genomics and reproduction that may be coming in the future?**

Dairy breeding so far has been a black box approach. We select for the more heritable traits without knowing which gene variants we select for and without knowing what the side effects are. This has resulted in a decline of fertility and herd life in dairy cattle.

Genomic selection is an important boost for the overall program, but there is still uncertainty. Progress is faster due to improved accuracy and a reduced generation interval, but the negative impact on fertility and herd life is not directly tackled. The use of a DNA test for fertility and reproductive longevity traits is an opportunity to directly select for gene variants that have a favorable effect on fertility and herd life.

### **What advice do you have for dairy producers considering the use of genomic technology to improve herd reproduction?**

It is important to use the tools that are being developed. Genomic selection will, mainly through the selection of bulls, speed up genetic improvement in general. The use of the more specific genomic testing will allow the producer to reverse the negative genetic trend for fertility and herd life. Use of this DNA test and the use of sexed semen and embryo technology will create opportunities to improve the herd replacement strategy.

It is also important that DNA tests are properly validated in the breed where the test is being used. It is very unlikely that tests work across breeds. Most of the complicated traits such as fertility and herd life will be controlled by a larger number of genes. DNA tests will need to incorporate a majority of these genes in order to have enough predictive power. Our DNA test in development is for the Holstein breed and will be based on a panel of markers for a group of relevant genes.