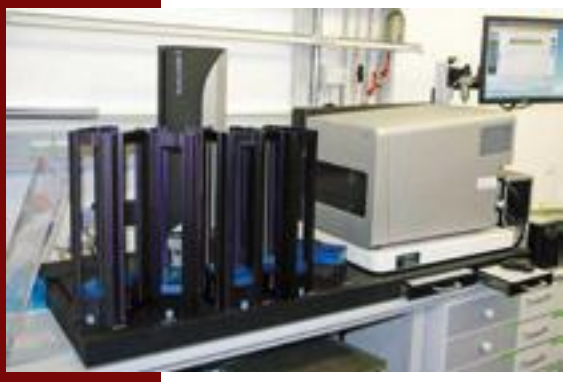


LEFT: The sire Voigtland Namibia. PHOTOS COURTESY OF THE SIMMENTALER/ SIMBRA CATTLE BREEDERS' SOCIETY

ABOVE: The machine that reads the chips with the DNA on.

Fleckvieh meets genomics

Genomic breeding values were published in August 2011 for the first time in Austria and Germany where the milk Simmentaler is referred to as the Fleckvieh. After six months, the method will be fully implemented. It is sure to cause the greatest changes in organised cattle breeding since artificial insemination.

What is genomic selection?

Genomic selection has nothing to do with changes of the genome of an animal. It is a method to read the genetic information encoded in the DNA of an animal and to use that information in selecting and breeding.

Especially in cattle breeding, there was always an attempt to accelerate breeding progress by mating younger animals to shorten the gene ration interval. The aim of molecular breeding is to reliably obtain the breeding value of an animal directly from its genome, without any information on its progeny. Genomic selection combines molecular breeding and pedigree information and makes it possible to already estimate breeding values of calves based on their genome.

How does genomic selection work?

In almost all somatic cells of an animal's body, the DNA that forms the genome (blueprint of life) is located in the nucleus. Even though it is possible now to read the whole genome of cattle (3 billion base pairs), scientists are far from understanding how all these genes work and how to use this information for breeding. This is a new technology that allows the genome of individual animals to be read and compared with certain locations – single-nucleotide polymorphism (SNPs) – in different animals. This so-called array technology currently reads 50 000 SNPs.

Thus genomic selection is a statistical approach to compare animals by their SNPs, making it possible to predict breeding values of a young animal by comparing its SNPs with the SNPs of a large group of animals with secured progeny-tested breeding values. The genomic breeding values are completed by the pedigree index.

The combination of the genomic breeding value and the pedigree index is called the 'genomic optimised breeding value' and provides a maximum amount of information. Once the progeny of an animal are on the ground, their information is incorporated in the genomic optimised breeding value.

Accuracy

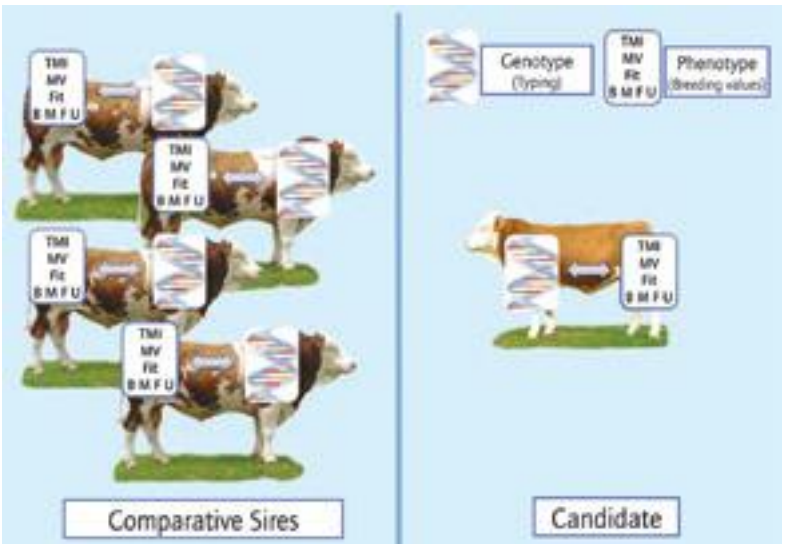
The main advantage of genomic selection is that the accuracy of the breeding values for animals without progeny is higher than would be the case if the estimation of the breeding values is only based on pedigree information. For example, the total merit index reaches in average 65% and the milk index 62%. Secondary traits such as productive life reach an accuracy of 61%, which is much higher than if the accuracy of these breeding values would be estimated from the pedigree index only. However, young bulls with genomic breeding values do not reach the accuracy of daughter-proven sires. It is now possible to use bulls without any progeny information on the basis of their genomic breeding values of AI only. In the future, the breeder has to double check the accuracies and reliability of the breeding values of a specific bull.

'GENOMIC SELECTION WILL SPEED UP GENETIC PROGRESS.'

Definition of the breeding programme

One has to distinguish between the two different ways of using genomically selected bulls. One is to produce the next generation of AI sires and the other to use them as AI sires in dairy herds.

They have different goals. On the one hand the next generation of top sires has to be produced and on the other hand a reliable, easy handling and well-performing cows are needed. Each purpose requires a different use of genomic selection.



ABOVE: The Junior Champion at the Vryburg Show 2011, Endricus, of Andre Ellis.

TOP RIGHT: Information from the comparative sires is used to deduce the breeding values from a candidate's genome.

RIGHT: The extracted DNA becomes visible.

FAR RIGHT: A 50k-chip, suitable for typing 12 animals' DNA.

Effects on the breeding work of dairy farmers

At first glance, a breeder will notice no difference because breeding values are published as before. However, the accuracy of the breeding values of bulls that have only genomic breeding values is lower than that of progeny tested bulls. Now it is left to each breeding company to choose its strategy. Some will push marketing genomically selected sires because these bulls are younger and will have a higher breeding value, others will be more reluctant with the recommendation of genomically selected bulls.

It is not a decision whether to use genomically selected bulls or not, more a question of the portfolio. Actually we do not recommend using genomically selected sires only.

It makes sense to accept the higher risk and to use about 25% of promising genomically tested young bulls, especially if they are polled or have outcross pedigrees.

DRAWBACKS OF GENOMIC SELECTION

Figures versus breeder's eye:

Ever since the introduction of BLUP-breeding values there has been a discussion about the importance of figures in breeding. Genomic selection will put more weight on indices. Many traditional breeders are afraid that type traits of animals will in future be neglected.

Losing dual purpose

Breeders and breeding organisations are talking about the big advantages of dual purpose breeds, especially nowadays with high beef prices. However, when it comes to mating decisions, traits such as muscling, beef value and carcass grade are often neglected. In the long term this may cause the loss of the identity of the whole breed. For milk traits, genomic selection is most efficient.

More risk

Genomic selection will accelerate breeding progress, but compared to progeny tested sires the accuracy of a genomically selected bull is lower, and this means a higher risk for the farmer. The breeding programmes for the next generations of AI bulls are becoming increasingly risky, since it is now possible to use a bull that is not progeny-tested as a sire's sire and a heifer as a sire dam.

Diversity of the breed

Selection always causes a loss of diversity. Genomic selection will offer the possibility to select more animals out of so called outcross lines. Yet testing outcross animals will be expensive because it is not as efficient as testing members of the successful lines. Maybe, at the end of the day, the same genotypes will be selected from the outcross lines as from the well-established lines.

More research is therefore needed.

In conclusion, genomic selection will speed up genetic progress.

However, the question is, does quick genetic progress solve all problems in breeding and does it lead to a happy farmer? People are talking about accelerating breeding programmes. But shouldn't we rather talk about breeding aims? You can't drive a fast car without a steering wheel!

In Germany, the Milk Simmentaler is referred to as the Fleckvieh. At Bavarian Fleckvieh Genetics we are debating the advantages and drawbacks of genomic selection. We try to find an independent way of sustainable Fleckvieh breeding by using modern breeding technology without losing an eye for the cattle and the farmers who have to work with the cattle every day.

- *Fleckvieh World 2011/2012 Journal.*
- *Contact the Simmentaler and Simbra Cattle Breeders' Society of Southern Africa on 051 446 0580 or email info@simmentaler.org.*