Fleckvieh meets Genomics

♦ Christoph Gschöderer

Now it is official: In August 2011 for the first time genomic breeding values will be published for Fleckvieh in Austria and Germany. After a testing period of only half a year, the method will be fully implemented into practice, with all its consequences. There are a lot of advantages but also many risks, and it will cause the biggest changes in organized cattle breeding since the introduction of artificial insemination.

What is Genomic Selection?

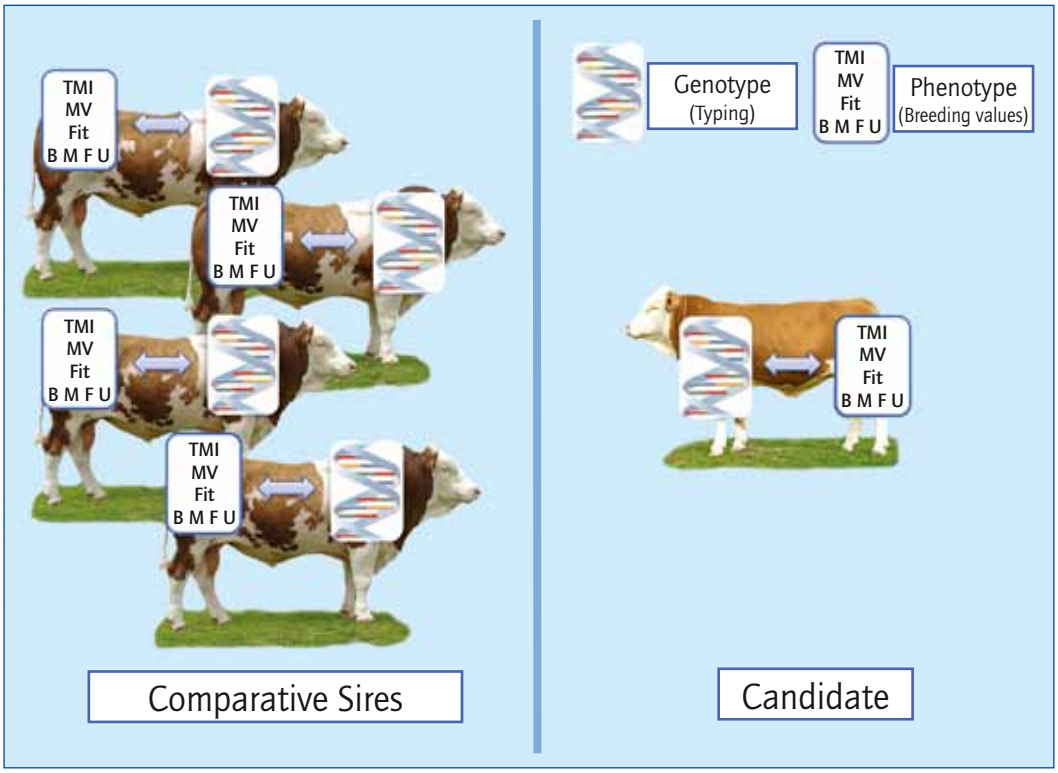
Genomic Selection has nothing to do with changes of the genome of an animal! It is just a method to read the genetic information encoded in the DNA of an animal and to make use of that information in selection and breeding decisions.
Especially in cattle breeding, there was always an attempt to accelerate breeding progress by mating younger animals to shorten the generation interval. The aim of molecular breeding is to get the breeding value of an animal directly from its genome, without any progeny information. Genomic Selection combines molecular breeding and pedigree information and makes it possible to estimate breeding values already from 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 away from understanding how all these genes work and how to use this information for breeding.
There is a new technology that allows us to read the genome of individual animals and to compare certain locations (so called SNP's) to the same locations in different animals. This so called array technology currently reads 50.000 SNPs.
Thus Genomic Selection is a statistical approach to compare animals in their SNPs. So it becomes possible to predict breeding values of a young animal by comparing its SNPs with the SNPs of a big group of animals with secure-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 Genomic Optimized Breeding Value and provides a maximum of information. Once the progeny of an animal are on the ground their information is incorporated in the Genomic Optimized Breeding Value and more and more replaces the pedigree and the genomic index.

Accuracies

The biggest advantage of Genomic Selection is that the accuracy



♦ **The information from the comparative sires is used to deduce the breeding values from a candidates´ genome. (TMI = Total merit index, MV = Milk value, Fit = Fitness, B = Body, M = Muscularity, F = Feet & Legs, U = Udder).**

♦ 50k-Chip,
suitable for typing 12 animals.

of the breeding values for animals without progeny is higher than 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 like Productive Life reach an accuracy of 61 %, which is much higher than if the accuracies of these breeding values would be estimated from the pedigree index only. However, certainly 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 only on the base of their genomic breeding values for AI. In the future the breeder has to double check the accuracies when reading breeding values in order to find out how reliable the breeding values of a certain bull are.

Definition of the breeding program

We have to distinguish between 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. There are two different goals: On the one hand the next generation of top-sires has to be produced and on the other hand we want to have reliable, easy handling and well performing cows. Each purpose requires a different use of genomic selection.

Effects on the breeding program of Bavarian Fleckvieh Genetics

Currently we face an extraordinary situation: In August more than 500 waiting sires will get genomic breeding values at the same time. Those with the lowest breeding values will be slaughtered, like we used to do when the first results of milk recording of a bull's daughters were published. From then on bulls with low breeding values will not be bought anymore.
The breeding program of Bavarian Fleckvieh Genetics is still focused on progeny proven top sires. Every young sire we buy based on genomic breeding values will run through a testing period to get progeny information as soon as possible. For us Genomic Selection does not mean a hunt for the bulls with the highest genomic breeding values. It is rather a possibility to keep less promising bulls out of the testing system. Bayern-Genetik used to test 200 young bulls each year and now we have the possibility to reduce this number a little bit.
The next challenge will be to find a working system for testing the right number of bulls and to decide which of them to buy for progeny testing.

Effects on the breeding work of dairy farmers

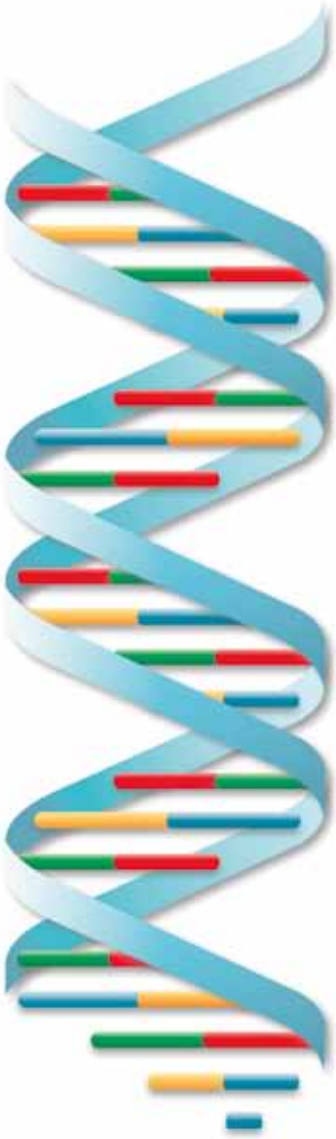
At the first glance a breeder will notice no difference because the breeding values are published the same way as before. However, as I explained before, the accuracies of the breeding values of bulls that have only genomic breeding values are lower compared to those of progeny tested bulls. Now it is left to each breeding company itself to choose a strategy. Some will push the marketing of 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 of whether to use genomically selected bulls or not, it is more a question of the portfolio. Actually we do not recommend to only use genomically selected sires. But 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.

Are there any drawbacks of genomic selection?

Figures versus breeder's eye:
Ever since the introduction of BLUP-breeding values there is a discussion about the importance of figures in breeding. And that is for sure: Genomic Selection will put more weight on indexes. Many traditional breeders are afraid that type traits of the animals will be neglected in future.

Loosing dual purpose
Breeders and breeding organizations are talking a lot about the big advantages of dual purpose, especially nowadays, when the beef prices are high. However, when it comes to mating decisions, often traits like muscling, beef value and carcass grade are neglected. In long term this might cause the loss of the identity of the whole breed. For milk traits, Genomic Selection is most efficient, so pressure on dual purpose will rise.

More risk:
Genomic Selection will accelerate breeding progress, but compared to sires that are progeny tested the accuracy of a genomically



♦ Structure of the DNA:
The genetic information is encoded in the base pairs.

♦ The extracted DNA becomes visible.

selected bull is lower, and this means a higher risk for the farmer. Also the breeding programs for the next generations of AI bulls are getting more and more risky, since now it is possible to use a bull that is not progeny-tested as a sires sire and a heifer as a sire dam.

Diversity of the breed

Selection always causes a loss of diversity! Genomic Selection will give us the possibility to select more animals out of so called outcross lines. Yet the testing of outcross animals will be expensive because it is not as efficient as testing members of the successful lines. And maybe, at the end of the day, we select the same genotypes from the outcross lines than from the well established lines. Therefore a lot more research is needed.

Conclusion:

Our Opinion is that Genomic Selection will make genetic progress a lot faster. However, the question is: Does a fast genetic progress solve all problems in breeding and does it in the end lead to a happy farmer? People are almost only talking about accelerating breeding programs. But shouldn't we rather talk about breeding aims? You can't drive a fast car without a steering wheel!

We at Bavarian Fleckvieh Genetics are discussing a lot the advantages and drawbacks of Genomic Selection. We try our very best to find an independent way of sustainable Fleckvieh breeding by using modern breeding instruments without loosing the eye for the cattle and the farmers who have to work with the cattle every day.

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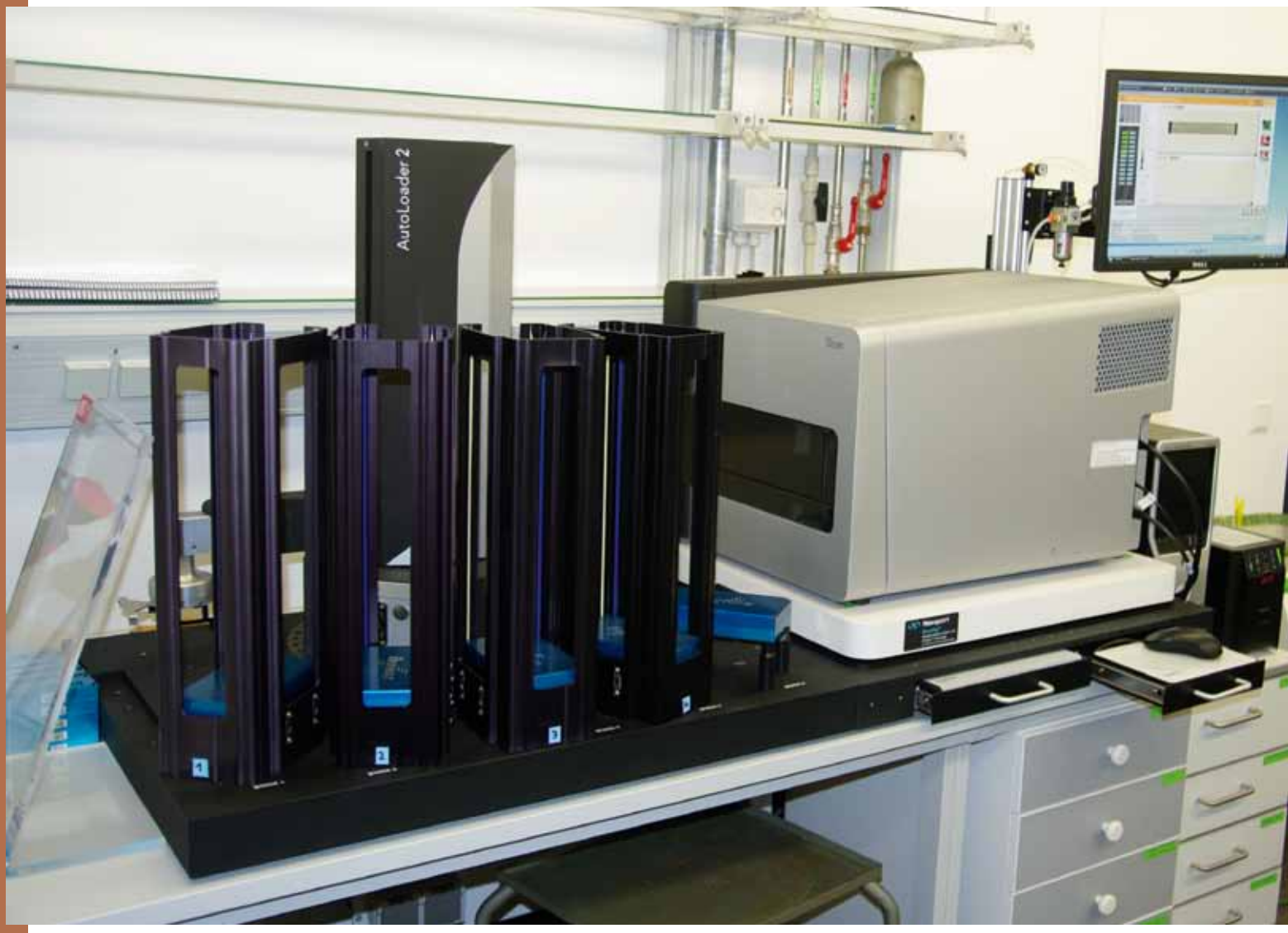

♦ Technology for reading the chips.