Fact or fiction? The truth about genomic selection

Genomic myths and misnomers

There are many rumours about genomic selection. Some are true and some are false. Because some breeders are still unfamiliar with this technology we thought it timely to raise the most frequently asked questions about genomic selection. Do you know which statements are fact and which are false?

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There is still a lot of uncertainty about genomic selection. Just take the different names that it's given – genomics, markers and InSires.
They are essentially three terms for the same thing. Genomic selection (selection on the basis of genes) is also called marker-assisted selection.
Dutch AI company CRV has sires with a genomic breeding value, which it calls InSire bulls. So it is high time that the most common facts and fiction about genomics were explained in more detail.

In a genomic breeding value parentage is also considered.
FACT: The genomic breeding value is determined by parentage and by markers in a 50:50 split.
The relationship between markers and parentage is one where a characteristic can be just that little bit different to another characteristic, but in general this proportion is 50:50.
This, therefore, means that when a bull father in the course of time sees his breeding values drop considerably, this greatly affects the genomic breeding values of his son. Take, for example, a bull like Sunrise.
His father Jardin, when put into service as a bull father, obtained 108 for leg quality. Now, four years later, he only scores 97. This is a drop of 11 points. In the same period Sunrise dropped from 109 (genomic breeding value) to 100 (breeding value on the basis of daughters) for leg quality. This is a drop of eight points. This lower score for Sunrise's leg quality is mainly caused by the fact that his father saw a drop in leg quality and it is not, therefore, due to the sire's genomic breeding value.
The fact that bulls can fall or rise is a prior condition of breeding in general and not something typical of genomics.

Table 1: Use of genomic bulls

country	AI company	%
The Netherlands	CRV holstein	40
	CRV red and white	35
Denmark	Viking Genetics	50
Germany	OHG	65
France	Creavia	75
	Amelis	75
	Genes Diffusion	45
US	CRI	60
	other	> 50

The use of genomic bulls in the Netherlands is very high.
FICTION: The Netherlands is actually restrained in its use of genomic bulls. Use is much greater in other European countries and in the US. Table 1 illustrates this well.
Genomic young bulls are being sold and used in the UK. The UK works closely with North America on genomics but most EU countries work with GES. Avoncroft sells CRV's InSire genomic bulls to UK breeders and producers.

CRV wants to greatly increase the use of InSire bulls.
FICTION: CRV has a wide range of breeding and genomic bulls. Breeders are free to choose the bulls that they want to use. By providing honest information about genomics, CRV wants breeders to see the full picture and view a wide range of the various possibilities. In this way a producer can make a sound and well-considered choice through their own judgment. CRV's task is to ensure that the breeder, irrespective of the bulls that they select, can choose from the best bulls available via the breeding programme.

Suppose you have an InSire bull and a 'converted' foreign bull that already has foreign daughters in milk. Both have 60% reliability for NVI. The NVI of the InSire bull in this case means less than that of the 'converted' foreign bull.
FICTION: The same applies to both groups of bulls: two of the three bulls achieve a breeding value on the basis of daughters that deviate by less than 40

DNA profiling: genetic markers form 50% of a genomic sires predicted proof

points from the genomic breeding value or from the converted breeding value. And one in six bulls will increase by more than 40 points, while one in six bulls will drop by more than 40 points NVI.

Genomic breeding values are still in their infancy and must prove themselves.

FICTION: Around 600 genomic bulls at CRV have already obtained their breeding values on the basis of daughters. The results of this show that the genomic breeding values match their daughter breeding values. The rises and falls with regard to the genomic breeding values are exactly as you might expect with 60%.

Genomic breeding values are totally accurate. Some bulls deviate by 100 points NVI or more from their genomic breeding values after the daughters from the test period begin to milk.

FICTION: The reliability of genomic breeding values amounts to 60%. This 60% reliability means that you can expect that one in 100 bulls drops by about 100 points and one in 100 rises by about 100 points.

For breeding bulls (85%) fewer than one in 1,000 bulls can fall or rise by 100 points NVI.

Reliability of only 30% is found in test bulls without genomic breeding values and with only an expected value. Globally one in 10 bulls will rise or fall by 100 points NVI after the daughters from the test period have begun to milk.

In the selection of bull mothers, CRV only looks at the genomic breeding values of the cow. The performance of a cow does not play any further part.

FICTION: Firstly, by means of the genomic breeding value of a cow, a pre-selection of top-ranking cows takes place. After that the breeding technicians examine the actual performance of these top-ranking cows, their cow family and the relationship of each animal with the population.

Each cow is individually assessed as to whether the animal is suitable as a bull mother.

At CRV no young bull is used without the bull itself and its mother being assessed by a breeding expert. Genomic breeding values of young bulls compared to test bulls not only have higher reliability (60%), but also their level of breeding values is clearly higher.

FACT: With genomic selection, particularly with half brothers and full brothers, a selection is made at the highest genomic breeding value. For example: four full brothers have the same expected value (reliability is only 30%) of 200 NVI. After genomic selection a few brothers will come out above 200 NVI and the others below. The young bull that comes out the furthest above its expected value has the greatest chance of being selected for use as an InSire test bull.

In this way the young InSire test bulls have a much higher genomic breeding value than test bulls. Furthermore, the reliability of a genomic breeding value (60%) is naturally also significantly higher than that of an expected value (30%). |