

Genomic data adds to confidence as reliability increases

The value of reliability

With the advent of genomic selection, sires have arrived at CRV about which we know more than just their predicted values, but less than for a sire with a daughter proof. How much can the breeding value of a genomic sire change? Reliability is one way of measuring this.

text **Mathijs van Pelt**

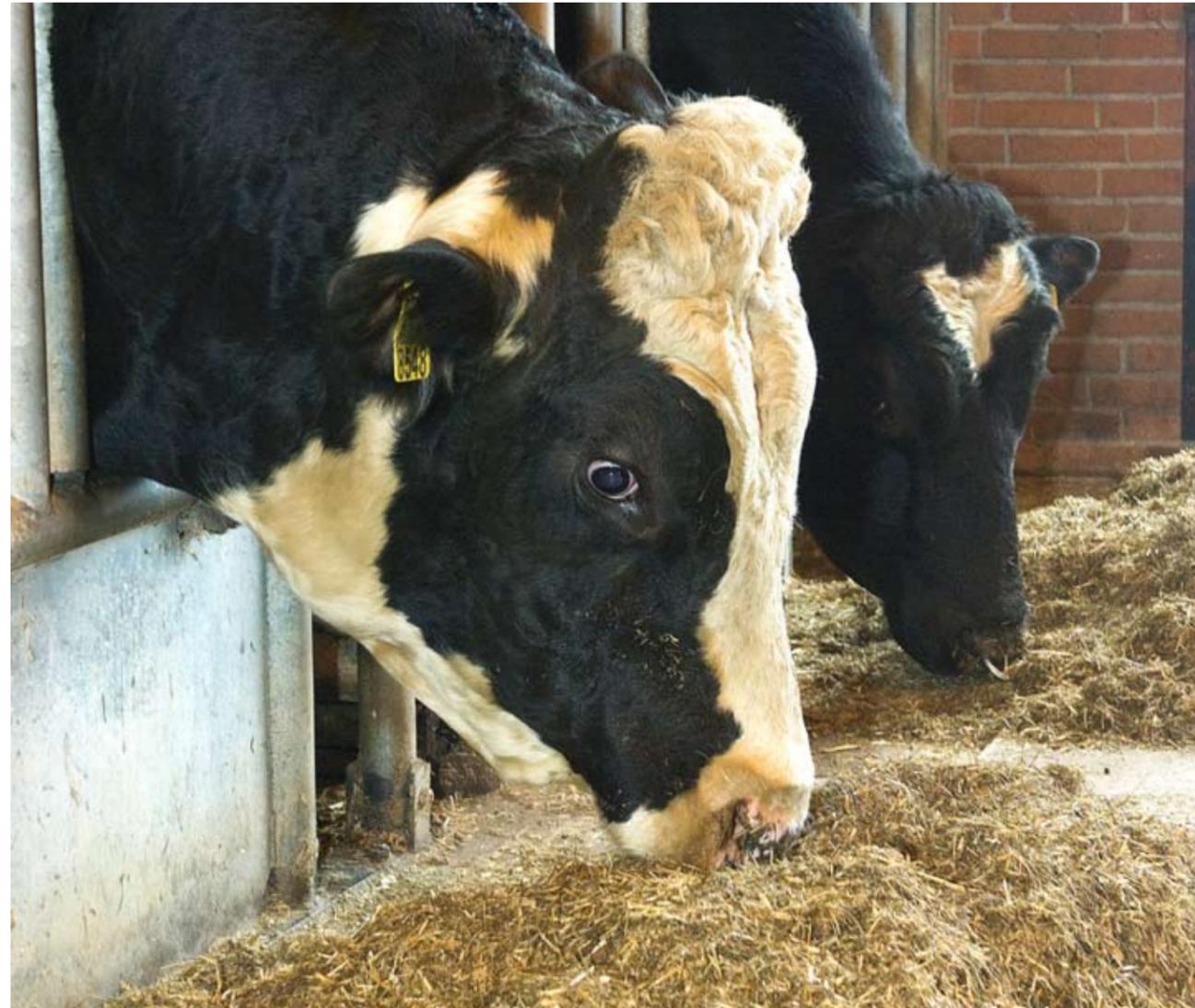
The breeding value of an animal is the best possible way to estimate its actual genetic make up. How reliable this breeding value is indicates how likely it is that the estimated breeding value will match an animal's actual inherited make up or breeding value.

Getting a reliable breeding value involves using information from a range of sources including pedigree details, their performance and that of their descendants, and genomic data (DNA).

The more details that are included in the breeding value, the more reliable it is. Reliability can be anything from 1% to 99%.

Heritability role

Heritability also influences reliability and indicates how much information is passed on to the next generation via the genes. Type is highly heritable and, with a limited number of daughters, it is fairly easy to say



precisely what a sire's genetic make up is. However the non-return percentage at 56 days is largely non-heritable, so a sire needs lots of daughters before it is possible to say with any certainty what its genetic make up is.

Figure 1 on the next page shows how a sire's reliability increases as its groups of daughters also increase but at different degrees of heritability.

At a high heritability level of 0.30 for type, for example, a sire with 100 daughters has a reliability of 89%. With a characteristic which is largely non-heritable, like fertility, reliability in that case is just 56%.

With daughter groups of a thousand animals or more, type reaches its maximum reliability of 99%, whereas the breeding value fertility is 93% reliable.

With large daughter groups, the contribution of pedigree or genomic information is negligible. Breeding value is then based more or less entirely on daughter information.

Breeding values

Reliability also indicates how much a breeding value can still change. The predicted breeding value of a sire can change more than once with thousands of daughters in milk. Breeding values can never be more than 99% reliable in practice, so they are not entirely fixed.

To illustrate how breeding values can still change, we distinguished between four groups of sires: sires with predicted values, sires with genomic breeding values without daughter information, sires with



Mathijs van Pelt from CRV's genetic evaluation team

Leo de Jong: "More diversity is possible with genomic sires"



"We use young genomic sires on all our cows," says Barnkamper Holsteins' Leo de Jong. With his wife Artje and daughter Linda de Jong he milks 125 cows.

"We have faith in genomic selection and there are more genomic sires available, which allows for diverse blood lines," he says.

"We have used OMan and Shottle a lot ourselves, so our opportunities are limited. Genomic sires with

Goldwyn and Planet bloodlines, for example, are easier for us to use." With genomic sires being less reliable, Leo spreads the risk. "We never use more than ten straws from a sire. You have to allow for the fact that some sires are disappointing. That's all part of the game."

Sires he has used recently include Explode, Gofast, Observer, Malindo, Atwood and Caliber.

Gert Kroes: "Older sires have proven themselves"

"We use mainly older sires that have proven themselves, like Rafael, Stilst, Canvas, Lightning, Kian and Paramount," says Gert Kroes, who milks 85 cows. "I like to know what I'm getting. These are sires that have proven their breeding value. You may not get any stars, perhaps, but the chances of one being really disappointing are low too. I think it's a shame if I rear a heifer for two years to find that she's disappointing because I used the wrong sire."

"With the older sires, I know precisely how

they breed. I look for three points for improvement in the cow, and know just which sires score well there. As well as having proven quality, older sires are often cheaper. When we are milking good daughters of a sire, we use them again, and the daughters are satisfactory again."

There's one exception Gert has to his breeding rule at present, and that's Impuls. "This sire is high, and I have a lot of confidence in the sires from Woudhoeve."



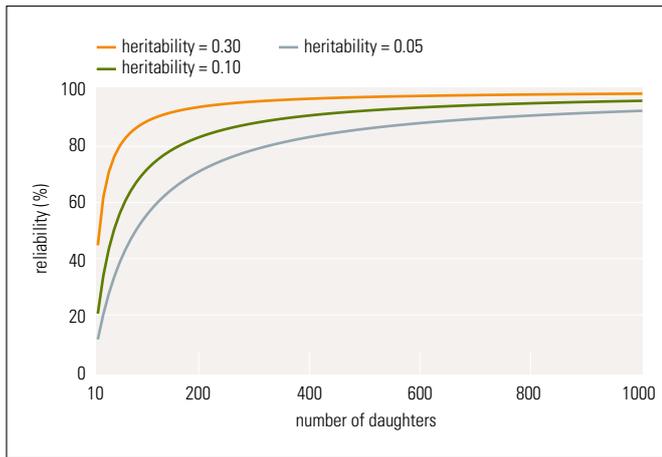


Figure 1: Relationship between number of descendants and breeding value reliability for three heritability levels

test daughters only and the 20 most used bulls in the AI year 2009/2010 with milking daughters.

Breeding value may change to a greater or lesser extent, because the volume of data that goes into the breeding value varies from one group to another, as Figure 2 shows. This allows for the average genetic level of the different groups. Young sires with an expectation value or genomic breeding value will score 200 for NVI on average, whereas sires with test sire daughters score 100 for NVI on average and the most used breeding animals score 140 for NVI on average.

As more information becomes available to estimate breeding value, reliability increases from 35% for sires with a pedigree index to 91% on average for the breeding animals (see Table 1).

Young sires

It is possible to say with more certainty what the actual breeding value is as reliability increases. How far a breeding value with an established reliability can still change is called 'spread'.

Spread indicates with 68% certainty how much a breeding value could change if reliability increased to 100%, which means the spread amongst young sires is much greater than amongst sires with breeding values based on large groups of descendants.

Figure 2 shows what the range is within which the NVI value can change for the four groups of sires. The genomic animal group scores 200 NVI on average: the darker-coloured area around this indicates with 68% certainty what the actual NVI will be.

Some sires change more than the spread is, however, so the light-coloured area shows with 95% certainty the range in which the NVI will actually be.

With 100 genomic sires with an NVI of 200, we can expect that 68 of these 100 will ultimately have an NVI of between 158 and 242. The average NVI for the group as a whole will be 200.

Table 1: Average NVI, average reliability and NVI spread for four groups of sires

	reliability (%)	NVI	NVI spread
young bulls with pedigree index	35	200	53
genomic sires	60	200	42
daughter proven sires	80	100	30
20 most used daughter proven sires	91	140	20

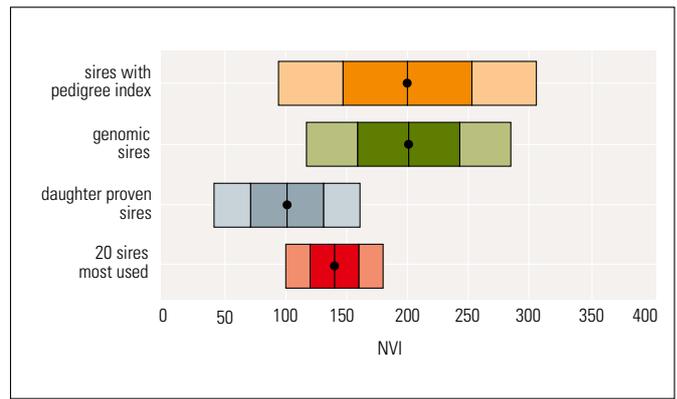


Figure 2: Actual NVI expected for four groups of sires with increasing reliability, each based on the current average NVI for the group (black spot). In the dark areas, the result will be 68%, in the dark and light coloured areas 95%.

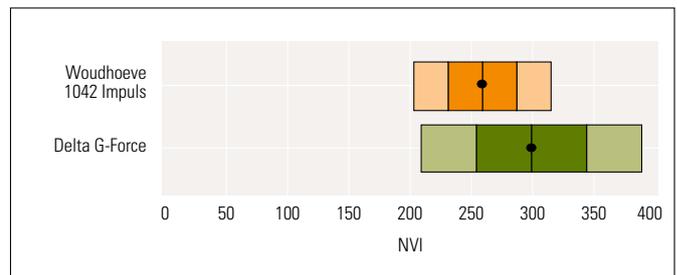


Figure 3: Actual NVI expected for Woudhoeve 1042 Impuls and Delta G-Force with reliability increasing to maximum in terms of current NVI (black dot). Dark area is 68% certainty, dark and light area is 95%

A sire with a pedigree index only has a 68% chance of the actual breeding value being between 147 and 253 NVI: so adding genomic information means we can say with more certainty what its breeding value will be if this is ultimately 99% reliable.

With breeding animals, the range within which the breeding value can vary is much smaller, namely 120-160 NVI, with an average of 140.

Although young sire breeding values can change more, the level will ultimately be lower than the current group of breeding animals, as Figure 2 shows. The darker-coloured areas overlap one another closely.

Daughter proven

If we translate Figure 2 into a practical example of two sires, say the highest breeding sire and the highest genomic sire, these sires can change, as Figure 3 shows.

The highest sire with test daughters is Woudhoeve 1042 Impuls with 259 NVI and 82% reliability and the highest sire with genomics is Delta G-Force with 299 NVI and 53% reliability. There is a 68% chance that Impuls will actually have an NVI between 231 and 287 points and G-Force between 254 and 344 (the darker-coloured areas).

There is a 95% chance that the NVI will ultimately be between 203 and 315 for Impuls and between 209 and 389 for G-Force. So if things work out well, G-Force will be even better than he is now and better than Impuls.

In the worst case, in which the sires turn out lower than estimated, they are both about as good as one another, with an NVI just above 200 points. Even then, both sires are above average in terms of NVI. |