

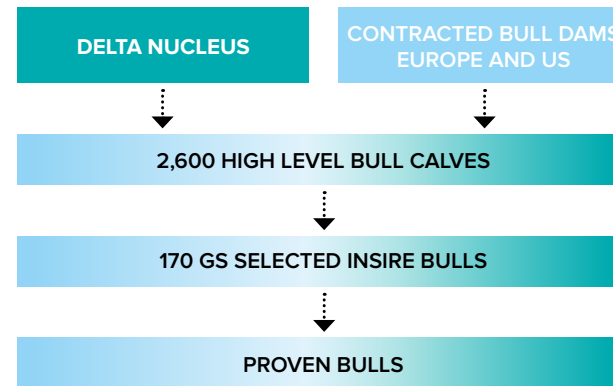
ADVANTAGES

GENOMIC SELECTION

- Faster genetic gain (30-40%)
- InSire bulls are of higher quality than young sires in the old system
- A higher variety in used pedigrees
- More diversity in bulls
- Selection at young age
- New families can be discovered
- The reliability for production is the same as for a cow with three lactations
- Greater understanding of the health characteristics than ever before

CRV BREEDING PROGRAM

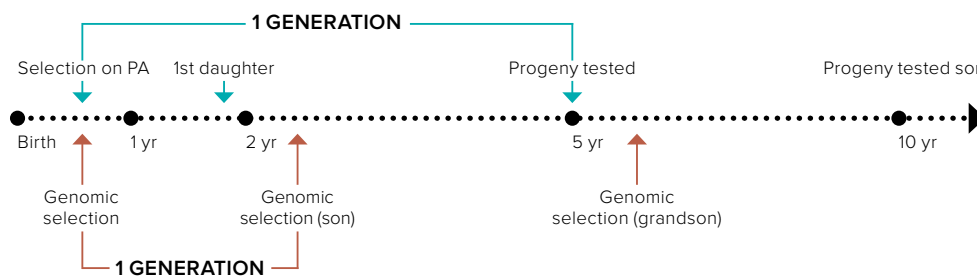
The CRV breeding program aims to breed the best bulls in the world. CRV uses different sources to achieve this goal. For Holstein-Friesian bulls these are the Eurodonor program, the US gene pool and CRV's own herd, the Delta nucleus. From these starting points CRV is looking for bulls that can fulfill the breeding goal of CRV: 'A healthy and long-lasting cow that delivers an optimal contribution to farm profits.'



CRV Holstein Program

DIFFERENCE BETWEEN GENOMIC AND DAUGHTER PROVEN BREEDING VALUES

In practice, genomic breeding values and breeding values on the basis of daughters are closely related. The figure indicates that the time interval is much shorter before the breeding values of the sires are known in the case of genomic selection.



'IT'S ALL IN THE GENES'
GENOMIC SELECTION



Hun Hopman



www.facebook.com/CRV4all
sales@crv4all.com

GLOBAL.CRV4ALL.COM

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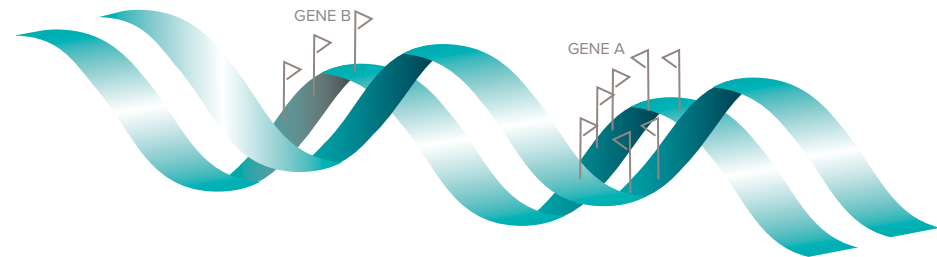


'IT'S ALL IN THE GENES'

GENOMIC SELECTION

'It's all in the genes'. These words are not only used for people with remarkable characteristics, but are also true for breeding bulls.

The genetic information of an animal is spread on the DNA in thousands of genes. They have approximately the same transmitting ability as the genes they are close to. A marker (or SNP) therefore, provides information about those genes and the genetic potential of an animal.



The more markers (flags) are close to a certain gene, the higher the reliability will be for traits related to this gene.

With genomic selection, by means of hair and blood DNA is taken from an animal after which the DNA is examined in a laboratory. It is important here to obtain a good idea of which part of the DNA affects which characteristic. For dairy cattle marker chips are already available on which there are 50.000 markers. These markers are spread over the whole genome and mark the genes that are responsible for the genetic characteristics of the animal. All this information is taken into account to determine the breeding value of the respective animal.



Genomic selection works!

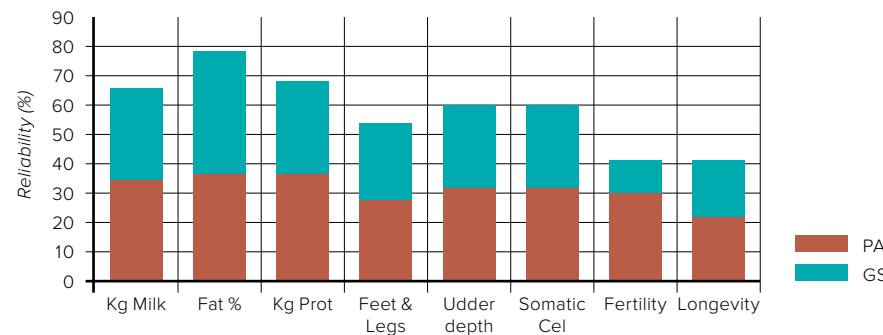


FROM CALVE TO PROVEN BULL

Every year CRV does genomic testing on 2,500 high level bull calves from the different sources. A selection intensity of 1 out of 15 results in the 140 best InSire bulls. These 140 are then progeny tested, which will result in proven bulls after the information from their daughters is known. The goal is to have at least 120 daughters in 100 herds after the bulls are progeny tested. In that way a reliability of >90% can be given into the bull's breeding values and the InSire bulls can become proven bulls within 5 years.

HIGHER RELIABILITY AT YOUNG AGE

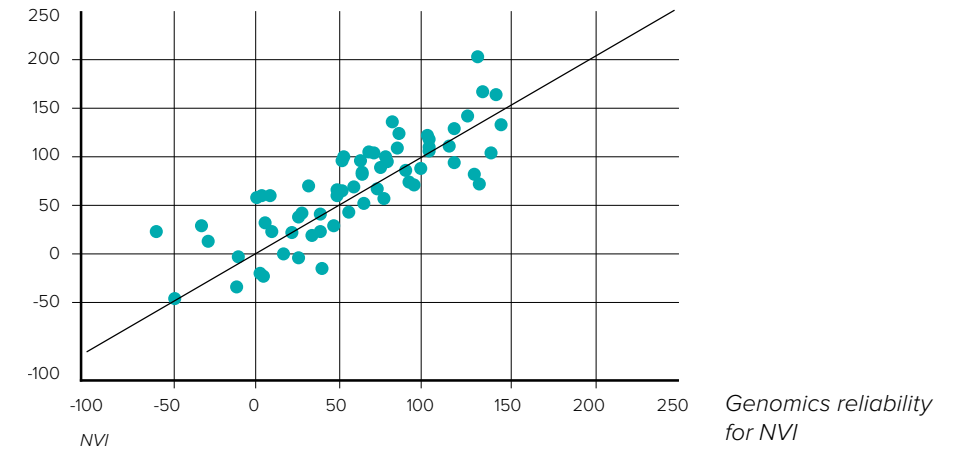
Before genomic information was used, the only way to predict the potential of the newborn animals was based on a calculation of the parents' average (PA). Nowadays, the information collected from the markers ensures better estimation of the calf's potential at a very young age. Where the reliability of a young bull would be 35% in the past, it is now around 65%. The bulls that are selected on genomics are called InSires at CRV.



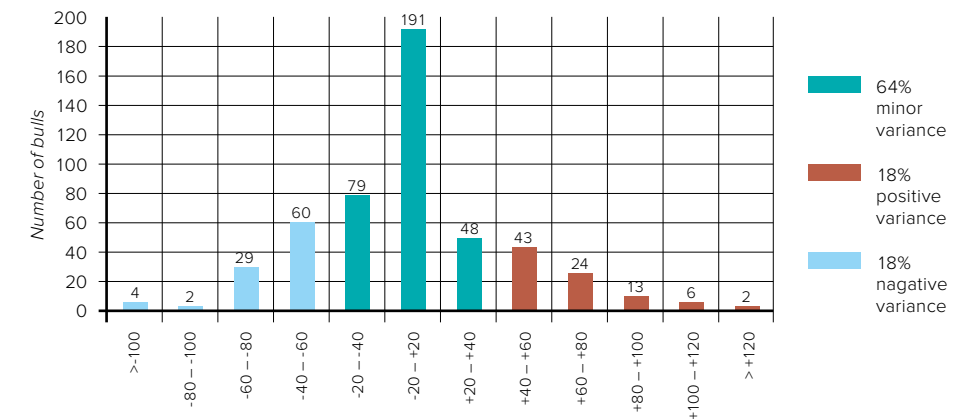
A higher reliability with Genomic Selection (GS)

RESULTS OF GENOMIC SELECTION

Since the introduction of genomic selection, the first batches of InSire bulls received their breeding values based on progeny testing and showed that their genomic and daughter proven breeding values are very close to each other. This means that the InSire breeding program delivers very reliable proofs. The figure below shows how close the progeny tested breeding values for NVI are to the InSire breeding values.



The figure below indicates that, in 64 per cent of the cases, the difference between the genomic breeding value and the daughter breeding value deviates by less than ± 40 NVI points. Only 18 per cent of the bulls drop by more than 40 points, and 18 per cent rise by more than 40 points.



Changes in NVI in the first 505 genomic bulls whose daughters are now being milked