

The Benefits of Genomics in Simmentaler Cattle



Dr. Mario Beffa
Acting CEO, LRF

Genomics, the study of genetic material (DNA), has been widely used to understand genetic disorders, especially in humans, and has now also found application in the genetic improvement of crops and livestock. As technologies rapidly advance, genomics has been greatly enhanced and commercial detecting genetic variation in DNA is now possible. DNA “stores” the genetic encoding (genotype) that determines growth and development of an individual and its performance in a specific environment.

The variance between genotypes is determined by differences in the base-pairs of the DNA of individuals, referred to as single-nucleotide polymorphisms (SNPs). These SNPs largely dictate the physical differences seen among animals, including coat colour, horns, genetic disorders, weight, size, fertility, feed efficiency, carcass yield and meat quality. DNA is extracted from the hair follicles, blood, tissue samples or semen and analysed on an SNP “chip”. The cattle genome contains three billion nucleotides and currently, commercially available SNP

chips analyse between 50 to 100 thousand nucleotides, called a SNP array, on the genome.

By comparing an animal’s SNP array with its’ reference population, it is possible to estimate its genetic merit for a range of traits with reasonable accuracies, even without having any performance records/measurements of the individual. Importantly, the SNP array can also be used to check its’ parentage and to confirm that the recorded sire and dam are correct.

Genomics is proving to be of immense value as an animal’s genetic merit can be estimated early in its life, particularly for difficult and expensive to measure traits (e.g., feed efficiency), traits measured later in life (e.g., fertility) or traits measured post-slaughter (e.g., carcass traits and mean quality/tenderness).

The dairy industry in North America has doubled the rate of genetic progress for most traits over the past decade since the introduction of genomically enhanced estimates of breeding values (GEBVs) in 2009 as future parents can be selected more accurately and the generation interval is also reduced (Kent Weigel, 2017, <http://www.jabg.org/view/N0270010101.pdf>). The combination of performance, pedigree and genomic data improves the accuracy of estimating an animal’s genetic merit.

Accuracy of GEBVs depends on the establishment of a properly constructed reference population consisting of



animals with accurate estimates of genetic merit (Estimated Breeding Values, EBVs, derived from progeny records) and a genotype (SNP array). The combination of performance data, pedigree and genomic data improve the accuracy of estimating an animal's genetic merit, especially for young animals with no phenotypic records.

Studies have shown that the minimum number of animals with both phenotypes and genotypes required in a reference population range from 2,000 for moderately heritable (carcass) traits to 6,000 for lowly heritable (fertility) traits.

The cattle industry in South Africa has benefited enormously from the multi-million-rand Beef Genomics Project (BGP) funded by the Technology Innovation Agency. Launched in 2015, the first phase met and exceeded expectations, and many breed societies have developed and implemented 10-year breeding goals and the establishment of a sound basis for improved accuracy in performance recording.

Bonsmara, Beefmaster and Drakensberger breeds have already published GEBVs on selected traits and several

other breeds are currently evaluating data soundness to include genomics in their breed evaluations. The Simmentaler Cattle Breeders Society of South Africa has started constructing a reference population with 295 genotypes in phase 1 of the BGP. The second phase will promote the recording of feed efficiency and meat quality and the analysis of genotypes to build reference populations for all participating stud breeds. Over 500 influential animals have been identified in the southern African Simmentaler population and the Society looks forward to taking advantage of phase 2 of BGP which will subsidise the analyses of 300 SNP arrays.

The livestock industry in South Africa eagerly anticipates the second phase of BGP to build upon the initiatives already successfully implemented so that the sector can properly position the beef value chain in both domestic and international markets.

Breeders are encouraged to contact the Simmentaler office for further information. ♦