A powerful new genetic tool - Genomic selection

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Glossary

Phenotype – measurement of on the ground performance of animals (i.e. live-weights, lambing traits, ultra-sound data, etc.)

Genotype – DNA makeup of an animal

Heritability – the transfer of superior (or inferior) genetics from parent to offspring

Background

The genome is the core genetic structure in every living species and is composed of DNA strands. DNA is the building blocks for genes. Every animal contain billions of pieces of DNA that generate genes that in turn control all functions throughout the body and therefore are one of the drivers of animal performances (capacity to grow rate, to lamb every year...). Since the 1980's, genetic evaluation of farm animals was solely derived from performances recording and pedigree structure. Recently, advances in bio-technologies made it possible to read animal DNA and place genetic markers at specific position on the genome to act as sign-posts to locate genes.

What is genomic selection?

Genomic selection is the new breeding technology that uses tens of thousands of genetic markers associated with genes. This genetic marker information along with performance records allow for more accurate estimates of the genetic merit of the sheep. The technology is currently available to measure over 54,000 genetic markers in sheep and is similar to the technology used currently in beef and dairy cattle.

What are the benefits of genomic selection?

The benefit of genomic selection is increased accuracy of estimates of genetic merit, thereby providing more accurate genetic evaluations for farmers. This will allow young animals to achieve higher accuracy's at a younger age before large amounts of information are collected on the animal and allow for a potential reduction

in the generation interval. Genomic selection can also be used to accurately assign parentage to lambs.

Simulation studies in cattle suggest that genetic gain can be increased by 50% with an appropriate genomic selection breeding program. Expected response to selection from genomic selection may actually be greater in Irish sheep since the current accuracy levels are low and therefore the potential scope for improvement is considerable. The potential increase in accuracy achievable with genomic selection is a function of:

1. the number of animals that are both genotyped (i.e. DNA information) and phenotyped (i.e. on the ground performance data)
2. and the genetic component of the traits, and
3. the number of genetic markers used.

The higher the number of animals phenotyped and genotyped, the higher will be the improvement in accuracy with genomic selection. Also greater increases in accuracy can be achieved for high heritability traits (e.g., growth rate) compared to low heritability traits (e.g., number of lambs born).

How can we prepare for genomic selection?

It is highly recommended that DNA of phenotyped animals is immediately collected, catalogued (i.e., the full animal EID) and stored appropriately. Rams with many progeny and high accuracy's should be particularly targeted. The number of phenotyped animals with DNA will be constantly monitored. Genotyping of animals will commence once the costs of the technology are reduced and/or a large number of DNA samples are available from informative animals.