Combining genomic selection and gene selection

In sheep, genotyping animals is an old custom: from 2002 on, the National Breeding Program for Scrapie Resistance organised the genotyping to the PrP gene of several tens of thousands of sheep per year in selection nucleus flocks. For several years, the major prolificacy genes Lacaune and BMP15 have been managed in the selection programmes for Lacaune meat sheep. Introggression of the double-muscled gene is effective and is currently being disseminated.

The availability of the OvineSNP50 chip from Illumina in 2009 opened the way for the development of genomic selection and its adoption in the Lacaune dairy breed in 2015.

Its extension to other breeds is currently challenged by the smaller size of the reference populations, by the relative cost of genotyping, and by the lower gain expected by generation interval. For many sheep breeds, where the impact of AI is low, parentage assignment coupled with genotyping for the known major genes constitutes the preferred path for innovation within the breeding schemes.
Lacaune worldwide leader

Genomic selection has been used in Lacaune dairy since 2015. It is the result of 6 years of Research and Development since the creation of the OvineSNP50 chip by Illumina in 2009. Several programmes contributed to the development of the tools necessary for this major evolution:
- Creation of a reference population of almost 5000 genotyped rams with performance recorded daughters;
- Construction of a process chain for managing the genotypes and genomic evaluation based on Single-Step GBLUP;
- Conception of an original and adapted genomic breeding scheme.

The reduction in the number of rams to be maintained along with the disappearance of progeny testing almost compensates for the costs associated with genotyping: at a similar cost price, the genomic scheme enables increased genetic gain of 10 to 20% compared to the present scheme, which corresponds to the very impressive figure of almost +0.25 standard deviation per year.

Focus on meat sheep and selection by gene

Since the 80s, the major genes of prolificacy, main drivers of productivity, are sought after in meat sheep breeds: mutations are well-known in Lacaune meat, merinos d’arles and grivette and the presence of a major gene is confirmed in the vendeen, grivette and noire du velay breeds. According to the frequency of mutations and their effects, several strategies are applied to the management of breeding animals. For example, in Lacaune meat Ovitest, the Lacaune mutation is maintained at a heterozygous state (advantage of heterozygotes on prolificacy but mutated homozygotes are judged too prolific by the farmers). In the Lacaune meat population of GID Lacaune, lamb conformation is improved by the introgression of the double-muscled allele, without significant effect on maternal abilities.

Towards a wider use of genomics

It is important that all sheep populations participate and benefit from the genomic revolution.

For meat breeds, parentage assignment coupled with genotyping of the major known genes, such as PrP, enables increased genetic efficiency of the breeding schemes and facilitates the organisation of these schemes. In dairy breeds, the cost/benefit ratio of genomic selection should be improved by using the low density chip expected for 2017.

In any case, these gains in genetic efficiency open the way for the introduction of new traits in the selection goals (health, longevity, productive life...).