



## DAIRY AND MEAT SHEEP GENOMIC SELECTION IN FRANCE



### KEY FIGURES

**13 576**  
genotypes for selection

**951 502**  
genotypes

**15 898**  
genotypes  
of prolificacy genes

## 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. Introgression of the double-muscléd 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.





# 1

## 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.

### TESTIMONY

**Philippe Boudou - Lacaune breeder and President of the ANIO**

« The work carried out for the establishment of genomic selection has been for us, breed associations and breed societies, an exciting adventure. In a sector where technical impact is high and the breeding scheme is efficient, a technological innovation such as this is very much welcomed. The National Institute for Agricultural Research (INRA) and the Institut d'Élevage are predicting for us a rise in genetic gain that we could use to select new traits. Even if genomics don't revolutionise our breeding schemes, we have had to make some adjustments and reorganisation, for example in performance stations in order to manage natural mating rams with the genomic index. What will change rapidly for the breeder is the average value of the insemination flask. The probability of getting a bad ram will get smaller and smaller ».

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# 2

## L'extension to Pyrenean breeds

Following in the footsteps of the Lacaune breed, the dairy sheep breeds of the Pyrenees Mountains (**manech tête rousse, manech tête noire, basco-bearnaise**) have resolutely turned towards a genomic selection goal. The objective is to launch the genomic scheme in 2017.

The possibility of a multibreed evaluation, explored among the homologous breeds of the Spanish Basque country with the aim of increasing the size of the reference populations, did not have the desired benefits. Nevertheless, the foundation for genomic selection is laid down and the reference populations have been initiated. At the same time, local constraints have pushed project managers to imagine a new scenario where young rams destined for artificial insemination will be genotyped on the breeder's farm and will integrate the semen production centre after a genomic pre-selection.

# 3

## 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-musled allele, without significant effect on maternal abilities.

# 4

## 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...).