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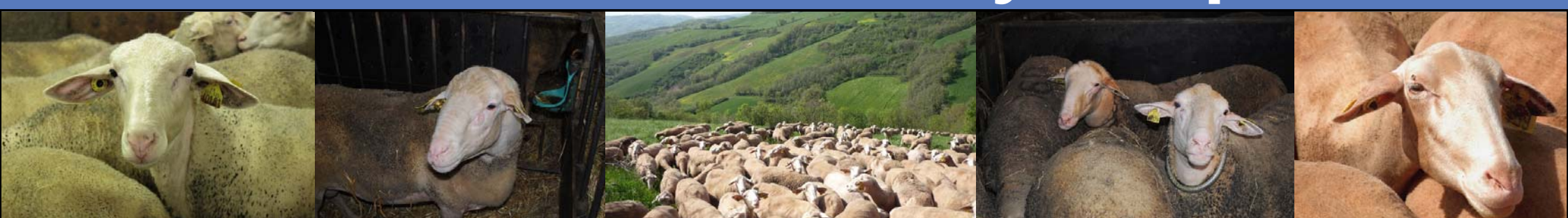
Genomic selection in practice in French Lacaune dairy sheep



D. Buisson, G. Lagriffoul, A. Legarra, P. Boulenc, P. Danflous, F. Fidelle, G. Frégeat, B. Giral-Viala, P. Guibert, F. Pichereau, C. Soulas and J.M. Astruc

World Congress on Genetics Applied to Livestock Production

Auckland – 12/02/2018

11th WORLD CONGRESS ON GENETICS APPLIED TO LIVESTOCK PRODUCTION
11–16 February 2018
Aotea Centre
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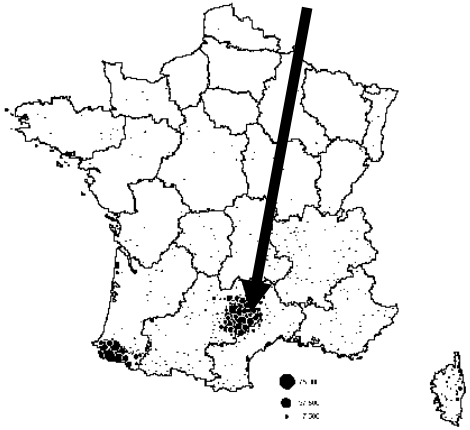
Context

Lacaune dairy sheep



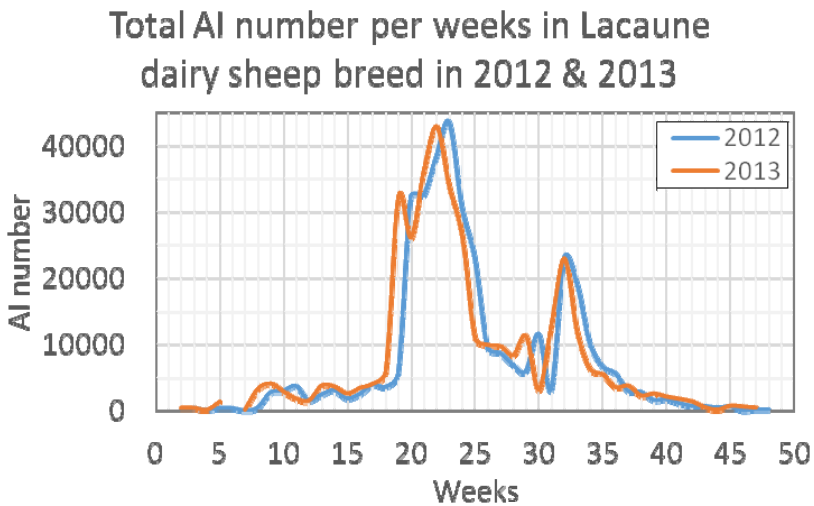
- Lacaune : a local breed selected within its original location : the Roquefort area

- Selection objectives :
  - Milk quantity & Milk quality (Fat %, Protein %)
  - Resistance to mastitis (Somatic Cell Count SCC)
  - Udder morphology
  - Resistance to scrapie

Size of population (# ewes)	870,000
Size of population in selection (# ewes)	175,000
Number of rams progeny-tested each year (before GS scheme)	450
% AI within the nucleus flock	85 %
Milk production	318 L
Annual Genetic Gain on TMI	0.24 σG

Brake on Genomic Selection (GS)

- Fresh-semen AI realized within a few weeks
  - → Significant number of alive AI rams required
- Lower precision of ram's EBV compare to dairy cattle
  - •Rams known on 30-40 daughters only
  - •Lower linkage disequilibrium than in dairy cattle
- Limited decrease of generation interval
  - •Progeny-test : 50 % of AI in nucleus flocks
  - •1 year of lay-off
- → A key point : the genomic selection rate
  - •High genotyping cost (Illumina Ovine SNP50 BeadChip) : 115€ in 2012, 70€ in 2017

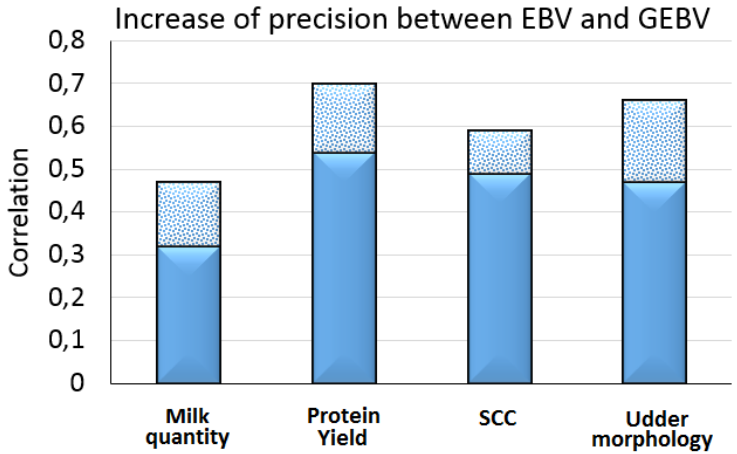


5 years of R&D on GS : 2010-2014

- Constitution of a reference population

Genotyped rams in 2016	With daughers	Year of birth	1rst complete year
10.552	5.108	1996-2016	2003

- Improvement of genomic evaluation
  - → Implementation of a single-step GBLUP in 2013
  - → Analyses of EBV's and GEBV's accuracy (Astruc *et al.*, 2016)



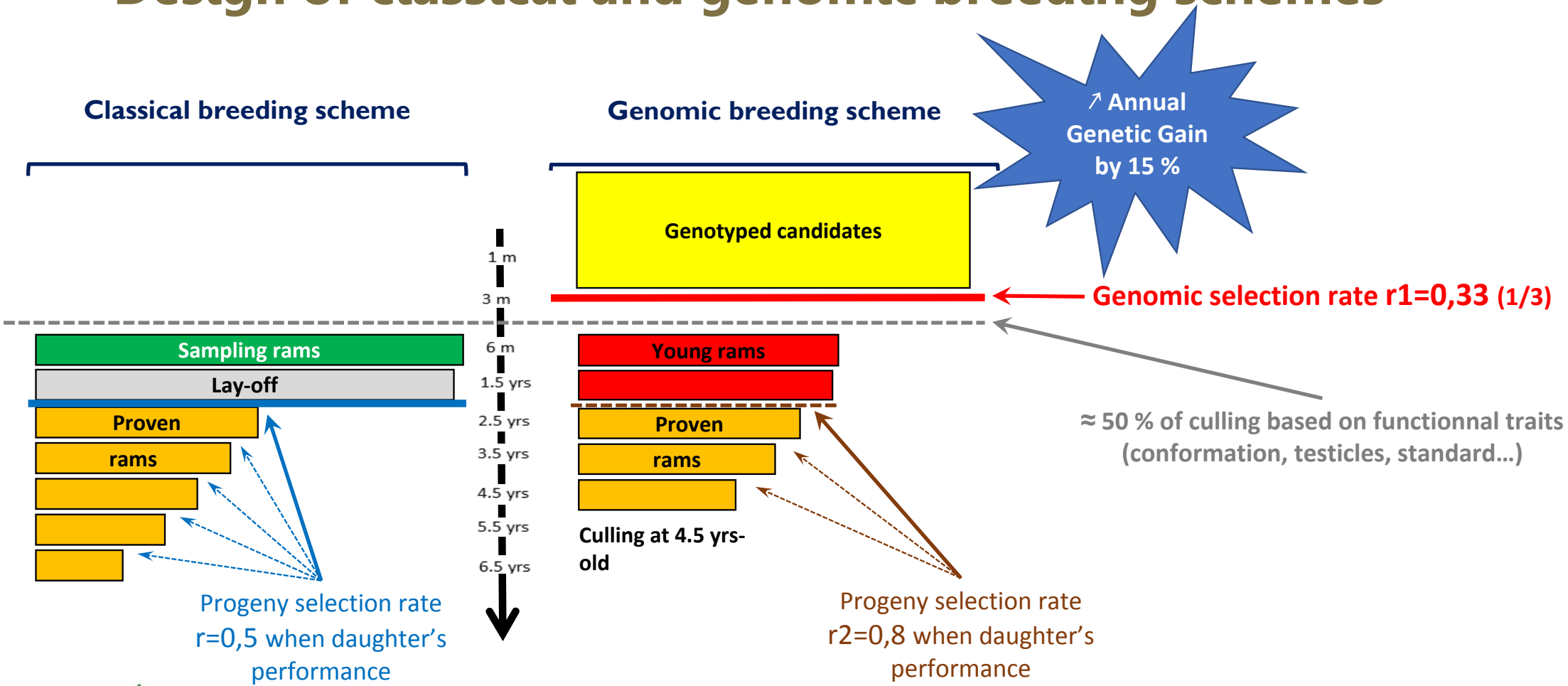
- Modeling of GS breeding scheme (Buisson et al., 2014)
  - → Technical and economical relevance of GS in french dairy sheep breed

- Genomic experimentation in Lacaune breed in 2012 and 2013 (Baloche et al., 2014)

→ Choice of Lacaune breed societies to move toward GS in 2015

Astruc *et al.*, 2016. INRA Prod. Anim., 29, 153-156.
Baloche *et al.*, 2014. WCGALP, Vancouver, Canada, 335.

Design of classical and genomic breeding schemes

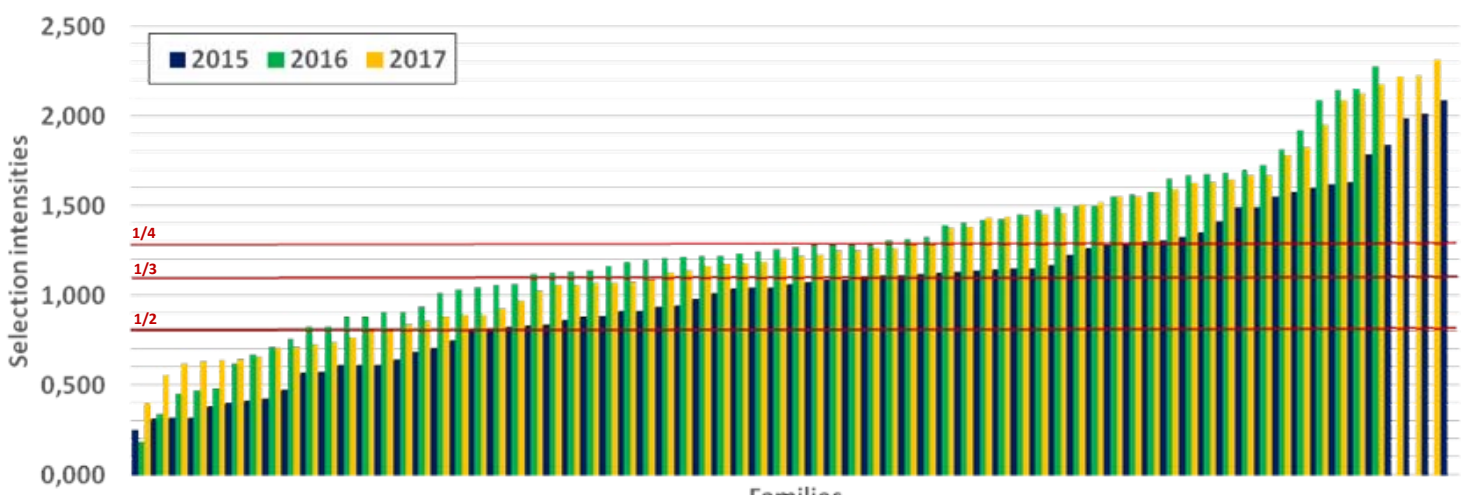


Baloche *et al.*, 2014. WCGALP, Vancouver, Canada, 335.

Selection intensities applied during the last 3 years

	2015	2016	2017
Genotyped candidates with GEBV	1611 (59 families)	2252 (68 families)	2638 (63 families)
Selected young rams (YR)	284 (58 families)	271 (61 families)	284 (60 families)
Realized selection intensity (r1)	1.053 (35%)	1.129 (31%)	1.255 (26%)

- Increase of genotyping number → Improvement of selection rate r1
- Less families with r1<1/2 and more families with r1>1/4



Reranking of rams between 2015 et 2017 for rams born in 2015

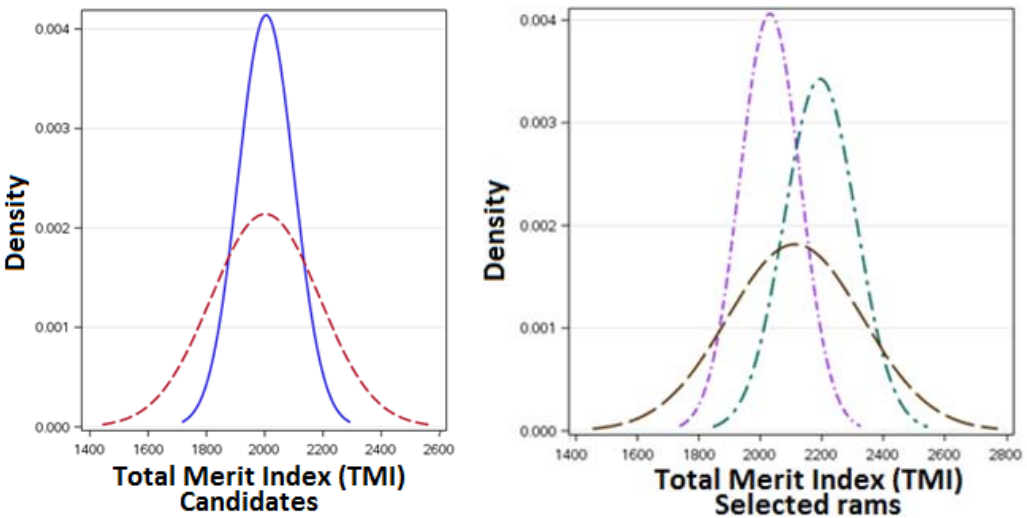
- Arrival of first proofs in 2017 for rams born in 2015

- Study of evolution of GEBV using a threshold

Selection rate r2 applied at the arrival of the first proofs	
Classical scheme	0.50
Genomic scheme (theoretical)	0.80
Genomic scheme (realised in 2017)	0.79

- Selection rate r2 applied in 2017 is very close to modellings

Impact of GS on the accuracy of GEBV

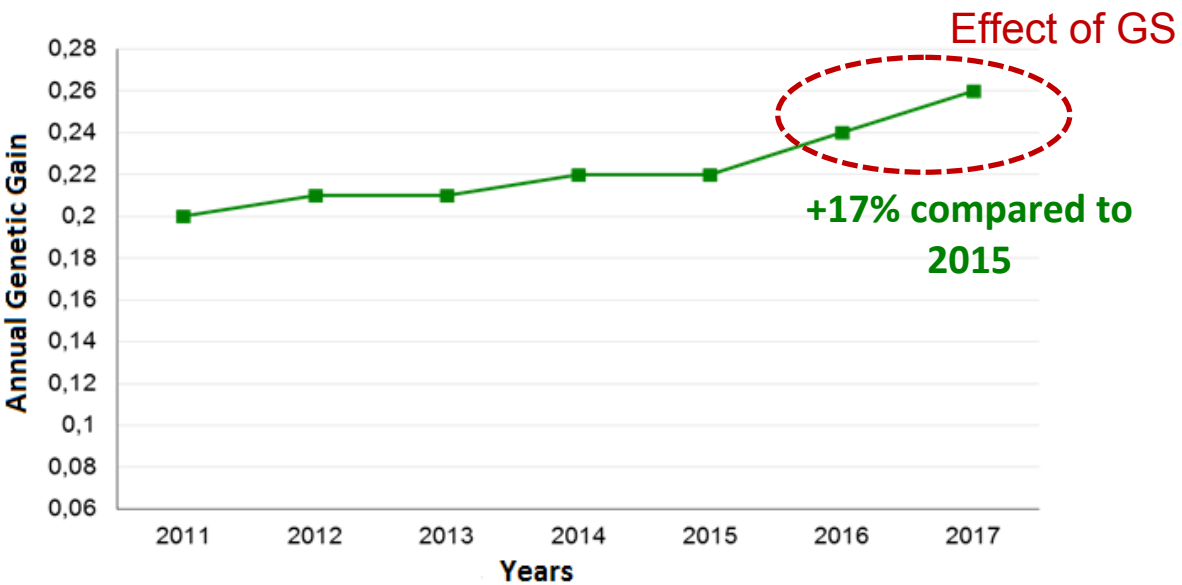


Evolution of Total Merit Index (TMI)						
TMI	Treat	N	Mean	Std	Min	Max
Candidates						
EBV	$T_{A,2015}$	1611	2005	96	1656	2513
GEBV	$T_{A,2015}$	1611	2002	186	1420	2587
Selected rams						
EBV	$T_{A,2015}$	225	2032	98	1796	2513
GEBV	$T_{A,2015}$	225	2195	116	1943	2557
GEBV	$T_{A,2017}$	225	2113	220	1309	2720

- Average EBV (parental average) and GEBV are the same but GEBV is more precise
- GEBV at the arrival of proofs are slightly lower than expected
  - → Overestimation of GEBV without daughters
  - → Bias in evaluation ?

Correlations	GEBV, $T_{A,2017}$
EBV, $T_{A,2015}$	0.202
GEBV, $T_{A,2015}$	0.379

Effect of GS on genetic gain



- Genetic gain calculated from the different paths for generating the animals born in 2017
  - Dams of rams
  - Sires of rams
  - Dams of ewes
  - Sires of ewes

- +17% of Annual Genetic Gain in 2017 compared to 2015 (2016 = transition period)

  → Impact of GS implementation

Conclusion

- Results very close to modelling :
  - A moderate genomic selection proportion r1=1/3 at 3 months of age completed at the arrival of progeny records by a selection proportion r2≈20% allows an annual genetic gain increase of 17%
- GEBV at $T_{A,2015}$ are slightly overestimated compared to GEBV at $T_{A,2017}$
  - possible bias in evaluation to be investigated
- Realized selection intensities quite low with regards to the number of genotypings
  - Selection pressure on functional morphology at 6 months
  - Semen production
  - Selection intensity within families
- Since 2017 :
  - Candidates are genotyped with a low-density BeadChip (24K - 35€) and only selected young rams are then genotyped with medium-density BeadChip
  - Implementation of GS in Pyrenean dairy sheep breed
  - The increase in AGG will allow the selection of new traits such as functional longevity, milk persistency, resistance to internal parasites, semen production and functional morphology…

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Thank you for your attention !