Assessment of technical and economic efficiency of French dairy sheep genomic breeding programs

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Genomic selection: many achievements, mainly in dairy cattle, over the last decade

- Great expectations in increase of genetic gain
  - Good genomic accuracy
  - Dramatic reduction of generation interval (selection decisions made early in the life of bulls)
- Genotyping affordable regarding animal value & progeny-testing cost

→ Genomic breeding programs cost-effective

And in dairy sheep?
French dairy sheep breeding programs

Lacaune
AI 85% in nucleus
450 rams progeny-tested / yr
35 daughters / rams

Red-Faced Manech
AI 55% in nucleus
150 rams progeny-tested / yr
30 daughters / rams

<50 rams progeny-tested / yr
Progeny testing in dairy sheep

Illustration with a Lacaune breeding company

Progeny test (225 rams)

Categories of AI rams within flock

- 6-month-old rams
- 1,5-yr-old rams
- 2,5-yr-old rams
- 3,5-yr-old rams
- 4,5-yr-old rams
- 5,5-yr-old rams

700 rams in AI center

Rel > 0.7

Rel 0.2 – 0.3

6-months-old rams

Few reduction of generation interval to be expected in dairy sheep
R&D programs on genomic selection in French dairy sheep

**Lacaune**

Reference population
2900 rams

**Pyrenean breeds**

Reference population
(Red-Faced Manech)
1300 rams

GEBV: moderate gain in accuracy (15-40% depending on trait and breed)

→ Genomic reliability intermediate (0.4 - 0.5) between parent average and progeny-testing
Constraints of AI in dairy sheep

Fresh semen $\rightarrow$ Limited power of diffusion of rams

AI period highly seasoned

$\downarrow$

700 rams required in AI center to supply AI demand

$\Rightarrow$ No more lay-off = hope to reduce number of rams
Challenge: is it possible to get at least a similar genetic gain without extra costs?
Modeling a genomic program in dairy sheep
Illustration with a Lacaune breeding company

Genotyped candidates

Maintain ref. pop.
Diffusion sires
of rams & ewes

Range of genomic precision
(0.4 ; 0.45 ; 0.5)

Range of semen production

Age at culling : 
{2.5;3.5;4.5}

Genomic selection pressure :
{1/3;1/4;1/5;1/6;1/7}

Selection pressure after progeny-testing :
{1;0.9;0.8;0.7}
In most cases, genomic selection increases genetic gain.

Genetic gain increased in (almost) all genomic scenarios.

Any genomic pressure cannot be applied regarding genotyping costs and logistical reasons.

→ Increase in genetic gain less dramatic than in dairy cattle.
Number of AI rams reduced in all designs

Genomic vs conventional scheme:

Number of rams in AI center dropped by 40%

Number of rams per cohort (rams required to maintain ref.pop.) fell by half

Number of sires of rams increased more than 2-fold

Less rams to manage... costs savings
Economic balance: taking into account cost of genotyping & costs of keeping rams

Scenario: culling 4.5, p=0.7
Conclusion

A genomic program may be efficient (at least in Lacaune and Red-Faced Manech) : slightly higher genetic gain ; less rams in AI center to offset genotyping costs.

With current cost of genotyping : apply genomic pressure of \( \frac{1}{2} \) to \( \frac{1}{4} \).

Key factors for cost-efficiency : cost of genotyping and semen production of the rams.

Genomic breeding program :

- more flexibility
- tool for better management of inbreeding
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