INTROGRESSION OF WOOL-SHEDDING GENES INTO THE ROMANE BREED SHEEP

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Context
sheep industry to day

- European countries
  - wool : generally not profitable
    - often undesirable compared to meat or milk
    - income from wool < shearing and wool associated costs
  - New interest for breeds with no wool or shedding wool
    - Hair sheep : Wiltshire, Barbados Blackbelly, Dorper, ….
    - Crossbreds with hair sheep

Back to a wool shedding sheep from a modern meat sheep ?

Back to a wool shedding sheep ?

From the Romane breed : a composite line

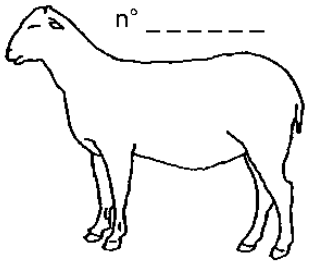
- « Berrichon du cher » X « Romanov »
  - 4 intercrossing generations
- a modern sheep selected for meat production and adaptive traits : prolificacy and maternal abilities
  - Large variability fleece type: long wool → kempy fleece

1. Genetic variability of wool shedding
   - In the Romane breed
2. Introgression of wool-shedding genes
   - into the Romane breed sheep
   - from the Martinik Black Belly breed:
     - a hair sheep from French West Indies (Caribbeans)

Wool sheeding measurements

Wool shedding measurement

- Once a year (summer onset)
  - before annual shearing time
    - ~ end of spring shedding period
  - use of standard sheep profile



» Drawn body surface with wool

» Each animal

- Image analysis software

✓ Extent of wool shedding

$$= \frac{\textit{body surface without wool}}{\textit{total body surface}}$$

2 pure Romane flocks

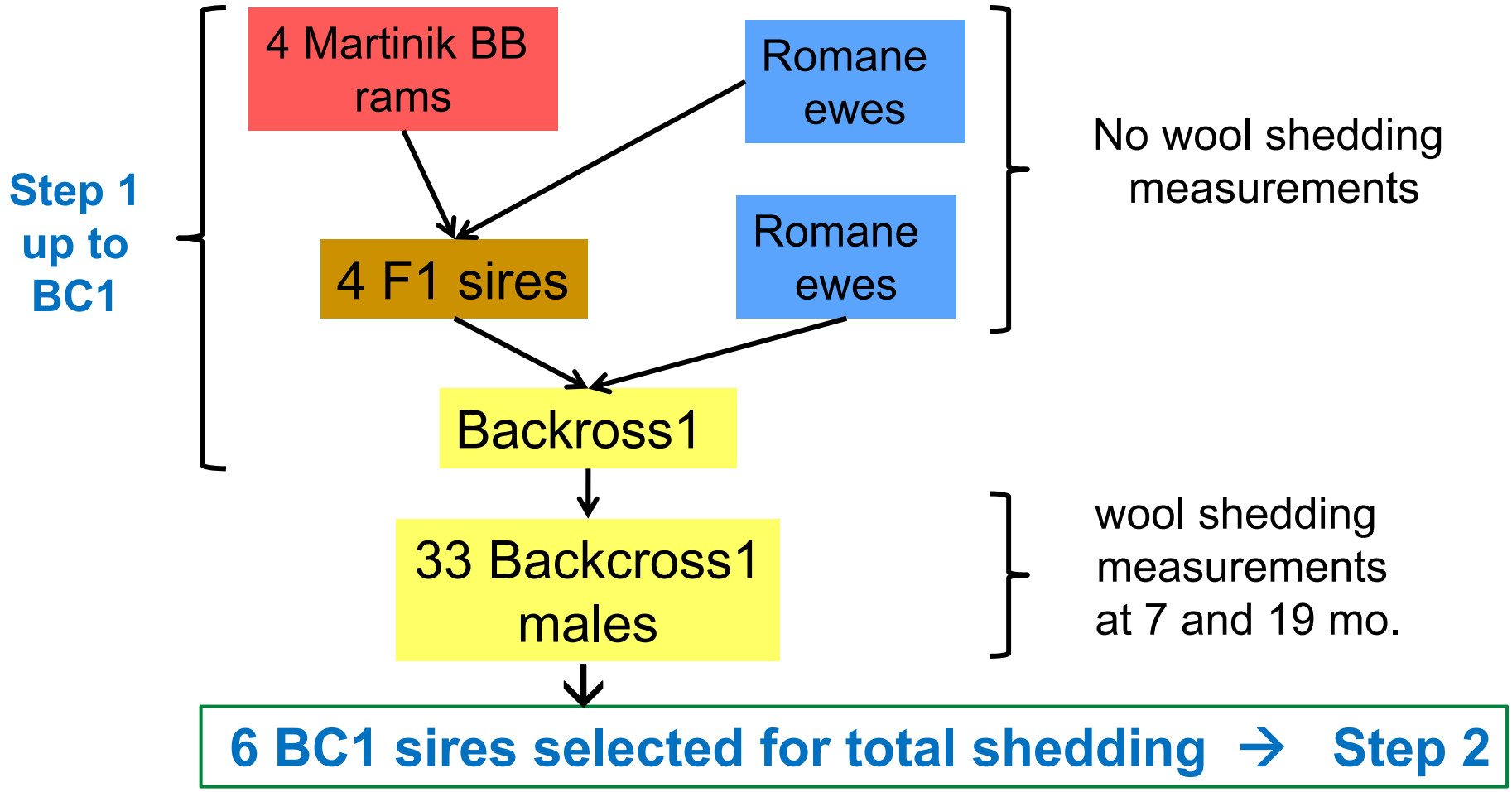
- 300 adult ewes
  - ✓ from 1. to 5 years age
  - ✓ from 2002 to 2013
- Lambs and young ewes
  - ✓ at 7mo, and 19 mo of age
  - ✓ for 3 years (2009 – 2011)

1 Introgressed flock

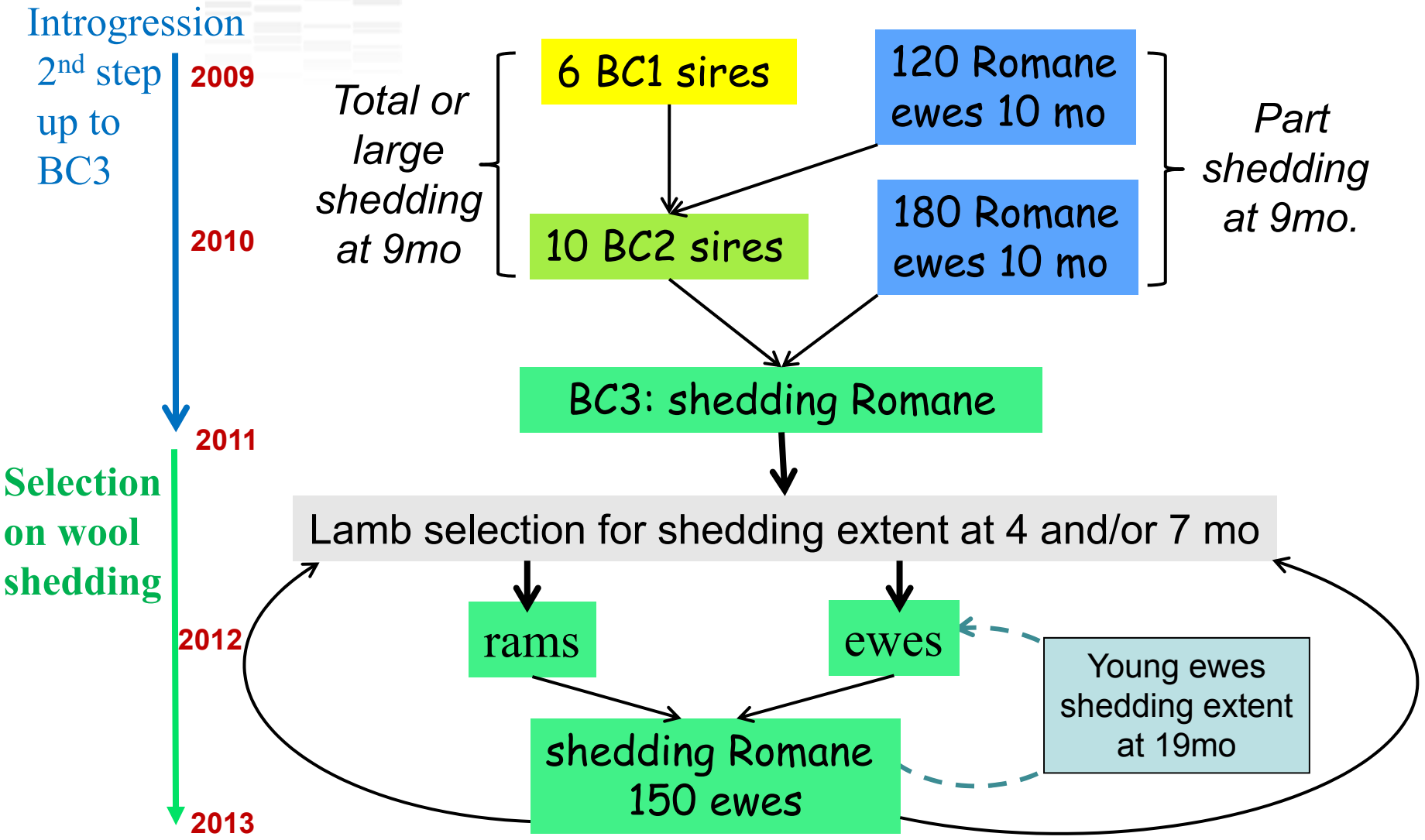
- ✓ lambs at 4 - 7 mo age
- ✓ ewes 1 & 2 y. age
- ✓ from 2011 to 2013

Introgression of wool shedding genes *from Martinik Black Belly into Romane breed*

4 successive backcrossing generations



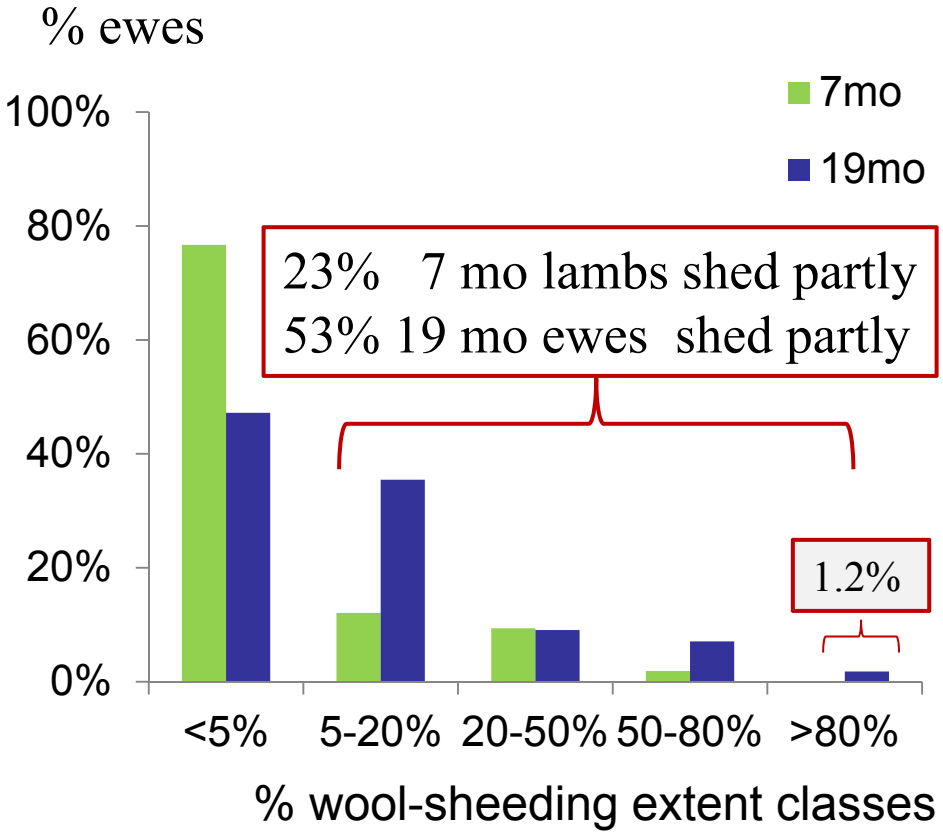
Introgression of wool shedding genes



Data analysis

- Traits
  - Ability to shed : binary trait
  - wool shedding extent : categorial trait (8 classes)
- 3 datasets
  - Lambs and young ewes Romane breed at 9 and 21 mo
    - 1503 animal records at 9 and 21mo, 3385 animals in pedigree
  - Adult Romane ewes: 1259 animals with performances
    - 2984 records, 2485 animals in pedigree
  - Introgressed Romane population:
    - 416 animals with performances : lambs at 4 -7 mo. and ewes at 1- 2 y
- Methods
  - Threshold model using TM software (Bayesian inference)
  - Fixed effects: age of ewe, year, age of dam, born and suckling lambs
    - Birth and rearing type on 2nd dataset (lambs at 9mo)
  - Random effects: genetic additive, permanent environment and residual

1- Genetic variability of wool shedding *lambs and young Romane ewes*



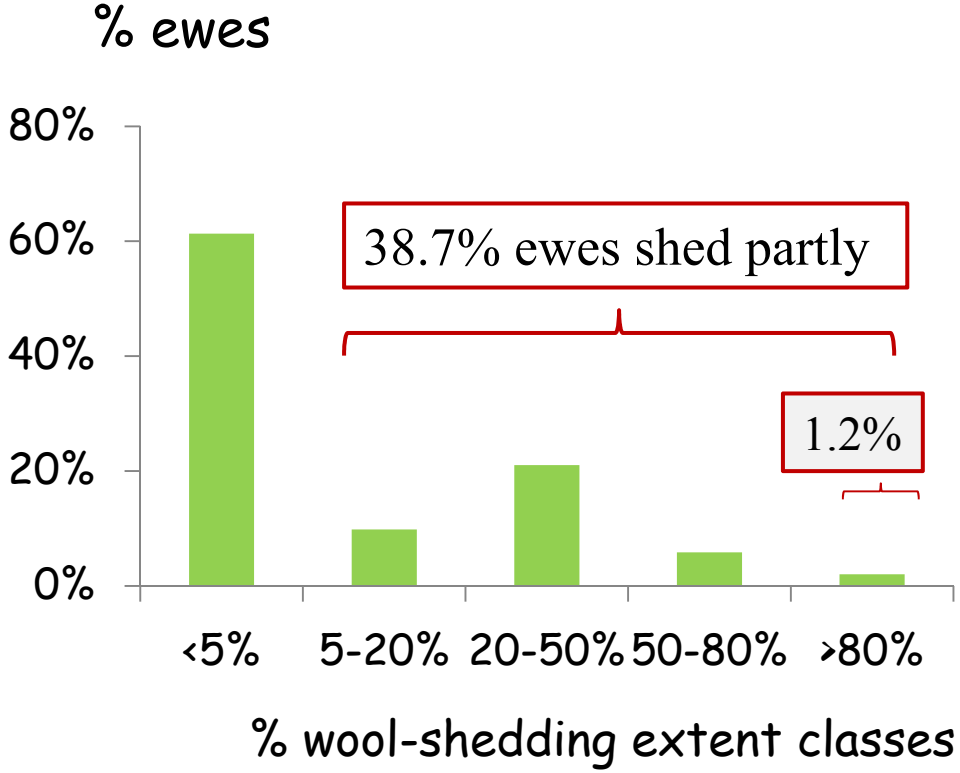
Genetic parameters as separate traits

	Lamb 7 mo age	Young ewe 19 mo age
7 mo lambs	**0,73** ± 0,11	**0,86** ± 0,19
19 mo ewes		**0,42** ± 0,05

High positive genetic correlation

Selection at lamb age

1- Genetic variability of wool shedding *adult Romane ewe*



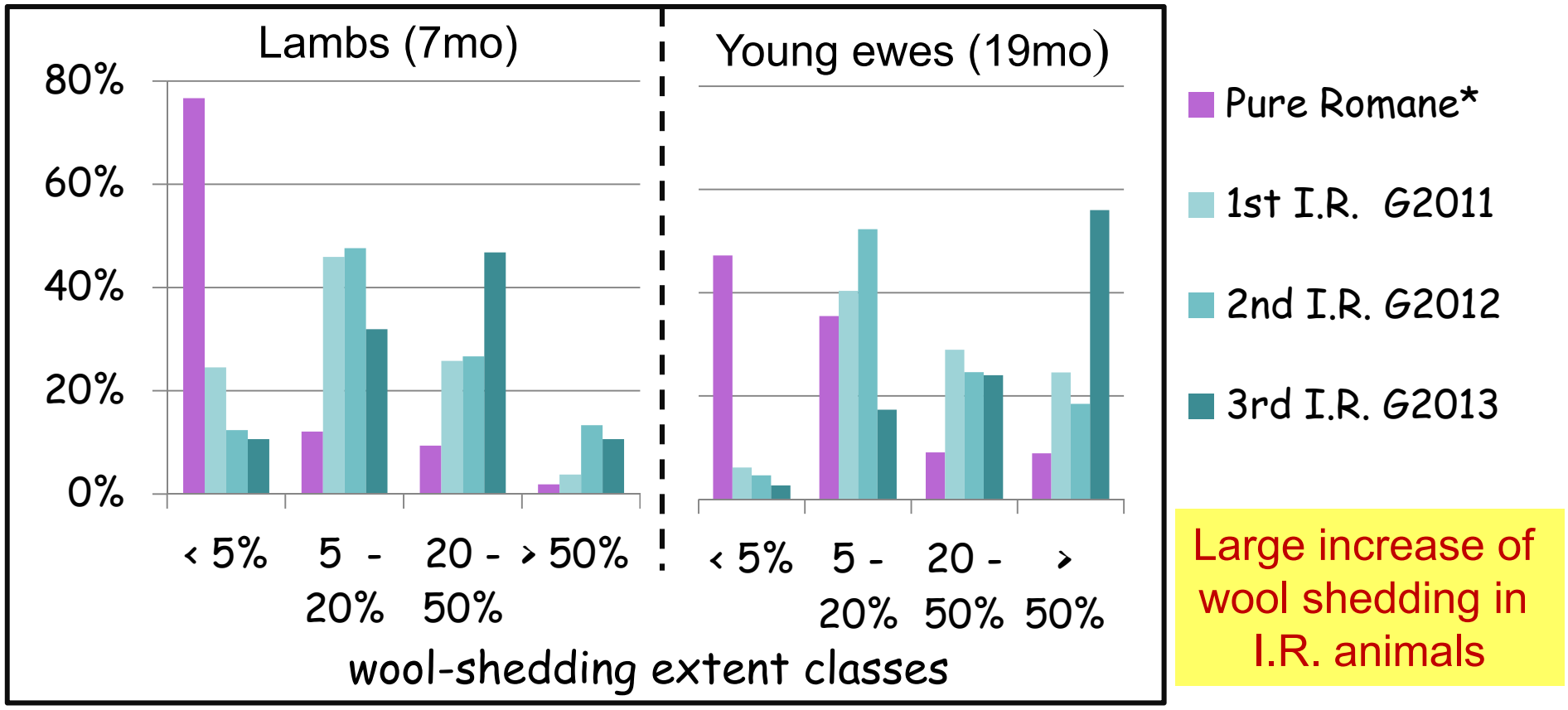
Variation factors

- Age of ewe
  - 1 year old shed less than others
  - No variation thereafter
- Reproduction activity
  - Ewe producing and suckling lambs shed more than others

$h^2 = 0.69 \pm 0.05$

But long selection process !

Introgressed Romane population (I.R.)
wool shedding in lambs & young ewes



Large increase of wool shedding in I.R. animals

** Control pure Romane animals measured at same age and same time*

$h^2 = 0.50 \pm 0.09$

1 σ_g genetic gain from 1st to 3rd I.R. generation

Conclusions

Variability of wool shedding in the pure Romane breed

- High genetic correlation (0.86) lamb ⟷ young ewe traits
  - Selection at lamb stage
- High heritability (0.69) estimate in adult ewes
- But as only a few animals (1- 2%) shed total fleece annually

→ Long selection process up to a shedding sheep

Introgression of wool shedding genes from Martinik Black Belly

*Through 4 successive backcrossing generations **with selection on wool shedding on lambs** along introgression process*

- Large increase of wool shedding
  - ✓ at the end of backcrossing process
  - ✓ thereafter by selection (2 generations)
    - In both lambs and adult ewes

→ **Efficient P-MAS* strategy up to a shedding sheep**

*** phenotype-marker assisted selection**

Acknowledgements

source: D. Allain

- INRA UMR GenPhySE
  - B. Pena-Arnaud
- INRA Domaine de La Fage
  - D. Foulquié
- INRA Domaine de Bourges
  - Y. Bourdillon

Thank you for your attention

Introgressed shedding Romane animals

source: D. Allain

source: D. Allain

source: D. Allain

source: D. Allain

Martinik BB, Romane & croosbreds

source : OS Romane

source : D. Allain

source : D. François

all F1 animals shed

source : D. Allain

some BC1 animals shed

The Romane sheep breed

A composite line of 2 breeds intercrossed during 4 generations

Berrichon du Cher : meat breed having a white fleece with merino infusion

Romanov : prolific breed having a black coarse fleece

source : OS Romane

source : A. Boissy

Selection goals : prolificacy, milking ability, adaptive traits

Large variability in fleece type: long wool → kempy fleece

The Martinik Black Belly Breed

A hair sheep from French West Indies

related to the other hair sheep populations present in the Caribbean Islands and Central America (Barbados Blackbelly, Pelibuey, West African)

source : D. Allain

source : D. Allain

Selection goals : prolificacy, milking ability, adaptive traits (nematode resistance)

Martinik – Romane crossbreds

source : D . François

F1 animals

all F1 animals shed

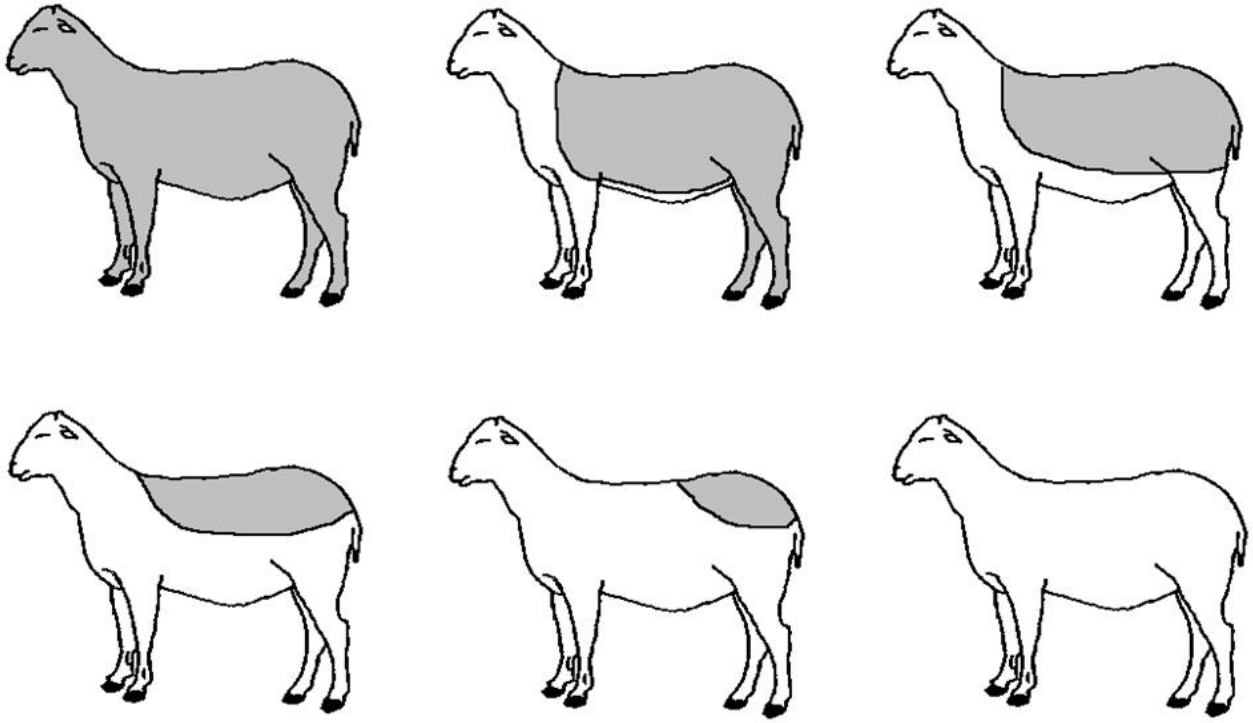
source : D . Allain

Backcross 1
Romane Martinik

some BC1 animals shed

General pattern of wool shedding extent

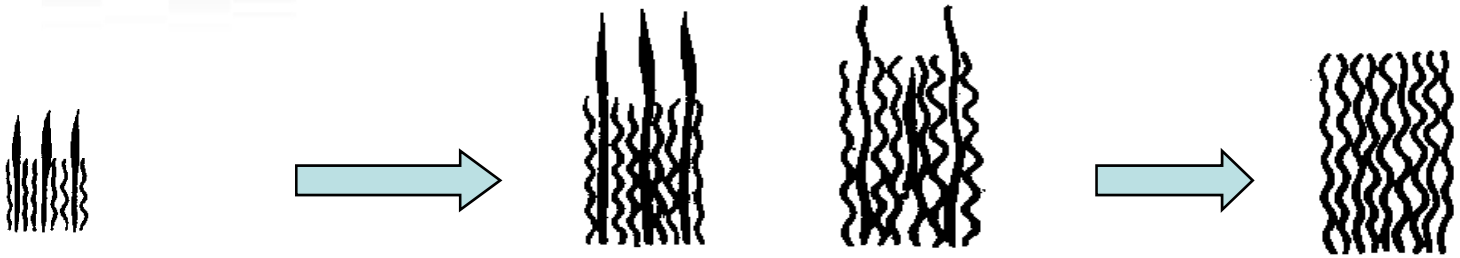
1- No shedding



6- Total wool shedding

Antero-posterior and ventro-dorsal gradient

Fleece evolution from ancestral sheep towards modern woolled sheep for textile use



Double coat

Apparent to true single coat

Wild hair sheep

Medium wool sheep

Merino sheep

Guard hair (kemp)
Fine woolly undercoat

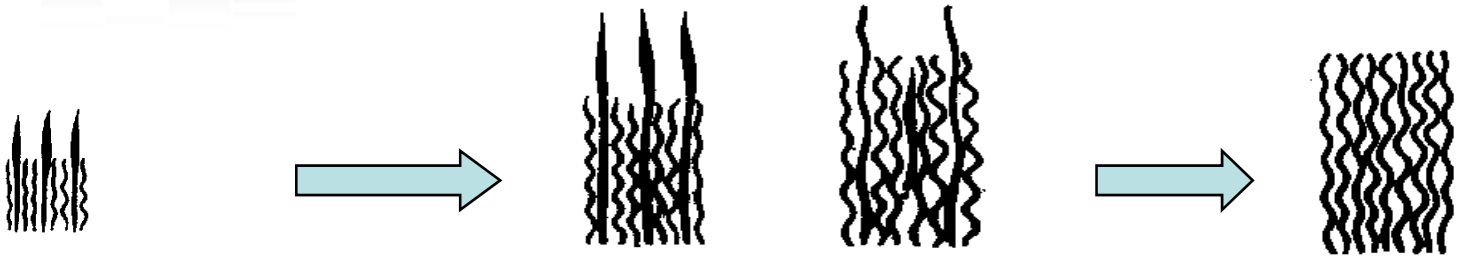
Coarse long wool with kemp for spinning

Fine wool only
For fine yarn

Seasonal growth and shedding

Permanent fibre growth requiring shearing

Fleece evolution from ancestral sheep towards modern woolled sheep for textile use



Double coat → Apparent to true single coat

Wild hair sheep	Medium wool sheep	Merino sheep
Guard hair (kemp) Fine woolly undercoat	Coarse long wool with kemp for spinning	Fine wool only For fine yarn
Seasonal growth and shedding	→	Permanent fibre growth requiring shearing

Back to a wool shedding sheep ? ←