Part lactation sampling as a powerful design to select dairy sheep both on milk composition and mastitis resistance provided to maintain ICAR sheep requirements regarding milk recording devices and analysis of sheep milk in laboratories

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Part-lactation sampling design

- **Conceived in 1985** *(Barillet)* to select the Lacaune population for fat and protein yields and contents

- **Implemented in**
  - the Lacaune nucleus flocks **in 1988 in first lactation**
  - the Lacaune nucleus flocks **in 2001 in the 2 first lactations**
  - in the Manech and Basco-Bearnaise nucleus flocks **in 2002-2004 in first lactation**
Simplification of milk composition recording

Milk quality (optional disposition): part-lactation sampling within AC method for milk yield

AC method: record of 1 of the 2 milkings

Parities 1 (& 2) X X X X X X

Milk yield

A4 method, all ewes

For 100 ewes: 100 x 2 x 6 = 1200 samplings

Part-lactation sampling within AC method, parity 1 & 2

For 100 ewes: 50 x 3 = 150 samplings

(12.5 % / A4)

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Part-lactation sampling design: in practice

*implemented within AC method for milk yield*

3/4 (primiparous) **to** 5/6 (adult ewes) **monthly test-days**

*for milk yield per lactation* (at only 1 on the 2 daily milkings)

1 to 3 **monthly test-days** for milk composition (fat and protein), **per lactation** involved in part-lactation sampling design.
Part-lactation sampling design (in France)

- **implemented in**
  - the Lacaune nucleus flocks in **1988 in first lactation**
  - the Lacaune nucleus flocks in **2001 in the 2 first lactations**

- **implemented in**
  - the Manech and Basco-Bearnaise nucleus flocks in **2002-2004 in first lactation**
# Genetic parameters (Lacaune breed, Barillet et al., 2006)

<table>
<thead>
<tr>
<th></th>
<th>Lait</th>
<th>QMG</th>
<th>QMP</th>
<th>TB</th>
<th>TP</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAIT</td>
<td>0.32</td>
<td>+0.77</td>
<td>+0.88</td>
<td>-0.43</td>
<td>-0.48</td>
</tr>
<tr>
<td>QMG</td>
<td>+0.83</td>
<td>0.26</td>
<td>+0.82</td>
<td>+0.24</td>
<td>-0.12</td>
</tr>
<tr>
<td>QMP</td>
<td>+0.93</td>
<td>+0.85</td>
<td>0.28</td>
<td>-0.18</td>
<td>-0.01</td>
</tr>
<tr>
<td>TB</td>
<td>-0.20</td>
<td>+0.35</td>
<td>-0.06</td>
<td>0.41</td>
<td>+0.57</td>
</tr>
<tr>
<td>TP</td>
<td>-0.35</td>
<td>-0.12</td>
<td>0.01</td>
<td>+0.40</td>
<td>0.51</td>
</tr>
</tbody>
</table>

**Heritabilities on diagonal**

- Genetic correlations above diagonal
- Environmental correlations under diagonal

- Genetic parameters
- 121,283 first lactations
- between 2001 et 2004
GENETIC TREND FOR LACAUNE RAMS
(animal-model evaluation 2009)

ANNUAL GENETIC GAIN
5.5 litres for Milk yield
0.19 g/l for Fat content
0.16 g/l for Protein content

Fat Content EBV
Protein Content EBV

YEAR OF BIRTH
MILK YIELD (litres)
FAT AND PROTEIN CONTENT g/l-1
PYRAMIDAL MANAGEMENT OF THE POPULATION

Nucleus flocks

Commercial flocks

rams born from assortative matings

sampling rams
proven rams

AI centre

natural mating rams

flocks in D recording

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# Nucleus flocks and commercial flocks (in D recording) in France according to the French dairy sheep breeds (year 2009)

<table>
<thead>
<tr>
<th>Countrie s</th>
<th>Breeds</th>
<th>Size of population</th>
<th>Recorded population (nucleus)</th>
<th>% recorded population</th>
<th>Ewes in D method (commercial flocks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>France (2009)</td>
<td>Lacaune</td>
<td>2,600</td>
<td>900,000</td>
<td>376</td>
<td>173,568</td>
</tr>
<tr>
<td></td>
<td>Manech red faced</td>
<td>1,150</td>
<td>270,000</td>
<td>203</td>
<td>70,712</td>
</tr>
<tr>
<td></td>
<td>Corse</td>
<td>420</td>
<td>95,000</td>
<td>72</td>
<td>21,050</td>
</tr>
<tr>
<td></td>
<td>Basco-Béarnaise</td>
<td>420</td>
<td>80,000</td>
<td>78</td>
<td>21,984</td>
</tr>
<tr>
<td></td>
<td>Manech black faced</td>
<td>510</td>
<td>100,000</td>
<td>52</td>
<td>14,509</td>
</tr>
</tbody>
</table>
Fat content of annual milk tanks * phenotype trend according to the type of Lacaune flocks (Roquefort area)

Samplings of milk tanks every 10 days for milk payment design
Nucleus flocks (AC recording)
Commercial flocks (D recording)
All flocks (Lacaune population in Roquefort area)
Protein content of annual milk tanks*: phenotypic trend according to the type of Lacaune flocks

Samplings of milk tanks every 10 days for milk payment design
Nucleus flocks (AC recording)
Commercial flocks (D recording)
All flocks (Lacaune population in Roquefort area)
Part-lactation sampling design (in France)

- implemented in
  - the Lacaune nucleus flocks in 1988 in first lactation
  - the Lacaune nucleus flocks in 2001 in the 2 first lactations

- implemented in
  - the Manech and Basco-Bearnaise nucleus flocks in 2002-2004 in first lactation
### Genetic parameters: Manech red faced breed

*(Barillet et al., 2008)*

<table>
<thead>
<tr>
<th></th>
<th>MY</th>
<th>FY</th>
<th>PY</th>
<th>FC</th>
<th>PC</th>
</tr>
</thead>
<tbody>
<tr>
<td>MILK yield</td>
<td>0.33</td>
<td>+0.87</td>
<td>+0.92</td>
<td>-0.39</td>
<td>-0.44</td>
</tr>
<tr>
<td>FAT yield</td>
<td>+0.84</td>
<td>0.28</td>
<td>+0.91</td>
<td>+0.10</td>
<td>-0.16</td>
</tr>
<tr>
<td>PROTEIN yield</td>
<td>+0.96</td>
<td>+0.82</td>
<td>0.30</td>
<td>-0.16</td>
<td>-0.06</td>
</tr>
<tr>
<td>FAT content</td>
<td>-0.17</td>
<td>+0.34</td>
<td>-0.16</td>
<td>0.28</td>
<td>+0.60</td>
</tr>
<tr>
<td>PROTEIN cont.</td>
<td>-0.34</td>
<td>-0.20</td>
<td>-0.04</td>
<td>+0.16</td>
<td>0.51</td>
</tr>
</tbody>
</table>

Heritabilities on diagonal
Genetic correlations above the diagonal
Environmental correlations under

**Genetic parameters**
58,378 first lactations
between 2002 and 2007

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GENETIC TREND FOR MANECH RED FACED RAMS
(animal-model evaluation)

ANNUAL GENETIC GAIN
between 1990 and 2009
- 4.1 litres for Milk yield
- 0.19 g/l for Fat content
- 0.09 g/l for Protein content

Main effort on PrP selection
Now on milk composition

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Fat content of annual milk tanks*: comparison of the phenotypic trend in Lacaune and Pyrenean areas

Samplings of milk tanks every 10 days for milk payment design
Roquefort area (Lacaune breed)
Pyrenean area (Basco-Bearnaise and Manech breeds)
Protein content of annual milk tanks*: comparison of the phenotypic trend in Lacaune and Pyrenean areas

Samplings of milk tanks every 10 days for milk payment design
Roquefort area (Lacaune breed)
Pyrenean area (Basco-Bearnaise and Manech breeds)
Part-lactation sampling design

- **Conceived in 1985 (Barillet) to select the Lacaune population for fat and protein yields and contents**

- **New question (by the end of the 90’s in the Lacaune breed)**
  is this simplified design relevant also to select for somatic cell count (selection for mastitis resistance) ?

  *the answer is: YES (Barillet et al., 2001)*
Genetic parameters : comparison **Lacaune** (121,283 first lactations) et **MRF** (58,378 first lactations)

<table>
<thead>
<tr>
<th></th>
<th>héritabilities</th>
<th>Genetic correlation with milk yield (MY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk Yield</td>
<td>0,32 et 0,33</td>
<td></td>
</tr>
<tr>
<td>Fat content</td>
<td>0,41 et 0,28</td>
<td>- 0,43 et - 0,39</td>
</tr>
<tr>
<td>Protein content</td>
<td>0,51 et 0,51</td>
<td>- 0,48 et - 0,44</td>
</tr>
<tr>
<td>LSCS</td>
<td>0,15 et 0,10</td>
<td>0,15 et 0,21</td>
</tr>
</tbody>
</table>
New breeding goals in Lacaune dairy sheep breed

- **Until 2004:**
  - Fat and Protein yields and contents = Milk traits
  - & PrP gene selection (scrapie resistance)

  *transition between 2005 and 2007*

- **Since 2007:**
  - ½ Milk traits + ½ udder functional traits
  (udder functional traits = ½ SCS + ½ udder morphology)
  - mastitis resistance
  - & PrP gene selection (scrapie resistance)
Genetic trend for Lacaune rams
(Animal model evaluation 2009)

Scale: positive EBV are favourable EBV

EBV (standard deviation unit)

Year of birth of the rams

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Conclusion (1/2)

- The part-lactation sampling design is relevant both for milk composition and SCC selection in dairy sheep.

- If we assume 4 lactations on average per ewe, using AC method for milk yield recording and part-lactation sampling for F%, P% and SCC for the 2 first lactations (or first lactation only):
  - In total 18 to 22 test-days for milk yield.
  - And 2 to 6 test-days for F%, P% and SCC (or 1 to 3 test-days for F%, P% and SCC) during the productive live of each ewe.

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during the production life of each ewe (*whatever the jars or meters, manual or electronic*), on average 18 to 22 test-days for milk yield, and 1 to 6 test-days for F%, P%, SCC…

such a very simplified design (1 to 6 milk quality test days recorded per ewe) needs to maintain relevant accuracy for each individual test day as presently defined in ICAR requirements for recording devices and for analytical quality analysis of sheep milk.