New French genetic evaluations of fertility and productive life of beef cows

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Interbull meeting – Nantes – 25th August 2013
French beef cattle genetic evaluations

- **Birth and Weaning Weights & Type Traits** since 1993
- **+ Calving Ease** since 2003
- **Carcass traits** since 2008
- **Post weaning growth** since 2010
- **Post weaning type traits** since 2013
- **Fertility** 2014
- **Productive life** 2014
Data available

- Parentage Validation
- Identification
- Animal Insemination
- Embryo Transfer
- Breed societies
- Performance recording

Extraction from the national database:
- Animal insemination
- Calving information
- Animal movements between herds
- Pedigree

Genetic Evaluations by INRA
Fertility and Cow productive life

2 main breeder wishes can now be addressed:

1. “I want my heifer gives birth to a calf after first AI”
   => heifer calving success after first AI (HCS)

2. “I want my cow has a maximum number of calves born”
   => productive life
HCS: Trait definition

Rule to determine whether first AI is successful:

- based on breed specific gestation length mean (GL in days):

<table>
<thead>
<tr>
<th>AUB</th>
<th>SAL</th>
<th>CHA</th>
<th>PAR</th>
<th>ROU</th>
<th>GAS</th>
<th>BAZ</th>
<th>LIM</th>
<th>BLA</th>
</tr>
</thead>
<tbody>
<tr>
<td>285</td>
<td>285</td>
<td>287</td>
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<td>288</td>
<td>289</td>
<td>290</td>
<td>291</td>
<td>295</td>
</tr>
</tbody>
</table>

- correction of GL for differences:
  - between sex: -1 day for female,
  - if twin: -5 days.

  $\Rightarrow$ GL*$

First AI is said successful if

Calving Date – AI date = GL* ± 19 days
**HCS: Model and parameters**

**Bi-trait BLUP animal model**

**Fixed effects:**

- HCS = CG (AI herd x AI camp x AI subgroup) + Age_class + AI_season + AI_day
- PCS = idem + time between 1st Calving and AI + Calving Ease + Calf Sex

**Random effects:**

- AI bull + AI technician + Animal

**Genetic parameters**

- Similar for all breeds,
- Heritability = 0.015
- Genetic correlation between HCS and PCS = 0.50

- AI bull variance part = 0.002
- AI technician variance part = 0.004

Software: genekit (Ducrocq)
Fertility and Cow productive life

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1. “I want my heifer gives birth to a calf after first AI”
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   => productive life

2 complementary ways to assess cow productive life:

- Longevity ↔ ability of a cow to achieve a long career
  => either in time or in number of calvings

- Reproductive efficiency ↔ number of calves born at a target age
Survival analysis of longevity in terms of Lifespan vs Number of calves

(Phocas and Ducrocq, WCGALP 2006)

Goal
define the best trait to be used for national genetic evaluation

Comparison between:

1. Survival analysis of longevity in terms of Lifespan vs Number of calves
   (Phocas and Ducrocq, WCGALP 2006) => Number of calves

2. Survival model applied on Number of calves (SURV) and
   Linear model applied on Number of calves at 2 different fixed ages:
   - 78 months (NC78) ↔ 6.5 years: opportunity of 4 calvings (1st at 3 years)
   - 150 months (NC150) ↔ 12.5 years: opportunity of 10 calvings

Comparison between 2 French breeds: specialized vs hardy

Survival rate vs Number of calving
Models

- **Longevity**: culling risk
  \[ h(t) = h_0(t) \times \exp(NC) \]

  - Fixed effects relatives to 1st calving
  - Fixed effects relatives to 1st calving and to calving ease mean observed on the other calvings

- **Reproductive efficiency**:
  - \( NC_{78} \)
    \[ = h_y C_1 + age\_C_1 + \underline{Calving\_Ease} + animal + e \]
  - \( NC_{150} \)
    \[ = h_y C_1 + age\_C_1 + \underline{Calving\_Ease} + animal + e \]

\( NC = ageV_1 + moisV_1 + cn + jusexe + parace + partroup + parcamp + troupcamp + père + e \)

Random effects
Residual

Survival Kit (Ducrocq et al.)
Genekit (Ducrocq)

\( NC = number\ of\ calvings \)
Censoring and prediction

![Diagram showing the process of censoring and prediction in cow life.](image)

**Censure Rate:**

<table>
<thead>
<tr>
<th>Breed</th>
<th>NC at 78 months</th>
<th>NC at 150 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aubrac</td>
<td>56 %</td>
<td>35 %</td>
</tr>
<tr>
<td>Charolais</td>
<td>26 %</td>
<td>19 %</td>
</tr>
</tbody>
</table>

**Prediction of the number of calving in case of censoring after calving i:**

=> Brotherstone et al. (1997) method

based on survival probability and interval between calving i and calving i+1

obtained from the complete career dataset
Comparison between traits

<table>
<thead>
<tr>
<th></th>
<th>SURV</th>
<th>NC78</th>
<th>NC150</th>
</tr>
</thead>
<tbody>
<tr>
<td>SURV</td>
<td>0.08</td>
<td>0.65</td>
<td>0.76</td>
</tr>
<tr>
<td>NC78</td>
<td>0.04</td>
<td>0.85</td>
<td></td>
</tr>
<tr>
<td>NC150</td>
<td></td>
<td></td>
<td>0.06</td>
</tr>
</tbody>
</table>

- Heritabilities low for all traits (not directly comparable between SURV and NC)
- Correlations between SURV and NC sire EBV’s are rather high
- Genetic correlation between NC78 and NC150 = 0.95

+ Practical point: easier to handle in the national genetic process (software, result explanation)

Choice of NC78 analyzed with Linear model for national genetic evaluation
Practical results – Heifer Calving Success
Heifer Calving Success for CHA and AUB breeds

<table>
<thead>
<tr>
<th>Birth year</th>
<th>Percent</th>
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<tbody>
<tr>
<td>2000</td>
<td>50</td>
</tr>
<tr>
<td>2001</td>
<td>55</td>
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<tr>
<td>2002</td>
<td>55</td>
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<td>2003</td>
<td>60</td>
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<td>2007</td>
<td>55</td>
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<tr>
<td>2008</td>
<td>60</td>
</tr>
<tr>
<td>2009</td>
<td>55</td>
</tr>
<tr>
<td>2010</td>
<td>50</td>
</tr>
</tbody>
</table>
EBV and REL – HCS - CHA

EBV distribution

REL distribution

=> same pattern for Aubrac with lower Reliabilities
HCS Sire reliability distribution

Only 18 AUB sires (1.1%) and 2,514 CHA sires (10.7%) with reliability above 0.3.
HPR genetic trends for CHA and AUB sires

(Standardized EBV: mean=100 and std = 10
Reference population: females born between 2001 and 2011 with perf)
Practical results – Productive Life
NC78 for CHA and AUB breeds

<table>
<thead>
<tr>
<th>Birth year</th>
<th>CHA</th>
<th>AUB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1988-1989</td>
<td>2.8 ± 1.2</td>
<td>3.4 ± 1.0</td>
</tr>
<tr>
<td>1990-1999</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000-2009</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NC 78 mean
EBV and REL – NC78 - CHA

EBV distribution

REL distribution

Progenies of AI sires

=> same pattern for Aubrac
NC78 Sire reliability distribution

2,898 AUB sires (35%) and 25,502 CHA sires (36%) above 0.3 reliability
NC78 genetic trends for CHA and AUB sires

(Standardized EBV: mean=100 and std = 10
Reference population: females born between 2001 and 2011)
Conclusions

• Data now available in the national database to work on fertility and productive cow life

• Analysis of number of calves along cow career with survival analysis or number of calves at a target age with linear model

  => good correlation  => Number of calvings at an “early stage” 78 months

• Heritabilities are similar for all breeds (specialized / hardy breeds)

• Heritabilities are low: 0.015 for HCS and 0.04 for NC78

• EBV reliabilities are low

  => results will be mainly used for planned mating

• Discussion now with partners on publication rules

  => genetic evaluation in practice at the end of this year
THANK YOU

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