RFI divergent lines in sheep and relationship with TMR RFI: first results

(Residual feed intake, Total mixed ration)

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background

• Lamb Production costs (fixed costs excluded):
  • Feeding costs = 60 to 80%
• Meat sheep selection programmes: traits such as growth and body composition
• One way to improve sheep industry: to increase the efficiency of feed transformation
• Indirect response: growth, body composition
• Go further:
  ▶ Feed intake
  ▶ Feed Conversion Ratio = FI/ADG
  ▶ Residual Feed Intake
    □ different diets
feed intake phenotypes

• concentrated diet intake *ad libitum*
• automatic feeders, 1 feeder for 20-25 sheep
• young rams undergone to individual test for selection on
  - liveweight (LW)
  - growth
  - and body composition (us scan)
• between 90 and 150 days of age
• $h^2 = 0.43$ (François et al, 2002)
residual feed intake

Feeders provide detailed data each meal: ram identity, intake (g), duration (sec) allowing computation of daily feed intake (DFI)

Since DFI strongly correlates with LW (Rg=0.85), growth (Rg=0.83) and body composition multiple linear regression of DFI on these traits was performed and residual feed intake (RFI) was expressed as the residue of the regression

<table>
<thead>
<tr>
<th>diet</th>
<th>RFI h²</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentrate + hay</td>
<td>0.30 ± 0.06</td>
<td>François et al, 2002, 7WCGALP</td>
</tr>
<tr>
<td>Low energy concentrate</td>
<td>0.46 ± 0.04*</td>
<td>François et al, 2006, 8WCGALP</td>
</tr>
<tr>
<td>Low energy concentrate</td>
<td>0.23**</td>
<td>François et al, 2012, EAAP</td>
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</tbody>
</table>

*low estimate of ADG h²=0.16
**realised heritability
“Well, interesting for fattening lambs”, but breeders say: “what is the impact for feeding the flock (majority ewes) with different diets including fodder? ”

What about the relationship between RFI_cc and RFI_tmr?

2013: no sheep feeder-recorder for total mixed ration (TMR) on the market

the institute has been developing one through the “FOURRAGRO” INRA-funded project
Total mixed ration sheep feeder prototype

TMR : mixing trailer for feeding indoor ewes fodder (chopped hay) + concentrate

Infra-red sensor:
presence detection (data event),
starts weighing events recording

Electronic Id:
tags, antenna

Data system
Trough and RFID antenna
Protocol and device adjustments

- Nb sheep/feeder: 10 then 8
- TMR composition 65 % fodder 35% cc :
  goal ADG 100 g / sheep LW60 kg
- data reliability: quick successive visits may induce deviations
  3 events recorded/s, 4s are needed to have weights stability: due to abnormalities of weighing data events, 5 % visits were considered as not reliable
  1 % visits were rejected because of multiple id : IR sensor having not detected new animal
  solution: slow down animal flow by a door with sensor (and remove the IR sensor)
  increase of reliability to 99, 8 % (0,2% data rejected)

- early 2016: lower quality fodder, sheep takes it but waste stems under it
  adopted solution: restrict width of the head passage
divergent lines

• breeding Values estimated for males for LW, Average Daily Gain, Body composition (Conformation and Backfat), RFIcc
• extended RFIcc EBV for the whole flock (rams & ewes)
• based on RFIcc EBV, two divergent lines have been established in the experimental flock in 2014 with 5 rams and 60 ewes per line
- 4 feeders have been developed
- feed intake TMR measurements have started with the lambs of the two lines born in 2015 following this schedule

* 32 or 38 selected as extremes among 90 following divergent lines & RFIcc
# first results

## 2015 males batch

<table>
<thead>
<tr>
<th>variable</th>
<th>Unfavorable RFI_cc (N=14) Mean ± std [min ; max]</th>
<th>Favorable RFI_cc (N=16) Mean ± std [min ; max]</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADG (g)</td>
<td>174 ± 62 [98 ; 266]</td>
<td>164 ± 58 [75 ; 284]</td>
</tr>
<tr>
<td>Final weight (hg)</td>
<td>715 ± 84 [591 ; 858]</td>
<td>704 ± 65 [612 ; 819]</td>
</tr>
<tr>
<td>DFI (g/j)</td>
<td>2351 ± 332 [1694 ; 2924]</td>
<td>2077 ± 342 [1394 ; 2685]</td>
</tr>
<tr>
<td>RFI_tmr (g/j)</td>
<td>124 ± 190 [-121 ; 415]</td>
<td>-108 ± 225 [-425 ; 301]</td>
</tr>
</tbody>
</table>
**first results**

**2015 males batch**

- Significant line effect
- $R(\text{RFI}_{cc}, \text{RFI}_{tmr}) = 0.41$

**2015 females batch**

- 1st CC feeder females data
- TMR

  - Non significant line effect
  - $R(\text{RFI}_{cc}, \text{RFI}_{tmr}) = 0.17$

**2016 phenotypes in progress**
Conclusion

Correlation between RFI concentrate and RFI TMR was 0.41 for males and 0.17 for females suggesting that probably DFI of both diets should be phenotyped to improve genetics of feed efficiency
Prospects
- add a convoyer to fill the trough
- description of feeding behaviour
- link RFI with microbiota diversity
- link RFI with methane emissions