Modelling herbage intake for predicting performance: the example of INRAtion software

Rémy DELAGARDE, Philippe FAVERDIN, Christine BARATTE, Jean-Louis PEYRAUD

INRA, UMR Production du Lait, Saint-Gilles, France
History

From 30 years: INRA Fill and Feed Unit systems
All ruminants, all feeds
Only indoors feeding
INRAtion software

2000-2003:
Grazemore European project (Mayne et al.)
Development of GrazeIn model (Peyraud et al.)

2007: Inclusion of GrazeIn model in INRAtion 4.0

2011: Full model published in Grass and Forage Science (Faverdin et al., Delagarde et al.)
The principles of INRA Fill Unit system (voluntary intake prediction)

Intake Capacity =

( Pasture Intake \times \text{Fill Value P} )

+ ( Forage Intake \times \text{Fill Value F} )

+ ( Concentrate Intake \times \text{Fill Value C} )

Cows characteristics

Chemical composition

Inputs

Substitution rate (energy balance)
Adaptation to grazing situations

- **Principle**: grazing intake = relative to voluntary intake

- **2 grazing systems**: rotational and continuous

- For each grazing system, **2 sources of limitations**:  
  - Pasture availability (allowance, mass)  
  - Time availability (access time)
General framework of the INRAtion pasture intake model

Cow intake capacity
(potential MY, LW, BCS, parity ...)

Pasture ingestibility
(fill value)

Supplementation
Concentrate
Forages
(amount, feed values)

Grazing conditions
(Pasture and time availability)

Indoors voluntary intake

Intake at grazing
(relative to VI)

Energy balance

substitution rate

(a)
Prediction of grazing conditions effects on herbage intake by grazing dairy cows

Relative herbage intake (% indoors voluntary herbage intake)

Relative HA > 2 cm (% VHI)

Daily access time (h)

Sward surface height (cm stick)

Rotational

Rotational+ Set-stocking

Set-stocking
## Factors affecting herbage intake at grazing

<table>
<thead>
<tr>
<th>Animal</th>
<th>Sward</th>
<th>Grazing management</th>
<th>Supplements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Botanical comp Species</td>
<td>Grazing system</td>
<td>Forages</td>
</tr>
<tr>
<td>Parity</td>
<td>Species</td>
<td>Stocking rate</td>
<td>Concentrates</td>
</tr>
<tr>
<td>LW</td>
<td>OMD</td>
<td>H. Allowance</td>
<td>(amount, nutritive values)</td>
</tr>
<tr>
<td>BCS</td>
<td>Fibre</td>
<td>Residence time</td>
<td></td>
</tr>
<tr>
<td>Growth</td>
<td>CP</td>
<td>Time of access</td>
<td></td>
</tr>
<tr>
<td>Peak milk</td>
<td>DM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIM</td>
<td>Sward height</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breed</td>
<td>Herbage mass</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strain</td>
<td>Bulk density</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>% dead</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>% lamina</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Weather

- Season, Temperature, Rain, Wind
Other INRA grazing intake models for dairy cows

INRA Feed Tables 2007:
Simplified equations from INRAtion model based on pre- and post-grazing sward height
(english version in 2010-2011)

Pâtur’In (Delaby et al.):
Software to assist grazing management of dairy cows
(herd, paddocks, pasture growth, decision rules)
Prediction of dairy cows pasture intake according to pre- and post-grazing sward height

\[ PI = \frac{IC}{17} \times (38.78 + 16.83 \times FV) + \frac{39.7}{PoH^2} + \frac{631}{PrH^2} - \frac{2.1}{PoH} - \frac{459}{PrH \times PoH} \]

Pre-grazing sward height (cm)

Post-grazing sward height (cm)

Kg DMI: 18

INRA Feed Tables
Discussion: Validation

• **Objectives**: Precision, robustness
  
  Time-consuming, but necessary (improvements)

• **Internal validation**
  
  Simulations (virtual experiments)
  
  ⇒ Response laws to inputs and interactions

• **External validation**
  
  Predicted vs. actual values (independent data)
  
  Global precision

  (INRAtion: 304 herds, TEAGASC and INRA, actual DMI 10-22 kg
  MPE: 11% MPE, 1.6 kg DM)
Discussion:
What we need to predict?

• **Objective of the model:**
  Grazing processes, grazing management
  Scale of approach (possible integration?)
  minute ↔ day ↔ year
  Need for different input variables
  (research model, practical tool?)

• **Milk production:**
  Responses law from energy and protein supply
  (relative to potential production)
  Not yet included in INRAtion
Thank you for your attention