Construction of individual breeding values for feed intake of Piétrain boars based on mean pen feed intake, weight and weight gain test station records

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General context

- Importance of feed efficiency (FE) in livestock production
- Feed intake (FI) is a component of FE
- Selection to reduce FI with growth rate constant
- Individual FI records needed
**Context of the study**

- **Progeny-test** of Piétrain boars in test station
- **No** facilities to record **individual FI**
  - Total pen FI records
  - Individual mean pen FI
- **FI different** between pigs in same pen
- **FI genetically related to important traits** (e.g. live weight, weight gain...)

**Objective**

To predict **reliable individual genetic merit** of Piétrain boars for FI based on **mean pen FI**, **weight** and **weight gain** records of their progeny.
Objective

To predict reliable individual genetic merit of Piétrain boars for FI based on mean pen FI, weight and weight gain records of their progeny

To compare heritability, estimated breeding values (EBV) and their reliability for FI estimated with different methods

Material

- Data collected
  - In the Walloon test station
  - On crossbred progeny of Piétrain boars
- Total pen feed intake (kg)
- Number of pigs per pen
- Length of testing for each pig (d)
Material

- Trait definition:
  Individual Estimated Feed Intake (EFI) = Total pen feed intake / Number of pigs per pen
  Daily EFI = EFI / length of testing
- 1397 records of daily EFI (g/d)

Methods

- Model 1

\[ y = Xb + Za + e \]

**Observation:**

- Estimated feed intake (EFI) (g/d)
Methods

- Model 1

\[ y = Xb + Za + e \]

**Fixed effects:**
- Sex
- Pen where pigs were tested

**Random effects:**
- Vector of additive genetic effects
Methods

- **Model 1**

\[ y = Xb + Za + e \]

**Random effects:**
- Vector of additive genetic effects
- Vector of random residual effects

Methods

- **Model 2 = Model 1**
  - + **Average daily gain** (kg/d) between 100 and 210 d (ADG)
  - + **Live weight** (kg) at 100 d (LW100) as linear covariables
- ADG and LW100 expressed **in breeding value**
Methods

- Model 2
  - By correcting for ADG and LW100, estimated breeding values = \textit{Residual feed intake (RFI)}
  - \textit{RFI} = Observed feed intake – Predicted feed intake based on maintenance and production requirements

Methods

- Construction of index combining
  - \textit{RFI} (g/d)
  - LW100 (kg)
  - ADG (kg/d)
    - weighted by regression coefficients estimated in Model 2
  \textbf{Index feed intake (IFI)}

- Heritability and reliability of IFI function of index weighting coefficients
Results: descriptive statistics

\[ N = 1397 \]

<table>
<thead>
<tr>
<th>Trait</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>EFI (g/d)</td>
<td>1876.8</td>
<td>177.5</td>
<td>1329</td>
<td>2444</td>
</tr>
<tr>
<td>ADG (kg/d)</td>
<td>0.651</td>
<td>0.035</td>
<td>0.523</td>
<td>0.762</td>
</tr>
<tr>
<td>LW100 (kg)</td>
<td>41.7</td>
<td>3.96</td>
<td>29.1</td>
<td>54.4</td>
</tr>
</tbody>
</table>

EFI = Estimated Feed Intake; ADG = Average Daily Gain between 100 and 210 d; LW100 = Live weight at 100 d

Results: Index equation

IFI = Index Feed Intake (g/d)

\[ IFI = RFI + 2.61 \times LW100 + 214.37 \times ADG \]

Regression coefficients from Model 2, used as weighting coefficients to estimate IFI
### Results: Heritability

<table>
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<tr>
<th>Method</th>
<th>Heritability</th>
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<tbody>
<tr>
<td>Model 1</td>
<td>0.08</td>
</tr>
<tr>
<td>Model 2</td>
<td>0.06</td>
</tr>
<tr>
<td>Index</td>
<td>0.09</td>
</tr>
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</table>

- Heritability of FI low compared to litterature values (averaging 0.29; ranging from 0.13 to 0.62)
- Heritability with Index the closest to litterature values
Results: Reliability of EBV

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<td>0.16</td>
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N = 56

With **Model 1** mean reliability of EBV was too low to base reliable selection decision.

With **Model 2** mean reliability of EBV was lower than reliability obtained with **Model 1**.
**Results: Reliability of EBV**

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<td>LW100 (kg)</td>
<td>0.72</td>
<td>0.08</td>
<td>0.43</td>
<td>0.89</td>
</tr>
<tr>
<td>ADG (kg/d)</td>
<td>0.71</td>
<td>0.08</td>
<td>0.39</td>
<td>0.86</td>
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*N = 56; LW100=Live weight at 100 d; ADG=Average daily gain between 100 and 210 d*

**Breeding values for LW100 and ADG were highly reliable**

**Results: Reliability of EBV**

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<td>0.35</td>
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*N = 56; LW100=Live weight at 100 d; ADG=Average daily gain between 100 and 210 d*

**By combining RFI with ADG and LW100 reliability of EBV was increased**
Conclusions

- **Heritability** of FI is **low** with the 3 tested methods.

- **Index** combining genetic values of:
  - RFI
  - LW100
  - ADG

-> Increasing heritability and reliability of EBV for FI

Conclusions

**Index** combining genetic values of LW100 and ADG with RFI allows to have more reliable prediction of **individual genetic merit** of Piétrain boars for FI.
Perspectives

- To include competitive effect into the model
  - Feed limitations
  - Competition relationships between pigs in a pen influence FI

- To get FI records corresponding to weight records
  - Weights are recorded every 15 days
  - Growth rate and FI are genetically related
Thank You For Your Attention!

- **Collaboration:**
  - Walloon Pig Breeders Association (AWEP)
  - Walloon Agricultural Research Centre (CRA-W)
  - ULg - Gembloux Agro-Bio Tech (GxABT)

- **Study supported by:**
  - Walloon Region of Belgium
  - National Fund for Scientific Research (FRS-FNRS)

- **Author’s contact:** marie.dufrasne@ulg.ac.be