ON-FARM RECORDING OF NOVEL TRAITS – GENETIC PARAMETERS AND RECOMMENDATIONS

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Overview

• On-farm data recording in project “Efficient Cow“
• Results on body weight (BW), body condition score (BCS) and lameness score (LSC)
• Results on claw health
• Results on metabolism
• Results on feed efficiency traits collected on-farm
• Lessons learned from on-farm-recording of novel traits
Efficient cow project (2012-2016)

- Elaboration of efficiency parameters
- Evaluation of the optimal body weight to achieve the highest nutrient and energy efficiency
- Analyses of genetic possibilities to improve production efficiency
- Relationship between efficiency and functional traits
- Analyses of environmental impact of cattle production under Austrian conditions
Approach – field data for novel traits

- **Preselection of farms** with higher degree of phenotype recording (AMS, health recording,..)

- **Distribution** of farms across different **production conditions** and levels of intensity in Austria

- Extended data recording on-farm on **170 farms in Austria** with app. 5,500 cows for one year (1.1.2014 – 31.12.2014)
  - 3,200 Fleckvieh (Simmental)
  - 1,200 Brown Swiss
  - 1,100 Holstein

- Comparison with data of limited number of cows from **research stations**
Data recorded

- General information about farm (housing, feeding, ...)
- Recording of direct health data (veterinarian diagnoses)
- Documentation of claw trimming
- BHB (β-hydroxybutyrate) test for ketosis
- Linear scoring of all cows across lactations
- At each time of milk recording in 2014
  - Body weight, body measures, body condition score, lameness scoring
  - diet and estimation of feed intake
  - Routine information about milk recording + MIR-spectra
- Austrian main breeds
  - Fleckvieh / Simmental (FL), Brown Swiss (BS), Holstein (HF)
### Observed data – Fleckvieh / Simmental

<table>
<thead>
<tr>
<th></th>
<th>COWS</th>
<th>N</th>
<th>LACT 1</th>
<th>LACT 2</th>
<th>LACT ≥3</th>
</tr>
</thead>
<tbody>
<tr>
<td>WEIGHT</td>
<td>3984</td>
<td>29,763</td>
<td>685 (±79)</td>
<td>734 (±83)</td>
<td>776 (±84)</td>
</tr>
<tr>
<td>WAIST</td>
<td>3981</td>
<td>30,031</td>
<td>251 (±14)</td>
<td>259 (±14)</td>
<td>265 (±13)</td>
</tr>
<tr>
<td>CHEST</td>
<td>3982</td>
<td>30,039</td>
<td>208 (±10)</td>
<td>212 (±10)</td>
<td>217 (±10)</td>
</tr>
<tr>
<td>MUSC 1-9</td>
<td>3977</td>
<td>29,866</td>
<td>5.58 (±1.21)</td>
<td>5.72 (±1.33)</td>
<td>5.89 (±1.4)</td>
</tr>
<tr>
<td>BCS 1-5</td>
<td>3981</td>
<td>30,044</td>
<td>3.32 (±0.52)</td>
<td>3.33 (±0.55)</td>
<td>3.37 (±0.62)</td>
</tr>
<tr>
<td>LAME 1-5</td>
<td>3981</td>
<td>29,768</td>
<td>1.13 (±0.43)</td>
<td>1.2 (±0.52)</td>
<td>1.42 (±0.77)</td>
</tr>
</tbody>
</table>
Body weight

• In Austria standard housing systems for dairy cows are without equipment for weighing routinely.

• During the observation period of the project “Efficient Cow”, all cows were weighed at each time of milk recording.
Lameness score (Sprecher et al. 1997)

Efficient Cow:
Lameness was recorded by trained staff from the milk recording organisations at each milk recording using the scoring system (Sprecher et al. 1997) with 1 = normal to 5 = severely lame.
Body condition score (BCS) (Edmonson et al. 1989)

Recorded at each milk recording by trained stuff. BCS 1= severe underconditioning; BCS 5 = severe overconditioning
Test for subclinical ketosis

Cows within “Efficient Cow” tested at day 7 and day 14 after calving with β-hydroxybutyrate (BHB μmol/l) milk test

- % of ketosis suspicious cows (>=100μmol/l) → 44 % !!
- % of ketosis suspicious cows (>=200μmol/l) → 14 % !!
Feeding information and feed efficiency

• Recorded on animal basis at each milk recording (Ledinek et al. 2016)
• Feed intake estimated using the model of Gruber et al. (2004)
• Dairy cow rations and forage analyses were included
• Dry matter intake (DMI) and energy intake (INEL) was calculated for each day of milk recording for each cow
• **Feed efficiency** was calculated as:
  • ECM_BWx: energy corrected milk related to metabolic body weight
  • ECM_DMI: ECM related to feed intake
  • LE_INEL: lactation energy related to energy intake
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Heritabilities and genetic correlations (Koeck et al. 2016) – Fleckvieh (Simmental)

<table>
<thead>
<tr>
<th></th>
<th>Body weight</th>
<th>BCS</th>
<th>Lameness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body weight</td>
<td>0.44 (0.05)</td>
<td>0.39 (0.08)</td>
<td>0.57 (0.13)</td>
</tr>
<tr>
<td>BCS</td>
<td></td>
<td>0.22 (0.03)</td>
<td>0.05 (0.15)</td>
</tr>
<tr>
<td>Lameness</td>
<td></td>
<td></td>
<td>0.07 (0.02)</td>
</tr>
</tbody>
</table>

Heavier cows have an increased risk of lameness
Overview

• On-farm data recording in project “Efficient Cow“
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• **Results on claw health**
• Results on metabolism
• Results on feed efficiency traits collected on-farm
• Lessons learnt from on-farm-recording of novel traits
Traits available for claw health

• Veterinarian diagnoses from routine health monitoring
• Claw trimming data
• Lameness scores (Sprecher et al. 1997) at each milk recording by trained stuff
  • LSC - overall lactation lameness score was calculated per cow and lactation taking the frequency of different severity cases into account. The score ranges between 0 and 4 (Burgstaller et al. 2016).
• Culling information
### Heritabilities and genetic correlations (Fleckvieh Simmental)

<table>
<thead>
<tr>
<th>Trait</th>
<th>No Obs.</th>
<th>Mean</th>
<th>$h^2$ (se)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Claw diagnoses (0/1)</td>
<td>6,427</td>
<td>0.016</td>
<td><strong>0.025 (0.021)</strong></td>
<td>0.568 genetic correlation to LSC; 0.827 to claw trimming; 0.99 to culling</td>
</tr>
<tr>
<td>LSC (0-4)</td>
<td>2,963</td>
<td>0.994</td>
<td><strong>0.095 (0.092)</strong></td>
<td></td>
</tr>
<tr>
<td>Claw trimming (0/1)</td>
<td>2,451</td>
<td>0.51</td>
<td><strong>0.042 (0.013)</strong></td>
<td></td>
</tr>
<tr>
<td>Culling (0/1)</td>
<td>9,666</td>
<td>0.005</td>
<td>0.007(0.006)</td>
<td></td>
</tr>
</tbody>
</table>
Summary – novel traits claw health

- Lameness scores can be used as auxiliary traits for genetic improvement of claw health (depending on model and trait definition – heritability between 0.07 and 0.095)
- Heritability based on claw trimming data lower than in most other studies (0.042) (reason could be that data were recorded from trained claw trimmers and farmers in this study)
- Heritabilities of veterinarian diagnoses low (0.025), but available on a wide range of animals in Austria; but it covers only severe cases

Different data sources related to claw health can be used
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Metabolic disorders

- **Body condition score (BCS)**
  - Together with body weight
  - by trained technicians at each milk recording.

- **Metabolic disorders**
  An issue of growing concern
  - veterinarian diagnoses
  - indicator traits for subclinical ketosis cases:
    - **Milk test** (Elanco) at day 7 and 14 after calving (determination of β-hydroxybutyrate (BHB) concentrations).
    - **Body condition and fat-protein-ratio:**
      - BCS1 and F:P1
        BCS and fat-protein-ratio at the first recording after calving and
      - **BCS1DIFF**
        difference in BCS between the first and second recording after calving
# Heritabilities and genetic correlations

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</thead>
<tbody>
<tr>
<td>Metabolism vet. diagnoses (-100d) (0/1)</td>
<td>5670</td>
<td>0.048</td>
<td><strong>0.028</strong> (0.013)</td>
<td>0.59 genetic correlation to ketotest; -0.55 genetic correlation BCS1; 0.56 genetic correlation to BCS1Diff</td>
</tr>
<tr>
<td>Ketotest/Subcl. ketosis (0-2)</td>
<td>1,805</td>
<td>0.56</td>
<td><strong>0.064</strong> (0.026)</td>
<td></td>
</tr>
<tr>
<td>BCS1</td>
<td>2,491</td>
<td>3.331</td>
<td><strong>0.161</strong> (0.040)</td>
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</tr>
<tr>
<td>BCS1DIFF</td>
<td>2,169</td>
<td>-0.147</td>
<td><strong>0.042</strong> (0.026)</td>
<td></td>
</tr>
<tr>
<td>F:P1</td>
<td>7,187</td>
<td>1.281</td>
<td><strong>0.138</strong> (0.026)</td>
<td></td>
</tr>
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### Heritabilities and genetic correlations

<table>
<thead>
<tr>
<th></th>
<th>ECM</th>
<th>BW</th>
<th>DMI</th>
<th>INEL</th>
<th>ECM_BWx</th>
<th>ECM_DMI</th>
<th>LE_INEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECM</td>
<td>0.13</td>
<td>-0.22</td>
<td>0.66</td>
<td>0.72</td>
<td>0.88</td>
<td>0.89</td>
<td>0.89</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.10)</td>
<td>(0.06)</td>
<td>(0.06)</td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.03)</td>
</tr>
<tr>
<td>BW</td>
<td>0.43</td>
<td>0.50</td>
<td>0.40</td>
<td>-0.66</td>
<td>-0.66</td>
<td>-0.57</td>
<td>-0.56</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.07)</td>
<td>(0.08)</td>
<td>(0.06)</td>
<td>(0.08)</td>
<td>(0.08)</td>
<td></td>
</tr>
<tr>
<td>DMI</td>
<td>0.18</td>
<td>0.99</td>
<td>0.27</td>
<td>0.37</td>
<td>0.27</td>
<td>0.24</td>
<td>0.23</td>
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<tr>
<td></td>
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<td>(0.01)</td>
<td>(0.10)</td>
<td>(0.10)</td>
<td>(0.10)</td>
<td>(0.10)</td>
<td>(0.11)</td>
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<tr>
<td>INEL</td>
<td>0.13</td>
<td></td>
<td>0.37</td>
<td>0.33</td>
<td>0.37</td>
<td>0.33</td>
<td>0.32</td>
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<tr>
<td>ECM_BWx</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.18</td>
<td>0.97</td>
<td>0.96</td>
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<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
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<tr>
<td>ECM_DMI</td>
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<td></td>
<td>0.13</td>
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<td>(0.01)</td>
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<tr>
<td>LE_INEL</td>
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<td>0.11</td>
</tr>
</tbody>
</table>
Conclusions for practical implementation

- Data recording from about 5,300 cows under on-farm-conditions was a big challenge
- Recording of body weight was easier to handle than taking different body measures
- Body condition score and lameness score are interesting management tools but also usable for genetic evaluation
- Genetic correlation between ECM, DMI and BW from on-farm-data comparable to results from station-data
- Practical use of diet information would need also reliable information (especially on concentrates) and detailed information on mobilization
- Body weight has high impact on feed efficiency
Acknowledgement

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Thank you!