Genetic selection for lower methane emission in dairy cattle – ready for implementation?

Birgit Gredler-Grandl & ICAR Feed&Gas working group

47th ICAR meeting, 2024
2021 FAO Livestock e-Methane (kt)

Tier 1 emissions

➢ Total enteric methane emissions from 5 major livestock species was 97,384 (kt) in 2021.

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<th>Species</th>
<th>E-Methane Emissions (kt)</th>
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<td>Sheep</td>
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<td>Goats</td>
<td>5,556</td>
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Beef cattle 56%
Sheep total 19%
Dairy cattle 12%
Buffalo 7%
Goats total 6%
Scope – dairy cattle in Global North
Where to start?

- 1. Definition of production system
- 2. Definition of breeding goal
- 3. Collection of information
  - Phenotypes
  - Family relationships
  - Genotypes
- 4. Determining selection criteria
  - Genetic model
  - Breeding value estimation
- 5. Selection and mating
  - Predicting selection response
  - Consequences of mating decisions
- 6. Dissemination
  - Structure of breeding program
  - Crossbreeding
- 7. Evaluation
  - Genetic improvement
  - Genetic diversity
Number of CH₄ phenotyped - Holstein cattle

27,314 Holstein cattle
Number of CH$_4$ phenotyped cattle – Jersey and Nordic Red breeds

9,050
Jersey, Red Dairy, Finnish Red, Norwegian Red
Number of CH$_4$ phenotyped cattle – Fleckvieh and Brown Swiss

1,000 Fleckvieh and 200 Brown Swiss cows with GreenFeed

1,500 Brown Swiss cows with sniffers

Session 11: Pitch Kristina Linke

Session 11: Pitch Beat Bapst
<table>
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<tr>
<th>Country</th>
<th>Number of Cows</th>
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How to measure CH$_4$ in dairy cattle?

**Respiration chambers**

- open/closed indirect calorimetry
- Gold standard
- Not used large-scale
How to measure CH$_4$ in dairy cattle?

**SF6 tracer gas technique – SF$_6$**

- Air is sampled near nostrils
- Permeation tube containing SF6 is placed in rumen
- Pre-determined release rate of SF6 is multiplied by the ratio of CH4 to SF6 concentrations in the canister to calculate CH4 emission rate
- Australia, Belgium, ...
How to measure CH$_4$ in dairy cattle?

**GreenFeed** (C-Lock Inc., Rapid City, South Dakota, USA)

- Close to Gold Standard

- Sniffer system where breath samples are provided when animals visit a bait station

- Flux

- USA, CAN, IRE, ...
How to measure CH$_4$ in dairy cattle?

- Air is sampled during feeding
- Canada, Denmark, Netherlands, Spain, Switzerland
How to measure CH$_4$?
Is methane emission heritable?

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## Genetic correlations between other traits?

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Bakke et al., 2024

Gonzalez-Recio et al., 2024

Session 11: Anouk van Breukelen
How many cows with phenotypes do we need?

Gonzalez-Recio et al. (2014)
How many cows with phenotypes do we need?

Gonzalez-Recio et. al. (2014)
Proxies for methane emission – multi-trait approach

Methane BV

- MIR/NIR
- Microbiome
- Green Feed
- Sensors
- Novel approaches
- Sniffers
Definition of methane trait in the breeding goal?

**Methane production**
- g/day
- Easy to understand
- Climate targets

**Methane yield**
- CH4 per unit of input
- Ratio trait
- Industry reporting
Definition of methane trait in the breeding goal?

Methane intensity

- CH4 per unit of output
- Ratio trait
- Industry reporting

Residual methane

- Expected vs observed
- Difficult to interpret

![Graph showing methane production vs feed intake/body weight](image)
### Are we ready for implementation?

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**WAGENINGEN UNIVERSITY & RESARCH**

**Are we ready for implementation?**

**Efficiency!**

Ill make history by publishing the first ever genotypes for the Holstein breed. This will make Canada the first country to embark on reducing methane emissions.
• Farm LCA models
• Genetics as mitigation tool
• Policy maker and dairy chain

• International collaboration
• Standardisation of methods

• Trait definition
• Selection indices
• Breeding value estimation

• Genetic variation exists
• Genetic correlation to important traits

• Involve front runners/farmers asap
• Develop tools for effective use

Session 11: talks!
• Farm LCA models
• Genetics as mitigation tool
• Policy maker and dairy chain
Thank you for your attention

birgit.gredler-grandl@wur.nl