Beef Cattle Methane –
Current state of play.....

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- Ireland, UK, North America and Canada, New Zealand, South America (Uruguay), Australia
- Thanks to funders and organisation that have contributed to activities
So where are we now?

The race has already begun!
Carbon management – what happens now?

- Soil: Improved practices to store carbon
- Livestock: The major carbon converter, Improved sequestration, Natural environment
- Plants: Plants that help animals be more efficient

Supplements, Probiotics/Microbiome manipulation, Vaccines, Genetics, Productivity
The best is yet to come

**Biogenic Carbon Cycle**

- **Photosynthesis**
  - Carbon dioxide (CO₂) is captured by plants as part of photosynthesis

- **CO₂** (Carbon Dioxide)

- **CH₄** (Methane)
  - Carbon (C) is stored as carbohydrates by plants and consumed by ruminants
  - Cow manure and belches release carbon (C) as methane (CH₄)

- **Hydroxyl Oxidation**
  - Methane (CH₄) is converted into carbon dioxide (CO₂) after 12 years through hydroxyl oxidation
What do we want to improve?

• Life-time methane output

• Per unit of product?

• Per unit of resource use (intake, energy)?
Two main options for improvement

Indirect selection
Breeding program optimisation

Direct selection....
Breeding program optimisation
Genomic selection
Indirect selection

We have already been doing it!

- Increased production per cow
- Improved disease resistance
- Increased fertility

- Dilute fixed maintenance costs
  - Fewer cows to produce same product
- Reduced wastage of productive days
- Reduced wastage of infertile cows and fewer replacements
- More opportunities to select best cows
  - Sexed semen has helped

But we can get BETTER

- New indexes
- production system efficiency

- Lower environmental cost
“Without data you’re just another person with an opinion.”
– W. Edwards Deming
#PHENOTYPE IS KING!

Genotyypin aikakaudella fenotyyppi on kunigas

Genotyypiaikakaudella fenotyyppi on kuningas

Fenotype blijft de koning

En la era del genotipo ... ¡El fenotipo es el rey!

في عصر التركيب الجيني البيانات المظهرية هي الملك

Την εποχή του γονοτύπου, ο φαινότυπος είναι βασιλιάς!
Measurement Technologies

• Everything is just a proxy...... or estimate of life-time methane production

• Large focus on when, who, where, how often to record
So where are we now – global summary of recording...

• All countries → indirect selection and breeding program improvements
• Countries building references → Ireland and Australia
• Other countries at early stages → who, when, how often to record, many small projects, validating recording procedures, overlay to feed additive projects
• New Zealand – alternative recording tool (s) (P?..AC)
More happening that first meets the eye..... More investigation of potential needed

**South America (example)**
- Systems in place for improvement (Brazil, Uruguay and Argentina)
- Feed intake and production system improvement emphasis
- Plans to record some methane on progeny test programs
- Example - INYA Hereford Information Nucleus (Uruguay) - ~200 CH4 records
- Don’t forget other traits too – Adaptation
  - Heat stress, water intake, health and disease

**Some of Asia and Africa**
- Many small holder systems
- But in some countries → central breeding programs
- Cows are often wealth and core to improving living standard
North America and Canada
Megan Rolf (and her team at Kansas State), Christine Baes, John Crowley

• Many groups with a few GreenFeeds (both standard and pasture systems)
• Some with a few hundred records
• Working on collection protocol for a GreenFeed, particularly in grazing settings
• Reference building in the near future
New Zealand – P...AC

- AgResearch - 6 Accumulation Chambers suitable for cattle up to about 400 kg
- ~120 heifers through these chambers, twice a couple of weeks apart (July '23).
- Rumen contents and buccal samples
- Aim to look at the rumen microbiome analysis developed in sheep useful in cattle?
- Results chambers worked well, methane measurements were repeatable.
- So an excellent start, but a long way to go for genetic parameters, etc.
(Republic of) Ireland

- 34 Greenfeeds – no sniffers dairy, beef, dairy-beef - growing & mature animals – indoors & grazing

- To-date
  - >2000 indoor methane measures in growing animals (+feed intake, carcass, ultrasound, growth……)
  - Growing ~800 annually
  - All types of crossbreds (including dairy-beef)
  - >400 (and growing by several hundred annually) growing beef animals at grass (with some feed intake)
  - Small numbers of suckler cows (~500 dairy cows)
(Republic of) Ireland

- National multi-breed genomic evaluations launched for growing cattle in 2022
- Carbon sub-indexes for total merit indexes launched in 2024

- On-going research
  - Developing SOPs
  - Automatic loading of data to national database + meta-data (e.g., diet)
  - Correlations across life stages and diet type (i.e., pasture v indoors)
  - Genetic evaluations
Australia – North and South

ZERO NET EMISSIONS
Agriculture CRC
A reference population for Northern Australian Beef Cattle

- 4500 Animals to be phenotyped (Greenfeed) and genotyped, 750 to date

<table>
<thead>
<tr>
<th>Trait</th>
<th>Units</th>
<th>Heritability (std err)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>kg</td>
<td>0.67±0.25</td>
</tr>
<tr>
<td>Methane</td>
<td>Methane g/day</td>
<td>0.15±0.02</td>
</tr>
<tr>
<td>Methane intensity</td>
<td>Methane g/day/kg LWT</td>
<td>0.30±0.04</td>
</tr>
</tbody>
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Measurements and number of animals - South

• Past records (2012-2015)
  • 1,046 young Angus bulls and heifers - respiration chambers
  • 119 Angus heifers and 326 Angus steers - Greenfeed

• New animals (6-8000 – Greenfeed – 4yrs (began 2022)
  • ~1200-1350 steers measured from 6 breeds (Angus, Hereford, Charolais, Shorthorn, Wagyu and Brahman)
  • ~650-750 heifers measured on pasture per yr
• ~3000 animals with >5 records
• Heritability estimates 0.15-0.4 (depending on trait definition)
GreenFeeds

- 20 South, 10 North
- 10 old for training
A common theme (across countries) - Training animals is important and challenging
Daily data monitoring essential! (at (nearly) real time)

Cup drops per animal per day

Total cup drops per day for monitoring

C-Lock API - Automated pipelines, raw data
Summary

Two ways of managing emissions
• Optimising the breeding program (efficiency)
  indirect selection (Ire, UK, NZ, Aus, Ur, USA, Canada)
• Direct recording and selection

Current recording (everyone wants to)
• Two large programs (Aus, Ire) ~6000 records
• Lessons for recording – training, keep machines running, who to record
• Trait definition is important
• The whole system is important
• It’s hard to go back to record the past – so planning is key – collect as much as you can!