**e-Cow:** a web-based model to predict performance of grazing dairy cows with and without supplements
e-Cow: a web-based model to predict the performance of grazing dairy cows

Available online at http://www.e-cow.net
e-Cow: a web-based model to predict the performance of grazing dairy cows

Grazed pasture cheapest source of feed

Conversion of non-human feed (pastures) into milk and beef
e-Cow: a web-based model to predict the performance of grazing dairy cows

BUT

Synchronisation between pasture growth and cow’s demand is required

Growth rate (kg/day)

Seasonal calving

Pasture growth

Pasture demand
**e-Cow**: a web-based model to predict the **performance** of grazing dairy **cows**

(Milk yield (kg/lactation)

Calving interval (months)

Sample of US herds

(Lucy et al., 2001)
Grazing systems, low cost but
   Require seasonal calving
   Set constraints to modern cows

Supplements crucial
body condition score and reproductive efficiency
Genotype x environment interactions
objectives
e-Cow
Objectives

To develop an animal model

What for?

- Simulate cow responses to changes in feed supply
- Explore genotype x environment interactions

How?

- Strong scientific base
- Genetic & nutritional drives
- User-friendly
- Web-based
e-Dairy: Whole farm model

e-Cow: Animal model
methodology

e-Cow
Mechanistic model: Represents biology
Empirical model: mathematical/statistical equations
Dynamic model: over one year (daily simulation)
Level: animal
Stochastic - Pasture allowance
**e-Cow**: a web-based model that predicts the performance for grazing dairy cows

**PREDICTION**

- Herbage intake
- Milk, fat and protein yields
- Live weight and body condition score

- Daily basis
- Whole-lactation
- Holstein-Friesian

http://www.e-cow.net
Integrates 3 models to predict:

1. Dry matter and energy intake model (Baudracco et al., 2010)


3. Body lipid change model (Friggens et al., 2004)
If intake is different to demand

Milk yield and body lipid change are reduced/increased

Iteration: loop until intake = demand
e-Cow – Model description

- Energy for maintenance, Pregnancy and Growth
- Energy intake
- Energy from/to BCS change (genetic drive)
- Potential milk yield
- Energy demand
- Energy to milk
- Actual Milk yield
- % Milk fat
- % Milk protein
- LW change
- BCS change
- ME/kg LW gain/loss
- kg LW/unit BCS

Balance = Intake – demand

ITERATION

Energy to milk yield

Energy from/to BCS

Nutrition & Genetics

Genetics
How to use the e-Cow model online?

Simple

5 minute training
Outputs screen

Inputs used (click to show)

Export daily outputs to spreadsheet

Daily outputs (run 9)

Body condition score & live weight

Annual outputs (click to show)

Milksolids

Days after calving

kg MS/cow/day
### Annual outputs (click to hide)

**Cow**

- Pot. yield (kg/cow/y): **9812**
- Milk yield (kg/cow/y): **6986**
- Milk fat (kg/cow/y): **247**
- Milk protein (kg/cow/y): **246**
- Milk fat (%): **3.53**
- Milk protein (%): **3.53**
- Milksolids (kg/cow/y): **493**

### Use of energy consumed

- **Milk**
- **LW gain**
- **Maint. and Preg.**

### Feeds and intake

- DM Concent. (kg/cow/y): **768**
- DM Silage (kg/cow/y): **351**
- DM Hay (kg/cow/y): **0**
- DM Herbage (kg/cow/y): **4961**
- Total DM (kg/cow/y): **6081**
- Grazing efficiency lactating(%): **32**
- Grazing efficiency dry(%): **35**

### Diet composition (DM basis)

- **Herbage**
- **Silage.Hay**
- **Concentr.**
e-Cow – Inputs

Cow
- Genotype of Holstein Friesian (NA or NZ)
- Live weight at calving
- Potential yields of milk, fat and protein
- Body condition score (BCS) at calving
- Conception date (days after calving)
- Dry-off date (milk yield or BCS limit)

Feeds
- Feeding periods
- Herbage allowance (mean and SD - stochastic)
- Neutral detergent fibre of feeds
- Metabolisable energy of feeds
- Supplements offered (amount and utilisation)
validation
e-Cow
NZ strain trial dataset (Macdonald et al., 2008)

Data from 3 years (3 parities)

Two strains

- North American (NA) \(> 90\%\) NA genetics
- New Zealand (NZ) \(\leq 13\%\) NA genetics
<table>
<thead>
<tr>
<th></th>
<th>Milk yield</th>
<th>Pasture intake</th>
<th>LW change</th>
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<tbody>
<tr>
<td></td>
<td>NA</td>
<td>NZ</td>
<td>NA</td>
</tr>
<tr>
<td>R</td>
<td>0.88</td>
<td>0.82</td>
<td>0.89</td>
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<tr>
<td>CCC</td>
<td>0.74</td>
<td>0.77</td>
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</tbody>
</table>

**CCC** = Concordance correlation coefficient reflects both:
- Degree to which predicted Vs actual values cluster about regression line
- Degree to which the regression line adheres to the 45° line through origin
Milk yield

CCC = 0.76
Pasture dry matter intake

Pasture intake (kg DM/cow/day)

Days in milk

Predicted

Actual

CCC = 0.80
Live weight change (kg/cow/day)

Days in milk

Predicted

Actual

CCC = 0.62
simulations

e-Cow
Example using:

- High pasture allowance (25 kg/cow/day)
- High pasture quality (11 MJ ME/kg)
- 2 Holstein-Friesian strains
  - North American HF
  - New Zealand HF

http://www.e-cow.net
Milk solids = milk fat + milk protein

- North American HF
- New Zealand HF

kg supplement (cow/ day)

Milk solids (kg/cow/yr)
Milk yield kg/cow/d

Days in milk

- North A. – 6 DM kg
- New Z. – 6 DM kg
- North A. – 0 DM kg
- New Z. – 0 DM kg
e-Cow - Simulations

BCS (1-5)

New Z. – 6 DM kg
New Z. – 0 DM kg
North A. – 6 DM kg
North A. – 0 DM kg
Practical use of the e-cow model

Teaching

University students

Perform simulations to understand:

- Effects of amount of feed offered
- Effects of feed intake
- Effects of feed quality
- Effect of cow’s genetic merit

on
Milk yield
Live weight
BCS
Practical use of the e-cow model

Applied research

- Effects of feeding level on estimated breeding values
- 5,000 cows with known breeding values
- Predict performance of individual cows at 4 feeding levels
- Genetic evaluation to recalculate breeding values & to estimate breeding values for feed intake and FCE
- Estimation of G x E (reaction norms)
conclusions

e-Cow
Quick simulation of

Response of cows

of

different genetic potential

under

different feeding systems

Conclusions
Useful for

Teaching

Applied research

Extension
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Questions?
e-Cow