Update of Economic Breeding Index

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<table>
<thead>
<tr>
<th>Sub-index</th>
<th>Trait</th>
<th>Weight</th>
<th>Emphasis</th>
<th>Emphasis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td>Milk (kg)</td>
<td>-0.09</td>
<td>11%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fat (kg)</td>
<td>1.04</td>
<td>3%</td>
<td>33%</td>
</tr>
<tr>
<td></td>
<td>Protein (kg)</td>
<td>6.64</td>
<td>19%</td>
<td></td>
</tr>
<tr>
<td>Fertility</td>
<td>Calving interval (d)</td>
<td>-12.43</td>
<td>24%</td>
<td>35%</td>
</tr>
<tr>
<td></td>
<td>Survival (%)</td>
<td>12.01</td>
<td>11%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Calving difficulty dir (%)</td>
<td>-3.52</td>
<td>3%</td>
<td></td>
</tr>
<tr>
<td>Calving</td>
<td>Calving difficulty mat (%)</td>
<td>-1.73</td>
<td>1%</td>
<td>9%</td>
</tr>
<tr>
<td></td>
<td>Gestation (d)</td>
<td>-7.50</td>
<td>4%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Calf mortality (%)</td>
<td>-2.58</td>
<td>1%</td>
<td></td>
</tr>
<tr>
<td>Maintenance</td>
<td>Cow (kg)</td>
<td>-1.65</td>
<td>7%</td>
<td>7%</td>
</tr>
<tr>
<td></td>
<td>Carcase weight (kg)</td>
<td>1.38</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>Beef</td>
<td>Carcase conformation (units)</td>
<td>10.32</td>
<td>2%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Carcase fat (units)</td>
<td>11.71</td>
<td>1%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cull cow (kg)</td>
<td>0.15</td>
<td>1%</td>
<td></td>
</tr>
</tbody>
</table>
## Breeding Objectives

<table>
<thead>
<tr>
<th>Country</th>
<th>CAN</th>
<th>USA</th>
<th>NLD</th>
<th>UK</th>
<th>AUS</th>
<th>NZL</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>0.84</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NLD</td>
<td></td>
<td>0.87</td>
<td>0.87</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td>0.85</td>
<td>0.85</td>
<td>0.82</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AUS</td>
<td>0.74</td>
<td>0.64</td>
<td>0.69</td>
<td>0.75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZL</td>
<td>0.49</td>
<td>0.44</td>
<td>0.44</td>
<td>0.54</td>
<td>0.78</td>
<td></td>
</tr>
</tbody>
</table>

The Irish Agriculture and Food Development Authority
## NextGen results - 2016

<table>
<thead>
<tr>
<th></th>
<th>National Average</th>
<th>Elite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days in milk</td>
<td>150</td>
<td>153</td>
</tr>
<tr>
<td>Milk solids to date (kg)</td>
<td>277</td>
<td>293</td>
</tr>
<tr>
<td>Fat %</td>
<td>4.12</td>
<td>4.41</td>
</tr>
<tr>
<td>Protein %</td>
<td>3.41</td>
<td>3.57</td>
</tr>
<tr>
<td>Live-weight</td>
<td>534</td>
<td>514</td>
</tr>
<tr>
<td>BCS</td>
<td>2.81</td>
<td>2.95</td>
</tr>
<tr>
<td>Submission 3 weeks (%)</td>
<td>91</td>
<td>96</td>
</tr>
<tr>
<td>6 wk in-calf rate (%)</td>
<td>51</td>
<td>77</td>
</tr>
<tr>
<td>9 wk in-calf rate (%)</td>
<td>69</td>
<td>91</td>
</tr>
</tbody>
</table>
NextGen results - 2016

6-wk in calf rate

Year

2013 2014 2015 2016

The Irish Agriculture and Food Development Authority
Economic values

• Milk price (29.5 c/l)
  • International projections (e.g., RaboBank) does not suggest otherwise

• Feed prices (€250/t)
  • No reason to change

• Farmer feedback
  • Live-weight
Missing suites of traits

- Product quality
  - Fatty acid content, protein profile, processing ability
  - BreedQuality
- Environmental load (incl. feed intake)
  - Methane, nitrogen, feed intake
  - RapidFeed
- Health (incl. disease) and welfare
  - Production diseases
  - HealthyGenes
Animal health

Genetics creates the potential

Management realises the potential

Disease destroys the potential

Animal health is the “new fertility”
...and breeding has a role in its control
Breeding possible??

**Fertility ~3%**

Limiting factor is data!
Categories of traits

• Close to implementation
  • TB, cystic ovaries

• Data available but no genetic parameters
  • Johnes, IBR, cow health traits, calf health traits, claw health

• Data not available and no genetic parameters
  • Liver-fluke, pneumonia, neospora, salmonella,
Animal Health

Lameness

Mastitis

Predicted probability of TB

Cow Incidence

Herd incidence

Worse 10% PTA

31%

13%

Best 10% PTA

5%

8%

Daughter prevalence

Daughter prevalence
Liver-fluke

Number of sires

Predicted probability of Fluke

Cow Incidence

Herd incidence

Worse 10% PTA

41%

45%

Best 10% PTA

47%

48%

≥ 30 daughters
≥ 10 herds
N=86
IBR

14% heritable
Hoof disorders

50% of cows had at least one hoof-disorder

Overgrown
Bruising
White Line
Breeding for reduced lameness

Overgrown: 8% heritable
Bruising: 24% heritable
White Line: 21% heritable
Including lameness and mastitis in a profit index for dairy cattle

A. W. Stott\textsuperscript{a1} \textsuperscript{c1}, M. P. Coffey\textsuperscript{a2} and S. Brotherstone\textsuperscript{a2}

Better information is needed on the influence of cow age (parity) on incidence of disease and on the probability of involuntary culling to determine the appropriate balance between the EVs for longevity and health. Currently, 16% of the weight in \textpounds PLI is attributable to non-production traits. In our revised index this weight increased to 23%. Even so, selection using this index is still predicted to result in an increase in mastitis and lameness, albeit at a very low rate. This situation may be changed by the introduction of fertility into \textpounds PLI and through better information about health traits. Incorporation of consumer preference into \textpounds PLI may require traits associated with health and welfare of the cow to receive more weight than their EV would suggest in order to maintain or improve health traits in national selection programmes.
Product quality
Saturated fatty acid content

National Average
Elite
P<0.05
Casein content

Proportion

Casein content

National Average
Elite
P<0.001
Omega-3 content in fat

National Average
Elite

P=NS
Mid-infrared spectroscopy (MIR)

- Fatty acids
- Protein composition
- Coagulation properties
Feed intake and efficiency
Feed intake and efficiency

Feed intake for same yield and body size

1.5 t DM/lactation
6 t DM/cow
Fat:protein and energy balance

Milk fat content

Milk protein content

Predicted Energy Balance
True & MIR-predicted Energy Balance

Energy Balance MJ/day

Week of Lactation

JDS. 98: 1310-1320
True & MIR-predicted Energy Intake

Week of Lactation

JDS. 98: 1310-1320
Intake predicted for Belgian Holsteins

![Graph showing effective energy intake (MJ/d) over days in milk for different parities: Parity 1, Parity 2, Parity 3. The graph indicates an increase in intake up to around 150 days, followed by a decrease. The data is from ADSA 2013 (Bastin).]
# Genetic parameters

<table>
<thead>
<tr>
<th>Heritability</th>
<th>True</th>
<th>Predicted (IRL)</th>
<th>Predicted (BEL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Intake</td>
<td>0.35(0.02)</td>
<td>0.20 (0.01)</td>
<td>0.20</td>
</tr>
<tr>
<td>Energy Balance</td>
<td>0.16(0.02)</td>
<td>0.10(0.01)</td>
<td>0.43</td>
</tr>
<tr>
<td>RFI</td>
<td>0.10(0.05)</td>
<td>0.16(0.01)</td>
<td></td>
</tr>
</tbody>
</table>

- $r_g$ True & predicted EB = 0.54
- $r_g$ True & predicted intake = 0.84

*JDS. 98: 1310-1320*

*WCGALP 2014 (McParland)*

*ADSA 2013 (Bastin)*
Validation of genetic evaluations

- Breeding values predicted for intake
  - 198 animals with actual intake recorded
  - MIR predicted intake for these animals removed from genetic evaluation

<table>
<thead>
<tr>
<th>EBV (MJ/d)</th>
<th>Actual intake (MJ/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>-1.5</td>
</tr>
<tr>
<td>Medium</td>
<td>4.4</td>
</tr>
<tr>
<td>High</td>
<td>10.2</td>
</tr>
</tbody>
</table>
International Genomic Evaluations

Accuracy of prediction

- Single country
- Multi-country
- No country phenotypes

Countries: Canada, Wisconsin, Denmark, Germany, Iowa, UK, Ireland, Netherlands
Conclusions

- Breeding is for 7-10 years' time
- What will the likely issues be?
- Animal health and disease, feed intake and efficiency, product quality