Genetic Improvement in Cattle.

Dr Andrew Cromie, Technical Director ICBF & Chairman of Interbeef.
Genetic Improvement in Cattle; Key requirements.

• Close collaboration.
  – Many parts to supply chain, especially in cattle.
  – Examples; ICAR (Interbeef) & ICBF.

• Some basic principles (using ICBF as an example).
  – Accurate identification, performance data, genetic evaluations & breeding Programs.

• Summary & discussion.
ICAR fact sheet

- ICAR: The International Committee for Animal Recording
- Non-Governmental Organization (INGO)
- Formed on March 9th, 1951, in Rome
- ICAR is composed of 117 Members from 59 countries; 30 Associate Members, 87 Full Members.
- The ICAR activities are managed by 4 Sub-Committees and 12 Working Groups. Interbeef is one of these working groups.
- ICAR has gone on to be “The” international guideline reference for animal identification, recording systems, data analysis and genetic evaluation.
ICAR’s members

ICAR has 117 members (87 Full members + 30 Associate members) in 59 countries

Countries (in dark blue) with at least one organisation as ICAR Member
ICAR’s Building Blocks

- ID ("Foundation Stone")
- Performance Recording
- Lab
- Genetic Evaluations

Central Livestock Databases, e.g., Interbull, Interbeef
ICAR Current Technical Organisation

4 Sub-Committees

Animal identification Devices SC
Milk Analysis SC
Interbull SC
Recording & Sampling Devices SC

Administrative bodies

Ex. Board
ICAR & S-ICAR Board
General Assembly

Expert Advisors and Task Forces

12 Working Groups

Animal Data Exchange
Artificial Insemination Technologies
DNA Genomics
‘Feed & Gas’
Interbeef
Breed Assns

Dairy Cattle Milk Recording
Sheep, Goat & Small Camelids
Conformation Recording
Animal Care *
Functional Traits

Global Reach

ICAR

THE GLOBAL STANDARD FOR LIVESTOCK DATA


30-8-2016
ICAR’s core products and services

• Guidelines
• Evaluation Services
• Certification Services
• Seminars and workshops
ICAR Guidelines and Standards

• Results of the work of the ICAR Sub-Committees and Working Groups are the “ICAR RECORDING GUIDELINES”

• Guidelines are a “live process” of amendments/updating, according to new technologies, tools and developments

• Every year new text of RG is proposed to GA for approval

• This meeting is timely as beef guidelines have not been updated (formally) since 2001. Focus of activity has been on genetic evaluations.
Irish Cattle Breeding Industry.

- Co-ordinated by ICBF.
  - ICBF => a “non-profit” co-operative of 30 cattle breeding organisations (AI, HB + MRO’s) + 2 Farm Organisations.
  - Established in 2000. Industry now responsible for cattle breeding decisions.
  - Central database in 2002. Now key cornerstone of Irish AgFood industry.

- Funded by industry & government (DAFM).
  - Turnover of €8m in 2015. 20% govt funding.
ICBF – Key Principles.

• Focused on farmer benefit.
  – Many stakeholders, but farmer is core.

• Strong principle of “Profit from science”.
  – Key relationship with Teagasc (govt research & extension).

• Independent genetic evaluations.

• Aim to be world-leading (research => implementation).
  – 2nd in world to launch dairy genomics, after US.
  – Beef Genomics => largest livestock genomics project globally.
ICBF Database

- Genetic Evaluation System
- Insems & Genetic Evaluations
- Milk Production & Management Rpts
- Ped. Certs & Linears
- Calf reg & movement
- Animal Events

AI Companies
Milk Recording
Herd Books
DAFF - AIM
Dairy & Beef Farmers

Less paper, more profit!
30m animals with 100m+ records.

100k farmers are now serviced from the database.

Dairy & Beef Farmers

Vets & vet labs.

Genotypes & gen labs.

Teagasc Research

Schemes, e.g., BVD, BGDP, Origin Green

Milk Recording

Herd Books

DAFF - AIM

Milk Co-ops

Teagasc & ACA Advisors

Marts & auctioneers

1m AI recs/yr

700k MR recs/yr

1.6 m carcass recs/yr

2.3m BVD recs/yr

7.0 m movement records/yr

1.6 m carcass recs/yr

Genetic Evaluation System

Animal Events

Ped. Certs & Linears

Insems & Genetic Evaluations

Milk Production & Management Rpts

Calf reg & movements

Carcass data

Weight & price

Bulk Tank

Reports

Genotypes

Health & disease data
IDB Chip – The database in 54k SNP’s!

- The International Dairy & Beef Chip.
- Developed in Ireland, with Illumina. Currently on v3.
- 54k SNP’s.
  - 40k core, 6k for better imputation, 7k for “regions of interest” & 1k for major genes/defects.
- 160 Major genes/defect.
  - Database will drive this.
- DNA based calf reg.
Genetics Works; Example EBI


2002. Establish ICBF & EBI

2005. Establish G€N€ IR€

2009. Establish Genomics; Rate of gain doubled

2016. Next Gen Herd

EBI has delivered ~€600m additional profit to industry over 20 years. ~€30m/year.
# NextGen results - 2016

<table>
<thead>
<tr>
<th></th>
<th>National Average</th>
<th>Elite</th>
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</thead>
<tbody>
<tr>
<td><strong>Days in milk</strong></td>
<td>150</td>
<td>153</td>
</tr>
<tr>
<td><strong>Milk solids to date (kg)</strong></td>
<td>277</td>
<td>293</td>
</tr>
<tr>
<td><strong>Fat %</strong></td>
<td>4.12</td>
<td>4.41</td>
</tr>
<tr>
<td><strong>Protein %</strong></td>
<td>3.41</td>
<td>3.57</td>
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<tr>
<td><strong>Live-weight</strong></td>
<td>534</td>
<td>514</td>
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<tr>
<td><strong>BCS</strong></td>
<td>2.81</td>
<td>2.95</td>
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<tr>
<td><strong>Submission 3 weeks (%)</strong></td>
<td>91</td>
<td>96</td>
</tr>
<tr>
<td><strong>6 wk in-calf rate (%)</strong></td>
<td>51</td>
<td>77</td>
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<tr>
<td><strong>9 wk in-calf rate (%)</strong></td>
<td>69</td>
<td>91</td>
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</table>
Genetic Trends in Pedigree beef Herd.
## Euro-Star Replacement Index

<table>
<thead>
<tr>
<th>Trait</th>
<th>Goal</th>
<th>Relative wt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calving</td>
<td>Less</td>
<td>16%</td>
</tr>
<tr>
<td>Feed Intake</td>
<td>Less</td>
<td>18%</td>
</tr>
<tr>
<td>Carcass wt (for age)</td>
<td>More</td>
<td>21%</td>
</tr>
<tr>
<td>Maternal milk</td>
<td>More</td>
<td>18%</td>
</tr>
<tr>
<td>Female fertility</td>
<td>More</td>
<td>23%</td>
</tr>
<tr>
<td>Docility</td>
<td>More</td>
<td>4%</td>
</tr>
</tbody>
</table>

**Emphasis:**

- Cow traits 71%
- Calf traits 29%
### Performance of all suckler females born in 2011, when ranked on new genomic test proofs

**5 Star Cows Leaving More Profit**

**All Suckler Cows**

<table>
<thead>
<tr>
<th>Star Rating</th>
<th>No. of Cows</th>
<th>Replacement Index</th>
<th>% Still Alive</th>
<th>Calv Weaning Weight (kg)</th>
<th>Cow Milk Score (1-5)</th>
<th>Age 1st Calving (months)</th>
<th>Calving Interval (days)</th>
<th>No. of Calvings</th>
<th>Carcass Weight (kg)</th>
<th>Carcass Value</th>
<th>Age at Slaughter (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>★★★★★</td>
<td>33,493</td>
<td>€108</td>
<td>83%</td>
<td>336</td>
<td>4.08</td>
<td>30.2</td>
<td>403</td>
<td>2.69</td>
<td>358</td>
<td>€1,474</td>
<td>697</td>
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<tr>
<td>★★★★</td>
<td>24,317</td>
<td>€76</td>
<td>80%</td>
<td>324</td>
<td>3.87</td>
<td>30.9</td>
<td>407</td>
<td>2.56</td>
<td>356</td>
<td>€1,469</td>
<td>712</td>
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<tr>
<td>★★★</td>
<td>21,644</td>
<td>€60</td>
<td>79%</td>
<td>319</td>
<td>3.74</td>
<td>31.3</td>
<td>411</td>
<td>2.47</td>
<td>356</td>
<td>€1,470</td>
<td>715</td>
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<tr>
<td>★★</td>
<td>20,908</td>
<td>€43</td>
<td>76%</td>
<td>315</td>
<td>3.61</td>
<td>31.5</td>
<td>416</td>
<td>2.40</td>
<td>357</td>
<td>€1,475</td>
<td>721</td>
</tr>
<tr>
<td>★</td>
<td>23,911</td>
<td>€12</td>
<td>72%</td>
<td>309</td>
<td>3.36</td>
<td>32.1</td>
<td>423</td>
<td>2.25</td>
<td>357</td>
<td>€1,477</td>
<td>726</td>
</tr>
</tbody>
</table>

**Difference 5 Star V's 1 Star**

- €96
- 11%
- 27kg
- 0.72
- 1.9 months
- 20 days
- 0.44 calves
- 0kg
- €-2
- 29 days
High Genetic Merit Herds are More Carbon Efficient.

*Breeds with at least 40 herds in data set
The Irish BDGP Scheme.

• Focused on breeding more profitable, sustainable and carbon efficient cows.

• Funded from EU Rural Development Program.
  – Co-funded by Irish government (DAFM).

• €300m total funding 6 years (2015-2020)
  – Farmers paid ~€90/cow/year to complete key actions re: the scheme.
  – ~500k animals genotyped to-date.
  – ~2.5m animals in total will be genotyped during period of scheme.
## Expected reductions in emissions from genetics

- Total non ETS GHG emissions from Ireland estimated at 41,680 kT, with 18,657 kT from agriculture (EPA 2012 report)

<table>
<thead>
<tr>
<th>Suckler beef breeding strategy</th>
<th>2020</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>kT of CO2e</td>
<td>% reduction Agri</td>
</tr>
<tr>
<td>Current replacement index trend</td>
<td>-66.14</td>
<td>0.4%</td>
</tr>
<tr>
<td>Genomics with increased Gene Ireland AI</td>
<td>-261.56</td>
<td>1.4%</td>
</tr>
<tr>
<td>Genomics with best case Gene Ireland AI</td>
<td>-385.02</td>
<td>2.1%</td>
</tr>
</tbody>
</table>
New Traits of Interest; Carcass and meat eating quality

- Length of loin, for a fixed loin area (retail pack).
  - Work underway between ICBF, Teagasc and meat processing industry.
  - Current status; Based on VIA images (1.6m animals/year), 200k animals with actual cut data (from one processor) + ~500 data from a primal grading machine.
  - Next 18 months; 7.5k animals with complete data (cut and meat eating quality) => apply to all animals.

- Meat eating quality.
  - Large differences within and across breeds. Heritability for tenderness of 25%. 
Can we breed to improve meat eating quality?

Evidence from breed premium schemes, e.g., Angus & Hereford, would suggest yes.

What about within each of our main beef breeds? Are there bulls that will breed progeny that are good to taste and those that are not so good to taste!

Current focus of work within the G€N€ IR€LAND performance test program at Tully.
Top AI bulls for Meat Eating Quality*

- Early results indicate significant genetic variation in meat eating quality.
- Initial “test” proofs generated based on sires with progeny evaluated at Tully*.
- Early results are very promising => plan to have official proofs during 2017.

<table>
<thead>
<tr>
<th>Brd</th>
<th>Code</th>
<th>Name</th>
<th>Owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA</td>
<td>RWB</td>
<td>Rawburn Lord Rocket</td>
<td>Doveea AI</td>
</tr>
<tr>
<td>BA</td>
<td>KCE</td>
<td>Kilmoney Bruce</td>
<td>Doveea AI</td>
</tr>
<tr>
<td>BB</td>
<td>VMP</td>
<td>Viilablues Empire</td>
<td>Doveea AI</td>
</tr>
<tr>
<td>CH</td>
<td>FSZ</td>
<td>Fiston</td>
<td>NCBC</td>
</tr>
<tr>
<td>HE</td>
<td>GZS</td>
<td>Goulding Poll Superduty</td>
<td>NCBC</td>
</tr>
<tr>
<td>LM</td>
<td>EFZ</td>
<td>Elite Flag</td>
<td>NCBC</td>
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<tr>
<td>PT</td>
<td>CBQ</td>
<td>Cambridge</td>
<td>NCBC</td>
</tr>
<tr>
<td>SA</td>
<td>PZB</td>
<td>Bonaparte</td>
<td>NCBC</td>
</tr>
<tr>
<td>SH</td>
<td>CZB</td>
<td>Creega Dice</td>
<td>Doveea AI</td>
</tr>
<tr>
<td>SI</td>
<td>RWV</td>
<td>Raceview Van Halen</td>
<td>Doveea AI</td>
</tr>
</tbody>
</table>
### Results from Consumer Tasting Session, Grange July 2016

#### Table 1. Consumer tasting session, Teagasc Grange Beef Open Day, 5 July 2016*

<table>
<thead>
<tr>
<th>Panel</th>
<th>High EBV Steak</th>
<th>Low EBV Steak</th>
<th>Diff</th>
<th>Consumer Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Brd Tag</td>
<td>EBV</td>
<td>Brd Tag</td>
<td>EBV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>BB IE331469770176 3.3</td>
<td>BB IE111104920402 -0.3</td>
<td>3.6</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>CH IE281166191119 3.6</td>
<td>CH IE281170330957 -3.2</td>
<td>6.8</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>CH IE341454730305 2.8</td>
<td>CH IE281170360943 -3.6</td>
<td>6.3</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>LM IE331461970185 2.9</td>
<td>LM IE371072440485 -4.0</td>
<td>6.9</td>
<td>7</td>
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<tr>
<td>5</td>
<td>LM IE3314619750190 2.5</td>
<td>LM IE111104960414 -2.9</td>
<td>5.4</td>
<td>4</td>
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<tr>
<td>6</td>
<td>LM IE281158740537 2.2</td>
<td>LM IE281170320956 -5.6</td>
<td>7.8</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>SA IE331469760183 1.7</td>
<td>SA IE331469760191 -1.6</td>
<td>3.3</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>SI IE331518830647 -0.2</td>
<td>SI IE331518890644 -6.7</td>
<td>6.5</td>
<td>6</td>
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<tr>
<td>9</td>
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<td>AA IE301049020234 -2.4</td>
<td>4.7</td>
<td>7</td>
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<tr>
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<tr>
<td>11</td>
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<td>6.0</td>
<td>5</td>
</tr>
<tr>
<td>12</td>
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<td>CH IE221068630680 -0.1</td>
<td>2.2</td>
<td>3</td>
</tr>
<tr>
<td>13</td>
<td>LM IE341454770300 2.4</td>
<td>LM IE281170310947 -1.0</td>
<td>3.4</td>
<td>5</td>
</tr>
<tr>
<td>14</td>
<td>LM IE151826220317 2.2</td>
<td>LM IE301049090240 -0.1</td>
<td>2.3</td>
<td>6</td>
</tr>
<tr>
<td>Tot</td>
<td>2.4</td>
<td>-2.5</td>
<td>4.8</td>
<td>75</td>
</tr>
</tbody>
</table>

*Based on young bulls slaughtered (<16 mts) on 11 Jan and 18 Jan 2016*
Summary.

• Genetic improvement in Ireland is now generating €30m/year for Irish dairy farmers with similar potential for beef. Additional GHG benefits.

• But, effective genetic improvement in livestock requires close collaboration at national and international level.
  – ICAR and ICBF are relevant examples.

• We must collaborate if we are to meet the “food versus climate” challenge in the future.

• We are very keen to engage with more partners in generating further improvements for farmers & industry, e.g., UNECE.
A balanced cow in Ireland!