Teagasc
The Irish Agriculture & Food Development Authority
Responsibility for Agriculture Research, Education and Extension
Overview of Presentation

Irish Dairy Industry
Moorepark Dairy Research Programme
Future Research direction
Irish Dairy Industry
Irish Dairy Industry Profile

• 4.5% of EU-15 milk supply
• 5.5 million tonnes of milk
• 18,000 suppliers
• 24 Co-ops/Plc
• 84% exported
Grassland production and grass growing season

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(Brereton, 1995)
Seasonality of Milk Supply

Milk Intake by Month

Ireland -v- EU

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Optimistic Outlook for Irish Dairy Farming

• Milk Quota Abolition in 2015
• Outlook for Milk Price +ve but with greater volatility
• World Demand for Food Increasing
• Dairy Industry Strategically Important to Irish economy.
• Irish grass-based Dairying- Sustainable & Competitive
• Ample Supply of Young Well Trained Workforce
Vision for agri-food sector for next decade

Ambitious growth targets
- milk volume: + 50%
- beef value: + 20%
- pigmeat value: + 50%

SMART – GREEN – GROWTH

Sustainability very important

Consumer and consumer needs are central

Potential for Expansion

- Currently 20% of grassland under dairying
- Specialisation – substitute cows for other livestock (Current specialisation 76%)
- Milking platform SR 1.84LU/Ha (Potential +2.5 cows/Ha)
- Significant potential to increase yields per cow
- Potential to increase national supply +50% on existing
Is Irish dairying competitive?
Recent Trends in Dairy Calf Births
(Source: DAFF AIM Bovine Statistics Reports 2006-2012)
Moorepark Dairy Research Programme
Moorepark Budget – 2012

State funding, 48%

Farm Receipts, 15%

Dairy levy, 15%

State comp. fund, 12%

Other Income, 2%

EU comp funds, 9%
Objectives of Research Programme

- Develop pasture-based dairy systems that are profitable, environmentally sustainable and an attractive career opportunity for young people
- Be the leading international science authority on the technologies for pasture-based dairy systems
- Provide technologies to facilitate expansion on Irish dairy farms while at the same time increase labour efficiency and quality of lifestyle
- Develop strategies that underpin the highest standards of quality and safety of Irish dairy produce
- Assist in delivering new knowledge and technology to the end user
Research Programme Areas

1. Dairy cow genetic improvement
2. Dairy cow reproduction
3. Grass supply and utilisation
4. Milk production systems and economic analysis
5. Dairy cow nutrition and increasing value added
6. Dairy cow health and welfare
7. Precision Dairy Farming
8. Environmental research
The Grazing Cow

The cow for pasture systems must have the following characteristics:

Productivity (1,200 - 1,400 kg MS per ha)
Calve every 12 months
Withstand a fluctuating feed supply ~ BCS
High pasture DM intakes (16 - 20 kg DM/day)
Survive in a larger herd scenario (18 hr/cow/yr)
Average 5 lactations – healthy resilient animal
Dairy Cattle Breeding

- Development of EBI Index (ICBF)
- Evaluation of different breeds and cross breeds - across-breed evaluation
- Development of genomic technology
- Development of breeding schemes for Gene Ireland
Future:
Animal Heath: Viral (BVD), Mastitis, Parasites
Sustainability: Efficiency linked to GHG
Milk Composition: especially fatty acid composition
Genomic Selection

- Giving reliability advantages of genotyped animals to un-genotyped relatives (e.g., AI bull daughters)
- Setting up genetic evaluation systems to handle tens of thousands of genotyped animals
- Evaluate potential of genomic selection in other breeds
- Acquire better information on individual genes and better statistical methodology to improve the reliability
  - Target 54% in 2011 to 65% in 2016
  - Was 48% in 2009 so is achievable (diminishing returns)
- Gene Ireland breeding programs to exploit genetics
Genomic selection

EBI (€)

<table>
<thead>
<tr>
<th></th>
<th>Use</th>
<th>EBI (Rel)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proof</td>
<td>29</td>
<td>143 (75)</td>
</tr>
<tr>
<td>DP-IRL</td>
<td>24</td>
<td>155 (47)</td>
</tr>
<tr>
<td>GS</td>
<td>47</td>
<td>218 (57)</td>
</tr>
</tbody>
</table>

Cost: €0.5m
Worth €8m

Year of birth
New indexes

Index to select beef bulls for dairy farmer
  • Live, good quality calf, delivered with no assistance required after short gestation

Culling index that includes heterosis on puts more emphasis on the cow’s performance
  • Crossbreds on average €100 more profitable than predicted based on EBI
    • Not transmitted to offspring so will never be included in the EBI
  • New index that includes this €100 (and less in advanced crosses)
Next generation herd

Genetic gain is going to increase rapidly with genomic selection and reproductive tools.

Need to quantify impact of EBI on difficult to measure traits:

- Feed intake & efficiency, health (e.g., lameness, mastitis), fertility

How high EBI animals perform in different grass based production systems.

Data for genomic selection on these traits.

Source of bulls for Gene Ireland.

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Increasing Cattle Reproduction Efficiency

Objective:
6-week Incalf Rate -> 70%
12- week NOT Incalf Rate -> <10%
Dairy Cattle Reproduction

- Commercial farm evaluation of different heat synchronisation programmes and detection aids
- Evaluation of new technologies for the identification of cows in oestrous
- Characterisation of cows with similar EBI sub-index for milk production but with extremes for fertility sub-index
- Replacement heifer rearing and management strategies to improve national calving pattern
### Holstein Friesian Sexed Semen Study 2013 (394 Herds)

<table>
<thead>
<tr>
<th></th>
<th>Conventional (3M fresh)</th>
<th>Sexed Fresh (1M)</th>
<th>Sexed Fresh (2M)</th>
<th>Sexed Frozen (2M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heifers (6,100)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conception Rate (%)</td>
<td>53</td>
<td>39 (75)</td>
<td>46 (87)</td>
<td>46 (87)</td>
</tr>
<tr>
<td>Cows (8,925)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conception Rate (%)</td>
<td>49</td>
<td>32 (64)</td>
<td>37 (76)</td>
<td>42 (85)</td>
</tr>
</tbody>
</table>

Over 90% X-sorted; female offspring
Automated heat detection

• Dairymaster Accelerometer device

• Activity automatically measured

• 173 cows monitored

• Detection Rate 82.0%

• Error Rate 6.8%

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Grass Supply and Utilisation/Nutritive value

Objective:
Increase Grass DM utilized/ha to 11 tonne
$R^2 = 0.9074$

- US Confined
- US Grazing
- DK
- GER
- NL
- FR
- IRL
- NZ
- AU
- UK

Dietary grass proportion (%)

Total costs of Production (€ c/l)
Grass breeding, utilisation & nutritive value

- Increase animal performance from grazed grass through better grazing management
- Launch Grass Selection Index in 2014 to select cultivars with increased animal performance
- Undertake on farm grass genetic evaluations incorporating genomic information
- White clover grass-based systems to lower nitrogen input on dairy farms
Importance of Grass Measurement & Budgeting: PastureBase Ireland

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Grass Economic Index

€ per ha/year

- Kg DM yield
  - Spring: €0.27
  - Summer: €0.03
  - Autumn: €0.16

- Unit change in DMD/kg
  - April to Sept.: €0.01 to €0.02

- Kg DM silage yield
  - 1st Cut: €0.09
  - 2nd Cut: €0.06

- % change
  - €4.96/ha per yr

DM yield → Quality → Silage DM yield → Persistency → Grass Economic Index

% change
€4.96/ha per yr
# Grass-clover Experiment 2013

<table>
<thead>
<tr>
<th></th>
<th>Grass clover 150 kg N/ha</th>
<th>Grass clover 250 kg N/ha</th>
<th>Grass only 250 kg N/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk yield (kg/cow/day)</td>
<td>22.2</td>
<td>22.8</td>
<td>21.9</td>
</tr>
<tr>
<td>Milk solids yield (kg/cow/day)</td>
<td>1.76</td>
<td>1.77</td>
<td>1.69</td>
</tr>
<tr>
<td>Milk fat (%)</td>
<td>4.41</td>
<td>4.29</td>
<td>4.26</td>
</tr>
<tr>
<td>Milk protein (%)</td>
<td>3.51</td>
<td>3.52</td>
<td>3.51</td>
</tr>
<tr>
<td>Cumulative milk solids yield</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(11 Feb. – 20 Oct.) (kg/cow)</td>
<td>453</td>
<td>466</td>
<td>442</td>
</tr>
<tr>
<td>Grass DM production (kg DM/ha)</td>
<td>13,065</td>
<td>13,198</td>
<td>13,347</td>
</tr>
</tbody>
</table>

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New Study: Based in Clonakilty Agricultural College

The effect of tetraploid and diploid swards sown with and without clover on the productivity of spring milk production systems

The aim is to assess the biological efficiency from tetraploid and diploid swards sown with and without clover over a full grazing season

- Milk production
- Total grass dry matter production
- Sward nutritive value
Milk Production Systems and Economic Analysis

Objective:
Develop profitable, resilient and sustainable milk production systems
Milk Production Systems & Economic Analysis

- Bio-economic modelling: Milk processing; GHG emissions; Grass Selection Index; EBI;
- Optimising milk production - heavy soils (Solohead), regional (Ballyhaise) and winter milk (Johnstown);
- Develop decision support tools that increase the adoption of key technologies: Mastitis Calculator; Grazplan; Grass Calculator; Milk Payment- A+B-C; Milk Prediction Modelling
Sustainable production systems

Farmlet studies to determine

- Profitability
- Nutrient output
- Labour input
- Capital input

Impact of

- stocking rate
- Calving date
- genotype
- Feed system
- Local constraints
Livestock systems farmlet research studies

- **Ballyhaise**
  - Regional Dairy systems

- **Solohead**
  - Heavy soils research

- **Moorepark**

- **Curtins**
  - Spring milk systems

- **Johnstown Castle**
  - Dairy calf to beef Winter milk systems

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Regional Milk Production

• Development of high profit spring calving systems for the northern region
• Farm system research on commercial dairy farms to access animal and grassland management practices in the region
• Economic modelling to develop blueprints for milk production using constraints (fragmentation, land base, soil type, etc) that are particular to the area
Heavy Soils Farm
Locations

- Doonbeg
- Boherbue
- Macroom
- Listowel
- Newcastlewest
- Castleisland
- Solohead Research Farm
- Clonoulty

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Types of drainage system

- Two principle types are distinguished:
  
  - **Groundwater drainage system**: A network of deeply installed piped drains establishing a deep drainage base in the soil.
  
  - **Shallow Drainage system**: These are used where soil is heavy and infiltration of water is impeded at all depths
Animal Nutrition and Increasing Value Added

Objective:
Efficient conversion of grazed grass (with strategic supplementation) into high quality milk
Vision: To improve the Productivity and Resilience of the Irish dairying through Better Dairy Cow Nutrition

Benefits of Improved Nutrition

- Increased Productivity
- Improved Health & Well-being
- Reduced Environmental Footprint
- Increased Processing Value

Research Platforms

- Component
- On-farm
- Laboratory
- System
- Modelling

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# Significant Factors Influencing Mid-season Milk Protein Content

<table>
<thead>
<tr>
<th>Mean Calving Date</th>
<th>PD Protein (%)</th>
<th>Grass OMD (%)</th>
<th>Milk Protein (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herd 1</td>
<td>Feb 28</td>
<td>+ 0.06</td>
<td>84</td>
</tr>
<tr>
<td>Herd 2</td>
<td>Mar 10</td>
<td>+ 0.01</td>
<td>77</td>
</tr>
</tbody>
</table>

A herd having a mean calving date 10 days earlier, a PD for milk protein % of 0.05 greater and grazing grass 7 units greater in OMD would have a higher milk protein % of 0.19. Grass digestibility accounted for 0.06%.
Equations derived to routinely predict fatty acid composition of milk using MIR

<table>
<thead>
<tr>
<th>Fat Group</th>
<th>Accuracy</th>
</tr>
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<tbody>
<tr>
<td>Saturated</td>
<td>0.98</td>
</tr>
<tr>
<td>Monounsaturated</td>
<td>0.96</td>
</tr>
<tr>
<td>Polyunsaturated</td>
<td>0.82</td>
</tr>
<tr>
<td>Short chain</td>
<td>0.91</td>
</tr>
<tr>
<td>Medium chain</td>
<td>0.92</td>
</tr>
<tr>
<td>Long chain</td>
<td>0.93</td>
</tr>
</tbody>
</table>

Predict groups of fats or individual fats in high quantities in milk with high accuracy

Work underway to develop similar equations to predict energy balance status of cows

Initial accuracies lower than above, but look promising
Environmental Research

Objective:
Reduce N losses to water & GHG emissions/ kg of milk
Environmental and Nutrient Efficiency Research

1. The effect of stocking rate and length of grazing season on nitrate leaching from a free draining soil

2. On-farm practices to improve nutrient efficiency

3. Mitigation strategies for methane emission by dairy cows in Irish milk production systems
Ireland is the most carbon efficient milk producer in the EU.

Source: Evaluation of the livestock sector’s contribution to the EU GHG emissions (GGELS) EC, Joint Research centre, 2010.
Nitrogen Leaching: Curtins Farm Case Study 2002 -2011

<table>
<thead>
<tr>
<th>Year</th>
<th>Stocking rate (cows/ha)</th>
<th>Grazing days (No.)</th>
<th>N application (kg/ha)</th>
<th>Mean NO₃- N (mg/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>2.25</td>
<td>231</td>
<td>294</td>
<td>16.5</td>
</tr>
<tr>
<td>2002</td>
<td>2.44</td>
<td>272</td>
<td>294</td>
<td>16.0</td>
</tr>
<tr>
<td>2010</td>
<td>2.88</td>
<td>282</td>
<td>252</td>
<td>7.3</td>
</tr>
<tr>
<td>2011</td>
<td>2.88</td>
<td>285</td>
<td>251</td>
<td>7.3</td>
</tr>
</tbody>
</table>
Precision Dairy Farming
Labour Efficiency, Milking & Energy/Water Efficiency

Objective:
Increase Labour Efficiency and Sustainability of Irish Milk Production
Labour, Milking and Energy Efficiency: Precision Dairy Farming

• Increasing labour efficiency - milking and calf rearing
• Production of high quality (SCC, Bacillus Cereus and SRC termoduric bacteria) reduction of residues - TCM and iodine
• Increasing energy & water efficiency on dairy farms
• Investigating the role of automation on dairy farms including AMS
TCM Trend in Irish Butter 2007-2013

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Energy Research audit

Average = 0.49 (C/L)
Max = 0.76 (C/L), Min = 0.23 (C/L)

Milk Tank/Compressor % 39%
Vacuum Pump % 20%
Water Heater % 21%
Other % 17%
Lights % 3%

Investing in opportunities
Animal Health and Welfare
(Aligned closely with AHI)

Objective:
Enhancing animal performance with superior animal health
Dairy Cow Health: Infectious Diseases

• Johnes: Pilot Control Programme & Evaluating Diagnostic Protocols

• IBR: Evaluating the benefit of Vaccination in relation to control

• Liver & Rumen Fluke: prevalence, prediction tools, anthelmintic resistance & economics

• Schmallenberg Virus: Investigate prevalence, impact and control
Dairy Cow Health: Management Diseases

- Mastitis: reduction of Antimicrobial Resistance:
  - Increasing antibiotic use efficiency
  - Dry cow & teat seal treatment
  - Pathogen profiling for parities
  - Evaluate the use of vaccination
- Lameness:
  - New farm prevalence study
  - Develop a gait scoring system
  - Investigate the impact of routine trimming
Education and Communicating Research Results: 2013

• Moorepark Open Day 3rd of July
• Ballyhaise Open Day 1st of October
• Liquid Milk Conference 30th of October
• National Dairy Conference 12th and 13th of November
• Milk Quality Conference 4th of December
• Large number of Discussion Group visits to Moorepark & research farms
• Providing Dairy Advisers with In-service Training
• Education- Dairy Business Degree & Professional Dairy Farm Managers