The importance of Genetics and Genomic tools in a changing industry

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DairyCo Breeding+

- Responsible for Genetic Evaluation in UK
  - Independent and Paid for by dairy farmers

- All breeds and crosses:
  - Production traits
  - SCC
  - Lifespan
  - Fertility Index
  - Type (excl. B&W)
  - Calving Ease
Who do we work with?

Breed Societies       Milk Recording       Service partner

Critical success factors;
Recording (ICAR accredited)
Collaboration – (inter)nationally
The Breeders ‘toolbox’

• Breeding has never been so easy!

• Many bulls on offer

• Many genetic indexes available to select on
  – Important to use UK validated indices

• However, they only add value if you use them!
Why is breeding important?

• Genes play important role in animal performance
  – Performance = Genetics + Environment

• Environment very important
  – Short term

• Genetic improvement is:
  – Permanent; long term solution
  – Cumulative over generations
  – Cost effective
## Impact of Genetics – Milk yield

( AHDB – UK data 06/03/14)

<table>
<thead>
<tr>
<th>Year</th>
<th>Cow Numbers (x1000)</th>
<th>UK production (x 1m.)</th>
<th>Avg. Yield</th>
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<td>2012</td>
<td>1,812</td>
<td>13,199</td>
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<td>2013</td>
<td>1,782</td>
<td>13,301</td>
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Change: 69% 98% 142%
Impact of Genetics

- Not a linear increase of production
- 1996 – 2005; Yield up by 161 kgs/yr; BV up 132 kgs/yr → = 82%
- 2005 – 2013; Yield up by 92 kgs/yr; BV up 77 kgs/yr → = 84%
Impact of Genetics (Somatic Cell Count)
Breeding ‘wish list’

- **Farm Needs**
  - Efficient Production
  - Meet milk contract
  - Reduced SCC/mastitis
  - Increase Longevity
  - Improved Fertility
  - Reduced Lameness
  - Easy Calvings

- **Genetic Tools**
  - Milk, Fat and Protein
  - Fat and protein %
  - SCC, Udders
  - Lifespan
  - Fertility Index
  - Locomotion/ feet & leg
  - Calving Ease (d & m)
Standardised Genetic Gains
(based on insemination data)
Can Genomics help us accelerate gains?

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<tr>
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<th>Traditional (years)</th>
<th>Genomic</th>
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<tr>
<td>Second crop daughter proof</td>
<td>6</td>
<td>99%</td>
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<tr>
<td>Progeny milking</td>
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<td>90%</td>
</tr>
<tr>
<td>Progeny bred</td>
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<td>65%</td>
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<tr>
<td>Progeny born</td>
<td>3</td>
<td>65%</td>
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<tr>
<td>Semen collected</td>
<td>2</td>
<td>65%</td>
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<tr>
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<td>DNA analysis</td>
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DairyCo
‘Unlocking’ the DNA code

- Using reference group for calibration;
  - Daughter proven bulls + their Genotypes
UK implementation (Holstein)

• (inter)national collaboration through DairyCo
  – UK, ITA, CAN, USA
  – ~23,000 daughter proven bull genotypes

• Bespoke UK Genomic evaluations
  – DairyCo (Production and Fitness) & Holstein UK (Type)
  – Males – April 2012
  – Females – April 2013
Should young sires be used?

- High quality young bulls on offer
  - And get better quick

- Averages £PLI of Top 100 available

<table>
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<tr>
<th>Top 100</th>
<th>Apr-12</th>
<th>Apr-13</th>
<th>Dec-13</th>
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<td>Young</td>
<td>197</td>
<td>230</td>
<td>246</td>
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<tr>
<td>Proven</td>
<td>182</td>
<td>197</td>
<td>201</td>
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<tr>
<td>Difference</td>
<td>15</td>
<td>33</td>
<td>45</td>
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</table>
Young sire use (Inseminations Jan-2000 to Sep-13)
Application – Beyond breeding

• Genomic testing soon Routine
  – All cows will have genotype

• Traceability
  – Animals and Products

• Opens door for other opportunities
Application – Today (female testing)

• Optimised breeding and Selection
  – Young stock pre-selection
  – Targeted breeding
    • Better ability to improve Health and Fertility traits
    • Choice of Sexed vs Beef semen

• Parentage Verification and Discovery

• Screening for genetic abnormalities
  – Also potential for discovery of ‘new’ recessives
Application – Tomorrow

• Nutritional Genomics
  – (Nutrigenomics)
  – Interaction Genes x Diet

• Personalised Genomic Medicine
  – Determine disease risk (Predisposition)
  – Appropriate therapeutic options
Potential for new trait evaluation

• New indices in development in the UK;
  – Fatty Acids & Protein fractions
  – TB resistance
  – Abattoir carcass traits
  – Feed efficiency (gDMI)

• Genomics increases the need for more data !!
  – And collaboration
Cow of the Future

• What kind of farming operation will we need in 5, 10 or 15 years to be competitive in a global dairy industry?

• What kind of cow is needed for that?

• Have we got the genetic info?

• What tool have we got to help us?
Goals are constantly changing

Selection from traditional ‘dual purpose’

Production - Milk, fat, protein (PIN)

Longevity – incl. Type (ITEM)

‘Fitness’ (£PLI)
National Breeding Goal

• To breed dairy cows which;
  – Thrive in the diverse UK dairy farming systems
  – Show improved health, welfare and productivity

• Such a breeding policy will contribute to a profitable, healthy and environmentally sustainable dairy herd.
£PLI update – August 2014

• Evolution of current £PLI
  – More emphasis on ‘Fitness’
  – Maintaining milk quality (fat and protein %)

• Additional traits added to the index
  – Calving Ease (direct and maternal)
  – Maintenance cost
New £PLI

- Reduce emphasis on Production (~1/3 of £PLI)
  - Less milk, maintain components
- Increased emphasis on Fertility
- Maintain importance of Longevity
- Increase emphasis on Udder Health
- Increased importance of functional type
  - Feet & Legs and Udders
- Include cost of Maintenance and Calving Ease
Introduction of a new index

• Spring Calving Index (£ SCI)

• Targeted towards;
  – Spring calving herds
  – Block calving
  – Extensive use of grass
£SCI

- Focus on milk quality, rather than high volume
  - Maintain Production efficiency with high components
- High emphasis on Fertility
- Recognise the importance of cost of maintenance
- Protect Udder Health
- Value the cost associated with Calving difficulties
- Strong selection on Longevity
- Protect functional type;
  - Feet & Legs and Udders
Breeding for your herd

- Identify areas of Strength and Weakness
- Monitor genetic potential of your herd
- Use on-line DairyCo Herd Genetic Report;
  - Milk (kg), Fat and Protein (kg and %)
  - Inbreeding Level
  - Management Traits - SCC, Lifespan and Fertility
- Set your future breeding goal!
- Use the genetic tools to tailor your future needs
Holstein Herd Standards

Shows the percentile levels required for a herd to be considered in the top 1%, etc, of the population. Herd averages have been calculated from live cows with reliabilities of 30% or more. Each trait has been calculated independently, thus a herd can be in the top 1% for milk yield but be in the top 10% for protein yield.

<table>
<thead>
<tr>
<th>Percentile</th>
<th>£PLI</th>
<th>PTA Milk (kg)</th>
<th>PTA Fat (kg)</th>
<th>PTA Protein (kg)</th>
<th>PTA Fat (%)</th>
<th>PTA Prot (%)</th>
<th>£PIN</th>
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</table>
The importance of Genetics and Genomic tools in a changing industry

• History has shown us that genetic selection is a powerful tool
  – Very important contributing factor in long term industry performance

• Changing industry requires an evolution of genetic needs
  – E.g. Differentiation of genetics to suit systems (£PLI vs. £SCI)
  – Note; Selection decision today will impact the industry for the next decade

• Genomic tools provide new opportunities
  – Ability to respond to changes more rapidly – incl. New traits
  – Ability to accelerate rate of change
  – Ability to be used as farm management tool

• We need to ensure we utilise its potential