Improving Bull Selection

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## Genetic Improvement

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
<th>Genetic Gain</th>
</tr>
</thead>
</table>
| **Accuracy Selection (Reliability)** | • Heritability  
• Amount of information  
• Genetic Evaluation | Higher accuracy  
• accurate information  
(calving, AI records, MR)  
• accurate genetic evaluation |
| **Genetic Variation**           | • Amount of variation that exists (e.g., spread in bull proofs) | More variation is better  
Biological, therefore no control |
| **Generation Interval**         | • Average age of parents when offspring are born | Shorter intervals are better  
Dairy cattle 6 yr due to progeny testing |
| **Selection Intensity**         | • Difference between the selected animals and average of pop | High intensity leads to more gain |
Selection Intensity

• Dairy cattle - 4 paths that contribute to genetic progress
  1. Sires to produce sires (sire of sons)
  2. Sires to produce dams
  3. Dams to produce future sires (bull dam)
  4. Dams to produce future dams

• GEN€ IRELAND® - objective is to maximise selection intensity of paths 1 and 3

• Farmer controls 2 and 4 when making breeding decisions
Top Cows

Top Bulls

Mixture of progeny
Good on average

Elite Cows

Fall through system

Young Test Sires
Selection Intensity

- Several constraints to maximising selection intensity
  - Inbreeding
  - Reliability of sires/dams
  - Minimum bull dam requirements
Inbreeding

- Increase in inbreeding can have some deleterious consequences
  - Affect traits such as production, fertility etc
  - Increase genetic disorders (e.g., CVM, BLAD etc)
  - Reduce genetic variation
- Over representation of few elite sires has caused an increase in inbreeding
  - Narrow selection goals, especially production traits
Descendents of Carlin M Ivanhoe Bell

McParland et al., 2007
Selection vs. Inbreeding

- GEN€ IR€LAND® needs to strike a balance between intense selection and inbreeding
- Historically – no new “top bull” each year
  - Many daughters of few bulls
  - Implications for testing bulls and availability of bull mothers
Sires of Sons

- Bulls that are likely to produce sons that perform well under Irish conditions
- High EBI
- Range of reliabilities – manage risk
- Range of pedigrees – manage inbreeding
- International breeding objectives are now similar to EBI
Sires of Sons

Distribution of EBI for Ho/Fr Bulls 1986-present

860 AI sires with EBI of €100+
Bull Dams

- Minimum criteria for bull dams
  - Ancestry requirement – at least 2 complete generations on dam
  - High EBI
  - Milk recorded
  - Others as deemed appropriate by AI company (e.g., calving interval records, good functional feet & legs, udder, protein % etc)
Bull Dams

No Restrictions

Top 2000

-170 +123 +170

• Ho/Fr
• + F&P%

Top 2000

-170 +117 +170

• Ho/Fr
• + F&P%
• + Fert SI
• Par 1+

Top 2000

-170 +108 +170

• Ho/Fr
• + F&P%
• + Fert SI
• Par 1+
Bull Dam Listings

- To help both AI companies/breeders with bull dam information, plan to make available a list of top X cows for each bull that has high EBI

<table>
<thead>
<tr>
<th>AI Code</th>
<th>EBI</th>
<th>Milk SI</th>
<th>Fertility SI</th>
<th>Min EBI</th>
<th>Max EBI</th>
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<tbody>
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</table>
Contract Mating

- Contract mating confers several advantages
  - More control over mating of best cows to best bulls
  - More control over resultant EBI of offspring
  - More control over inbreeding
  - Potentially more control from disease perspective
Contract Mating

- Disadvantage – Cost & Work involved
  - ~700 contract mating required to get 100 bulls
    - 350 pregnancies
    - 175 bull calves
    - Mortality, health tests, semen
  - More planning required
  - Who pays??
Genomic Selection

- Set to revolutionise dairy cattle breeding???
- Estimate EBI for a young bull based on a DNA profile
Genomic Selection

Genes associated with production
Genes associated with fertility/survival
Genes associated with calving
Genes associated with health
Genes associated with beef

GS EBI € = Sum(all genes associated with traits in EBI) * EV
Genomic Selection

- Current progeny test bulls are selected based on parent average (reliability ~ 35%)
- A genomically selected yearling bull would have a reliability of ~60%
- Faster genetic progress through higher accuracy of selection and a shorter generation interval
- Technology is currently unproven
Key Messages

- Maximising the genetic progress in EBI is key to increasing profitability

- **Identifying** and **accurately testing** top quality young bulls is necessary to ensure availability of high EBI bulls to farmers in the future
Key Messages

- Contract mating offers more control of the progeny testing programme but at extra cost

- Some tradeoffs between gain and maintaining genetic variation are necessary to sustain long-term progress