Breeding the dairy cow of the future

Donagh Berry

Teagasc, Moorepark, Ireland

Donagh.berry@teagasc.ie

National Dairy Conference, Kilkenny, Dec 2015
Characteristics of the ideal cow

1. Produce a large quantity of high value product

2. Good health, fertility

3. Does not eat a large quantity of food

4. Easy 
   - Product quality
   - Feed intake & environment

5. Low
   - Animal health & disease

6. Resilient to external perturbations

*Cannot be taken in isolation*
Gains in milk composition

Fat & protein percent

Year of calving

Fat %  Protein %  EBV Fat %  EBV Protein %

Worth €50.9m/yr in 2000

Worth €107.7m/yr in 2014

Fat %
Protein %
EBV Fat %
EBV Protein %
"Gains" in reproductive performance

On-farm
Genetic
"Gains" in reproductive performance

Still need ~30% emphasis on fertility to hold!
New traits
Tuberculosis

Number of bulls

Prevalence

The Irish Agriculture and Food Development Authority
Feed intake

- Feed intake for same yield and body size
- Ample genetic variation

1.5 t DM/lactation
6 t DM/cow
Conclusions

• The EBI is achieving gains in performance

• Plenty exploitable genetic variation
  • Product quality
  • Feed intake & environment
  • Animal health and disease

• Ample tools to make faster genetic change
  • 50% with genomic selection
Breeding the right cow

Brian Hilliard
Teagasc Dungarvan
# Group trends

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Herd EBI</strong></td>
<td>€134</td>
<td>€147</td>
<td>€170</td>
<td>+ €36</td>
</tr>
<tr>
<td><strong>Milk yield</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kg MS/cow</td>
<td>386</td>
<td>376</td>
<td>427 est.</td>
<td>+ 41</td>
</tr>
<tr>
<td><strong>Fertility</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calving Interval</td>
<td>386 days</td>
<td>372 days</td>
<td>370 days</td>
<td>- 16 days</td>
</tr>
<tr>
<td>6-week calv. (%)</td>
<td>63%</td>
<td>73%</td>
<td>78%</td>
<td>+ 15%</td>
</tr>
</tbody>
</table>
2015 herd size – average 170 cows
What the farmers want

• Good fertility / some want better fertility
• All want greater milk solids yield
• Ease of management more important
  • Walking ability
  • More healthy
  • Calving ease
Cow for the future; Analysis of data from commercial dairy farms?
Is the EBI working; Analysis.

- Analysis of 10,470 dairy herds.
  - Minimum of 30 cows.
  - Minimum of 30% of herd with EBI data.
- Based on key performance data from:
- Herds categorised based on:
  - Seasonality (Spring & Split).
  - Herd size (>150 cows, 100-150, 60-100 & 30-60 cows).
  - Main breed of cow in herd (HO, FR, JE cross & Others).
1. Herd Genetic Merit.

<table>
<thead>
<tr>
<th>Herd Rank</th>
<th>Herds</th>
<th>Cows</th>
<th>EBI</th>
<th>Fert Sl</th>
<th>Milk Sl</th>
<th>PD M kg</th>
<th>PD F kg</th>
<th>PD P kg</th>
<th>PD CI Days</th>
<th>PD Surv</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top 10%</td>
<td>1046</td>
<td>123</td>
<td>€176</td>
<td>€95</td>
<td>€52</td>
<td>71.1</td>
<td>10.0</td>
<td>7.3</td>
<td>-5.4</td>
<td>2.4</td>
</tr>
<tr>
<td>-11-20%</td>
<td>1047</td>
<td>94</td>
<td>€157</td>
<td>€89</td>
<td>€44</td>
<td>81.9</td>
<td>8.0</td>
<td>6.4</td>
<td>-5.2</td>
<td>2.1</td>
</tr>
<tr>
<td>-21-30%</td>
<td>1047</td>
<td>84</td>
<td>€148</td>
<td>€87</td>
<td>€39</td>
<td>78.6</td>
<td>7.0</td>
<td>5.8</td>
<td>-5.1</td>
<td>2.0</td>
</tr>
<tr>
<td>-31-40%</td>
<td>1047</td>
<td>83</td>
<td>€141</td>
<td>€86</td>
<td>€36</td>
<td>70.7</td>
<td>6.2</td>
<td>5.3</td>
<td>-5.1</td>
<td>1.9</td>
</tr>
<tr>
<td>-41-50%</td>
<td>1047</td>
<td>76</td>
<td>€135</td>
<td>€83</td>
<td>€33</td>
<td>73.7</td>
<td>5.8</td>
<td>5.1</td>
<td>-4.9</td>
<td>1.8</td>
</tr>
<tr>
<td>-51-60%</td>
<td>1047</td>
<td>76</td>
<td>€129</td>
<td>€81</td>
<td>€30</td>
<td>68.1</td>
<td>5.2</td>
<td>4.7</td>
<td>-4.9</td>
<td>1.8</td>
</tr>
<tr>
<td>-61-70%</td>
<td>1047</td>
<td>77</td>
<td>€123</td>
<td>€77</td>
<td>€29</td>
<td>73.9</td>
<td>5.0</td>
<td>4.6</td>
<td>-4.6</td>
<td>1.7</td>
</tr>
<tr>
<td>-71-80%</td>
<td>1047</td>
<td>77</td>
<td>€115</td>
<td>€71</td>
<td>€28</td>
<td>83.7</td>
<td>4.8</td>
<td>4.7</td>
<td>-4.2</td>
<td>1.5</td>
</tr>
<tr>
<td>-81-90%</td>
<td>1047</td>
<td>82</td>
<td>€101</td>
<td>€58</td>
<td>€30</td>
<td>120.9</td>
<td>5.2</td>
<td>5.3</td>
<td>-3.4</td>
<td>1.3</td>
</tr>
<tr>
<td>Btm 10%</td>
<td>1048</td>
<td>93</td>
<td>€63</td>
<td>€20</td>
<td>€32</td>
<td>217.4</td>
<td>6.2</td>
<td>6.8</td>
<td>-1.1</td>
<td>0.5</td>
</tr>
<tr>
<td>Overall</td>
<td>10470</td>
<td>86</td>
<td>€129</td>
<td>€75</td>
<td>€35</td>
<td>94.0</td>
<td>6.3</td>
<td>5.6</td>
<td>-4.4</td>
<td>1.7</td>
</tr>
</tbody>
</table>

- High EBI herds = higher genetic merit for milk solids & fertility.
2. EBI & Actual Performance.

<table>
<thead>
<tr>
<th>Herd Rank on EBI</th>
<th>EBI</th>
<th>CI Days</th>
<th>Sp 6 wk calv rate</th>
<th>% 2 yr calv</th>
<th>Litres/cow/day</th>
<th>Milk price/cpl</th>
<th>Milk value/cow/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top 10%</td>
<td>€176</td>
<td>374.1</td>
<td>72.3</td>
<td>87.2</td>
<td>16.15</td>
<td>32.01</td>
<td>5.17</td>
</tr>
<tr>
<td>-11-20%</td>
<td>€157</td>
<td>377.1</td>
<td>67.4</td>
<td>80.7</td>
<td>16.25</td>
<td>31.08</td>
<td>5.05</td>
</tr>
<tr>
<td>-21-30%</td>
<td>€148</td>
<td>381.1</td>
<td>63.8</td>
<td>74.2</td>
<td>15.97</td>
<td>30.70</td>
<td>4.91</td>
</tr>
<tr>
<td>-31-40%</td>
<td>€141</td>
<td>382.9</td>
<td>60.7</td>
<td>70.1</td>
<td>15.77</td>
<td>30.45</td>
<td>4.80</td>
</tr>
<tr>
<td>-41-50%</td>
<td>€135</td>
<td>386.8</td>
<td>58.4</td>
<td>60.7</td>
<td>15.61</td>
<td>30.22</td>
<td>4.72</td>
</tr>
<tr>
<td>-51-60%</td>
<td>€129</td>
<td>389.0</td>
<td>56.0</td>
<td>58.2</td>
<td>15.39</td>
<td>30.14</td>
<td>4.64</td>
</tr>
<tr>
<td>-61-70%</td>
<td>€123</td>
<td>391.9</td>
<td>55.1</td>
<td>52.2</td>
<td>15.43</td>
<td>29.97</td>
<td>4.63</td>
</tr>
<tr>
<td>-71-80%</td>
<td>€115</td>
<td>396.3</td>
<td>52.8</td>
<td>45.0</td>
<td>15.20</td>
<td>29.86</td>
<td>4.54</td>
</tr>
<tr>
<td>-81-90%</td>
<td>€101</td>
<td>400.7</td>
<td>50.2</td>
<td>43.3</td>
<td>15.68</td>
<td>29.81</td>
<td>4.67</td>
</tr>
<tr>
<td>Btm 10%</td>
<td>€63</td>
<td>417.8</td>
<td>42.5</td>
<td>33.4</td>
<td>17.05</td>
<td>29.71</td>
<td>5.05</td>
</tr>
<tr>
<td>Overall</td>
<td>€129</td>
<td>389.8</td>
<td>57.9</td>
<td>60.5</td>
<td>15.85</td>
<td>30.39</td>
<td>€4.82</td>
</tr>
</tbody>
</table>

- High EBI herds => Better fertility & milk value.
  - Consistent for both Spring & Split Calving.
3. EBI & Breed*

<table>
<thead>
<tr>
<th>Breed</th>
<th>Herds</th>
<th>EBI</th>
<th>CI Days</th>
<th>Sp 6 week</th>
<th>2 yr calv</th>
<th>Litres/ cow/ day</th>
<th>Price cpl</th>
<th>Milk value/ cow/ day</th>
</tr>
</thead>
<tbody>
<tr>
<td>HO</td>
<td>6794</td>
<td>€134.7</td>
<td>383.1</td>
<td>61.7</td>
<td>68.9</td>
<td>15.87</td>
<td>30.16</td>
<td>4.79</td>
</tr>
<tr>
<td>JE-x</td>
<td>262</td>
<td>€169.3</td>
<td>377.0</td>
<td>70.1</td>
<td>83.9</td>
<td>14.54</td>
<td>33.61</td>
<td>4.90</td>
</tr>
<tr>
<td>FR</td>
<td>680</td>
<td>€135.2</td>
<td>375.6</td>
<td>65.4</td>
<td>68.7</td>
<td>15.22</td>
<td>30.35</td>
<td>4.62</td>
</tr>
<tr>
<td>Other (Red)</td>
<td>312</td>
<td>€135.7</td>
<td>382.3</td>
<td>63.8</td>
<td>62.5</td>
<td>15.15</td>
<td>30.43</td>
<td>4.62</td>
</tr>
<tr>
<td>Total</td>
<td>8048</td>
<td>€135.9</td>
<td>382.3</td>
<td>62.4</td>
<td>69.1</td>
<td>15.74</td>
<td>30.30</td>
<td>4.77</td>
</tr>
</tbody>
</table>

* Based on Spring calving herds only.

- Herds with Jersey cross-bred cows are performing best.
  - Consistent with previous Teagasc & ICBF analysis => €150/lactation.
- Is it due to EBI, management or heterosis?
4. Genetic Trends for HF & JE.

Rate of genetic gain 240% higher in HF than JE
5. High EBI Holstein & JE herds*

<table>
<thead>
<tr>
<th>Breed</th>
<th>Herds</th>
<th>EBI</th>
<th>CI Days</th>
<th>Sp 6 week</th>
<th>2 yr calv</th>
<th>Litres/ cow/day</th>
<th>Price cpl</th>
<th>Milk value/ cow/ day</th>
</tr>
</thead>
<tbody>
<tr>
<td>High EBI Holstein Herds</td>
<td>131</td>
<td>€177.0</td>
<td>373.2</td>
<td>73.4</td>
<td>89.7</td>
<td>15.98</td>
<td>32.0</td>
<td>5.12</td>
</tr>
<tr>
<td>High EBI Jersey cross herds</td>
<td>90</td>
<td>€181.2</td>
<td>374.8</td>
<td>71.4</td>
<td>89.8</td>
<td>14.44</td>
<td>34.3</td>
<td>4.97</td>
</tr>
</tbody>
</table>

* Based on Spring calving herds >150 cows. 221 herds & 51,785 cows in analysis.

- At same level of herd EBI, little difference in performance between herds with high EBI Holstein & High EBI Jersey cows.
  - Further analysis of EPM => no difference in SR, meal fed or profit/ha between both groups.
- Same EBI, same management, where is the heterosis?
Many unanswered questions.

- Repeat analysis with full year milk co-op data.
- Are there management differences that we are not accounting for. Use EPM data for 2015.
- Understand what is happening with heterosis?
  - At higher levels of EBI, does it reduce?
- Genomic evaluations for other dairy breeds.
  - Lack of data, animals, cross-bred only data.
- Next Generation herd for high EBI JE pure-bred, JE-cross & HF animals.
- Cost:benefits of a breeding program to support multiple breeds, given that 90% herds and using B&W.
Summary.

• EBI is working on farms.
  – Regardless of system or breed.

• Cross-breeding has a role to play on farms.
  – Trade-off between average EBI (bull * herd) and heterosis.

• Rapid genetic gain in HF breed.
  – Driven by genomics (data, animals & breeding program).
  – Other breeds will “struggle” to match this level of gain.

• ICBF will continue to work with Teagasc and AI companies to make high EBI bulls (from all breeds) available through G€N€ IR€LAND.
  – Critical that farmers support => independent evaluations, to help identify best animals/breeds for Irish farmers.