Genotyping cows for the reference makes a small breed competitive

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Small active populations challenged by Genomic Selection

- Low reliabilities of genomic predictions due to small sire reference population
- Limited possibilities for cooperation compared to Holstein
- Across breed predictions – limited gain in reliability so far

Danish Jersey as model breed
Low reliabilities limit efficiency of genomic selection

(Thomasen, 2013)
Aim

• Evaluate the value of increasing the reference population
  
  • Adding genotyped cows
    • 2,000 annually

• Adding progeny tested bulls
  • From 15 to 500 annually
Method and traits

- Stochastic approach
  - Finite locus model

- Breeding goal condensed into two traits
  - Production trait
    - $h^2=0.30$
    - Economic value: 83 Euro
  - Functional trait
    - $h^2=0.04$
    - Economic value: 82 Euro
  - Genetic correlation between traits -0.30
Comparisons between schemes

• **Hybrid**
  - Mixed use of YB and PB as bull sires
  - Actual genomic scheme in Danish Jersey

• The **Turbo** breeding scheme
  - No use of proven bulls
Simulation design

Historic population
- 500 generations
  - LD
  - QTL

Sire reference population
- 20 years
  - Conventional scheme
  - 1000 reference bulls

Genomic Breeding Schemes
- 15 years
  - Evaluation
## Comparisons of breeding schemes

<table>
<thead>
<tr>
<th>Scheme</th>
<th>Info</th>
<th>ΔG/year (€)</th>
<th>ΔF/gen. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hybrid</td>
<td>60 PB/yr</td>
<td>24.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.97&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Hybrid</td>
<td>+ 2,000 cows/yr</td>
<td>27.4&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.55&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Turbo</td>
<td>60 PB/yr</td>
<td>28.1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.78&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Turbo</td>
<td>+ 2,000 cows/yr</td>
<td>34.6&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.43&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>
Reliability increases remarkably by adding genotyped cows to reference

Hybrid

Turbo

Progeny test
+2000 cows/yr
+60 PB/yr
Progeny tested bulls and genetic gain

![Graph showing genetic gain (Euro) vs. No. Progeny tested for Turbo and Hybrid.]

- Turbo: Genetic Gain (Euro) increases with No. Progeny tested.
- Hybrid: Genetic Gain (Euro) remains relatively stable with No. Progeny tested.

Daughter group size:
- 100
- 50
- 25
- 17
- 13
- 10
Economic evaluation of hybrid scheme

• Assumption
  ➢ Cost of genotyping: € 60 per cow (10K chip)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Gain in reliability</th>
<th>Relative Profit* (€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sire reference +60 PB/yr</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>+2000 cows/yr</td>
<td>0.38 (Simulation)</td>
<td>111.1</td>
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<tr>
<td>+2000 cows/yr</td>
<td>0.20</td>
<td>106.5</td>
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<tr>
<td>+2000 cows/yr</td>
<td>0.10</td>
<td>102.6</td>
</tr>
<tr>
<td>+2000 cows/yr</td>
<td>0</td>
<td>98.8</td>
</tr>
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</table>

* Deterministic (ZPLAN)
Genotyping Cows

- Genotyping cows:
  - Increases monetary genetic gain (10% to 23%)
  - Reduces rate of inbreeding (~20%)
  - Increases reliabilities of GEBV
  - Is profitable

- Most benefit in turbo schemes

- Genotyping cows makes a small breed competitive

- Next Step
  - Genotyping of 10,000 Danish Jersey females this year
Reliability of GEBV- varied number of progeny tested bulls

Hybrid

Turbo

500 YB
100 YB
60 YB
15 YB

500 YB
100 YB
60 YB
15 YB