Possibilities for a specific breeding program for organic dairy production

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Dairy production

• Organic dairy production
  – Management practices & labelling of products
  – Breeding animals originate mostly from conventional production
  – Specific regulations for breeding
    • Embryo transfer is not allowed

• Conventional dairy production
  – Embryo transfer
  – Breeding goal: economic values mostly based on conventional dairy production
  – Nordic Total Merit index
Aim

- Assess different environment-specific breeding strategies for organic dairy production
  - Breeding goal differences
  - Embryo transfer
  - Selection of conventional bulls
Methods

• Breeding goal
  – Traits: milk production, mastitis, cow fertility
  – Economic values for Holstein
  – NTM conventional and NTM organic
  – Match correlations sub-index NTM

• GxE estimates from Denmark (Liu et al., 2019)

• Five scenarios
Current scenario

Conventional
BG = conventional

Organic
BG = conventional

10,000 cows in breeding nucleus

3,000 bull calves genotyped

100 bulls selected

3,000 heifers genotyped

450 heifers selected for MOET

10,000 cows in breeding nucleus
10,000 cows in breeding nucleus

1,500 bull calves genotyped

100 bulls selected

1,500 heifers genotyped

225 heifers selected for MOET

Organic breeding goal

Conventional
BG = conventional

Organic
BG = organic

10,000 cows in breeding nucleus

1,500 bull calves genotyped

100 bulls selected

1,500 heifers genotyped

225 heifers selected for MOET
Within

Conventional
BG = conventional

10,000 cows in breeding nucleus

1,500 bull calves genotyped

100 bulls selected

1,500 heifers genotyped

225 heifers selected for MOET

Organic
BG = organic

10,000 cows in breeding nucleus

1,500 bull calves genotyped

100 bulls selected

1,500 heifers genotyped

225 heifers selected for MOET
Breeding strategies for multiple environments

No MOET

**Conventional**
BG = conventional

- 10,000 cows in breeding nucleus
- 1,500 bull calves genotyped
- 100 bulls selected
- 1,500 heifers genotyped
- 1,500 bull calves genotyped
- 225 heifers selected for MOET

**Organic**
BG = organic

- 10,000 cows in breeding nucleus
- 1,500 bull calves genotyped
- 100 bulls selected
- 1,500 heifers genotyped
- 1,500 bull calves genotyped


Conventional
BG = conventional

Organic
BG = organic

10,000 cows in breeding nucleus
1,500 bull calves genotyped
100 bulls selected
1,500 heifers genotyped
225 heifers selected for MOET

10,000 cows in breeding nucleus
1,500 bull calves genotyped
100 bulls selected
1,500 heifers genotyped
Relative genetic gain in aggregate genotype

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Breeding goal</th>
<th>MOET</th>
<th>Selection of conventional bulls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>Conventional</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Organic BG</td>
<td>Organic</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Within</td>
<td>Organic</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>No MOET</td>
<td>Organic</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Strict</td>
<td>Organic</td>
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<td>No</td>
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Relative genetic gain in aggregate genotype

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Breeding goal</th>
<th>MOET</th>
<th>Selection of conventional bulls</th>
<th>Genetic gain</th>
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<td>Current</td>
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<td>Organic</td>
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</table>
Genetic gain per trait

- Cow fertility
- Mastitis
- Milk production

Genetic gain in $\sigma_a$ units

- Current
- Organic BG
- Within
- No MOET
- Strict
## Conventional bulls selected

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Percentage of selected bulls originating from conventional environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>54%</td>
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<tr>
<td>Organic BG</td>
<td>37%</td>
</tr>
<tr>
<td>Within</td>
<td>0%</td>
</tr>
<tr>
<td><strong>No MOET</strong></td>
<td><strong>72%</strong></td>
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<tr>
<td>Strict</td>
<td>0%</td>
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</tbody>
</table>
Conclusions

• Specific organic breeding goal similar genetic gain in aggregate genotype

• Genetic gain on trait level more ‘organic’

• No MOET and/or no selection of conventional bulls: lower genetic gain in aggregate genotype

• No MOET: direction of selection ‘conventional’
  – Tradeoff between not using embryo transfer and desired direction of genetic change
Recommendations

• Implement specific breeding goal in organic dairy production

• Consider no selection of conventional bulls
  – Collaboration with other organic populations

• Alternative for embryo transfer?
  – Genotype more animals (in small populations)
  – No real alternative