Non-chemical disease management in fruit and berry production.

Present practise, on-going research and future potential.

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Organically grown areas with fruit and berries in Denmark 1991-2009

Source: www.naturerhverv.dk
## European organic apple-production in 2010

<table>
<thead>
<tr>
<th>Country</th>
<th>Ha Apples</th>
<th>Ha Organic Apples</th>
<th>% Organic Acreage</th>
<th>Yield: Tons pr. ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poland</td>
<td>188,200</td>
<td>4,790</td>
<td>2.5</td>
<td>?</td>
</tr>
<tr>
<td>Italy</td>
<td>57,900</td>
<td>3,364</td>
<td>5.8</td>
<td>?</td>
</tr>
<tr>
<td>South-Tyrol</td>
<td>18,512</td>
<td>1,247</td>
<td>6.7</td>
<td>40</td>
</tr>
<tr>
<td>France</td>
<td>40,000</td>
<td>1,470</td>
<td>3.7</td>
<td>14</td>
</tr>
<tr>
<td>Germany</td>
<td>31,800</td>
<td>2,772</td>
<td>8.7</td>
<td>18</td>
</tr>
<tr>
<td>Netherlands</td>
<td>8,700</td>
<td>270</td>
<td>3.1</td>
<td>19</td>
</tr>
<tr>
<td>Belgium</td>
<td>7,700</td>
<td>145</td>
<td>1.9</td>
<td>?</td>
</tr>
<tr>
<td>Austria</td>
<td>6,100</td>
<td>767</td>
<td>12.6</td>
<td>16</td>
</tr>
<tr>
<td>Switzerland</td>
<td>3,400</td>
<td>270</td>
<td>7.9</td>
<td>15</td>
</tr>
<tr>
<td>Denmark</td>
<td>1,684</td>
<td>268</td>
<td>15.9</td>
<td>6</td>
</tr>
</tbody>
</table>

Source: Markus Kelderer, Laimburg, IOBC-meeting 2011
Many growers find it profiting, making apple-juice of the unperfect apples.
The consumption of organic apples has tripled in 7 years.
Daily intake of pesticides in Danish food in 2008. (20 most important sources.)

<table>
<thead>
<tr>
<th>Food</th>
<th>Intake of pesticides µg/day/person</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>28</td>
</tr>
<tr>
<td>Wheatbread</td>
<td>11</td>
</tr>
<tr>
<td>Potato</td>
<td>5</td>
</tr>
<tr>
<td>Pear</td>
<td>6</td>
</tr>
<tr>
<td>Tomato</td>
<td>3</td>
</tr>
<tr>
<td>Cucumber</td>
<td>2</td>
</tr>
<tr>
<td>Wine</td>
<td>4</td>
</tr>
<tr>
<td>Lettuce</td>
<td>4</td>
</tr>
<tr>
<td>Grape</td>
<td>3</td>
</tr>
<tr>
<td>Orange</td>
<td>2</td>
</tr>
<tr>
<td>Lemon</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Food</th>
<th>Intake µg/day/person</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mandarin</td>
<td>1</td>
</tr>
<tr>
<td>Kiwi</td>
<td>2</td>
</tr>
<tr>
<td>Oatmeal</td>
<td>1</td>
</tr>
<tr>
<td>Peach</td>
<td>4</td>
</tr>
<tr>
<td>Pepper</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Banana</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Carrot</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Strawberry</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Ryebread</td>
<td>2</td>
</tr>
</tbody>
</table>

**Total sum** 81

Source: Pesticidrester I Fødevarer 2008,
Fødevare-Rapport 2009:06
Non chemical disease management in fruit and berry production. Present practise.
Fruit and berries are attacked by many fungus-diseases. In present practise they are generally prevented before planting by:

- Choosing a fairly dry location.
- Choosing a well drained soil, JB 2-6
- Choosing a “fresh” soil (not replanting)
- Irrigating only by drip irrigation
- Choosing varieties, that are robust to pests and diseases.
- Do not choose varieties with a single-gene resistance, which is easy to break down.
Choose the most dry climate for organic growing of fruit and berries.

The yearly precipitation in Denmark varies from less than 500 mm to more than 900 mm. In the darkblue areas it rains too much for organic applegrowing.
Pesent practise in organic production of apples:
Fungus-diseases in apples are also prevented by:

• Choosing robust varieties
• Choosing weak-growing rootstocks (M9)
• Pruning the trees to be open and airy
• Keeping nitrogen-level low (2-2,3%)
• Removing or mulching old leaves, infected branches, mummies etc. during winter.
• Spraying with approved organic fungicides
Choice of variety: The most important single factor in organic fruit production.
Economical results from the harvest 2004 in five model-orchards.

Best variety was ‘Red Aroma’, the poorest was ‘Elshof’.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Discovery</th>
<th>Holst. Cox</th>
<th>Rød Aroma</th>
<th>Elshof</th>
<th>Ingrid Marie</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield 2004 t/ha</td>
<td>9,3</td>
<td>9,9</td>
<td>17,9</td>
<td>8,9</td>
<td>11,2</td>
</tr>
<tr>
<td>Price DKr/kg</td>
<td>11,77</td>
<td>12,52</td>
<td>11,60</td>
<td>9,87</td>
<td>11,09</td>
</tr>
<tr>
<td>Costs kr/ha</td>
<td>79.463</td>
<td>82.822</td>
<td>109.103</td>
<td>96.605</td>
<td>90.390</td>
</tr>
<tr>
<td>DB kr/ha</td>
<td>30.104</td>
<td>41.711</td>
<td>98.247</td>
<td><strong>-8.530</strong></td>
<td>34,148</td>
</tr>
</tbody>
</table>

The planting distance is 0,8 x 3,5 meter.

Source:
http://www.landbrugsinfo.dk/Oekologi/Filer/IFOAMplakat.pdf
Results from harvest 2005 in four of the five model orchards.

Best variety was Holsteiner Cox, the poorest was Ingrid Marie

<table>
<thead>
<tr>
<th>Variety</th>
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<th>Holst. Cox</th>
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<th>Elshof</th>
<th>Ingrid Marie</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield 2005 t/ha</td>
<td>5,8</td>
<td>10,0</td>
<td>7,4</td>
<td>5,8</td>
<td>6,5</td>
</tr>
<tr>
<td>Price DKr/kg</td>
<td>11,61</td>
<td>11,15</td>
<td>9,51</td>
<td>10,79</td>
<td>6,76</td>
</tr>
<tr>
<td>Costs kr/ha</td>
<td>51.685</td>
<td>67.310</td>
<td>65.649</td>
<td>58.602</td>
<td>53.445</td>
</tr>
<tr>
<td>DB kr/ha</td>
<td>15.833</td>
<td>44.479</td>
<td>4.606</td>
<td>3.791</td>
<td>-9.359</td>
</tr>
</tbody>
</table>

The planting distance is 0,8 x 3,5 meter.
Recommended varieties of apple for organic production

Nanna
Collina
Discovery
Alkmene
Aroma
Ahrista
Holsteiner Cox
Ingrid Marie
Elstar
Rubinstep
Angold
Vf-Scab-resistance got broken down by new races of *Venturia inaequalis* in Denmark in year 2000.
Many of the Vf-resistant cultivars are very susceptible to "Topaz-spots", like this Rubinola-apple.
The same cultivar "Retina" grown at different nitrogen levels

“Sustainable production systems for organic apple production”. By Hanne Lindhard Pedersen.

Clovergrass

Annual cover crop of *Lolium multiflorum*

A permanent, slow growing grass mixture
Removing old leaves is important. Rainworms are essential!
Compost can boost rainworms.
Pruning prevents mildew and cancer
Allowed agents for regulation of pests and diseases in organic production*

Azadirachtin (Neem)
Gelatine
Lecithin
Plant oils
Pyrethrum (natural)
(Quassia)
Rotenon (Derris)
Microorganisms:
* Bac. Thuringiensis
Virus against Codling moth (Madex),
* Trichoderma and others

Pheromones (only in dispensers or traps)
Iron-orthophosphosphate (Ferramol)
Copper
Fatty acid potassium salt (soap)
Calcium hydroxide
Potassium permanganate
Potassium bicarbonate
Sulphur
Lime sulphur
Paraffin oil/ mineral oil

*)According to the EU council regulation EU 834/2007.
Only a few are permitted by the Danish environmental authorities (shown in green).
Apple scab (Venturia inaequalis) can be reduced by spraying with sulphur using the scab-warning-program “Rimpro.”
The effect of different organic fungicides on apple scab, predatory mites and scrub.

![Bar graph showing the effect of different fungicides on apple scab, predatory mites, and scrub.](www.ecofruit.net/proceedings-2008.html)
Present practise of organic production of Black currant (*Ribes nigrum*)

- Robust varieties, especially robust against mildew are planted. Recommended are ‘Ben hope’ and ‘Narve Viking’
- No fungicides are normally used.
Present practise of organic production of Strawberry.

• Robust varieties, especially robust against Grey mold (*Botrytis cinerea*) are planted. Recommended are ‘Honeoye’, ‘Sonata’, ‘Symphony’ and ‘Florence’ and others.
• No fungicides are normally used.
• Some are using bumble-bees for distribution of *Trichoderma* in the flowers to prevent grey mold. ”The flying doctor”
• Good croprotation to prevent root-diseases.
• Drip-irrigation to prevent Grey mold.
Ongoing research in organic disease management in apple.


WP2.1 FRUITGROWTH:
Robust cultivars suited for Danish organic production systems

Planting of new varieties (29 varieties)
Evaluation of a mature planting (2000-02) consisting of more than 30 varieties. From 2009 trees have been left totally unsprayed and in 2011, as part of the present project 18 varieties have been evaluated both in terms of disease occurrence and fruit quality. The remaining 12 varieties were identified as being unsuitable for organic production.

Trial with mechanical protection against apple scab
Strategic irrigation against apple scab.
Strategic irrigation against apple scab. Trial at the Pometum in Taastrup, KU. Trials in FRUITGROWTH made by Maren Korsgaard. Project-period: 2012-2013
Control of apple-scab by using irrigation-sprinklers for spraying with sulphur or potassium bicarbonate. Trials in FRUITGROWTH carried out by Marianne Bertelsen AU. Project period: 2012-2013.
Future potential for non-chemical disease management.

- Conventional (Non-GMO) breeding of new robust varieties
- Methods of prevention:
  - Reduction of the infecting material (old leaves etc.)
  - ”Healthy” soils (microbial balances)
  - Nutrient-balances
  - Protected production
  - Improve biological control of fungi
- Less potential in new ”organic” pesticides.
- Some potential in testing ”basic substances”