Early crop establishment
as a tool in late blight management in organic potato production systems

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Research in organic agriculture, health and nutrition
Two research projects on late blight

“Towards a solution to the blight-problem in organic potato growing”
Integration of agronomic, breeding and epidemiological approaches
1999 - 2003
Together with Plant Research International (Wageningen)

“Blight-MOP: a systems approach for late blight management”
2001 - 2005
Together with research partners in 7 European countries
Organic agriculture

• Ample rotations (6 - 7 years)
• Diversification at farm, crop and variety level
• Organic fertilisation (animal manure, compost)
• Crop protection by prevention and self regulation
• No use of chemical-synthetic protectants
• ....
Organic potatoes in Europe

Table 1. Development of area (hectares 2000 as percentage of hectares 1998)

<table>
<thead>
<tr>
<th></th>
<th>Denmark</th>
<th>France</th>
<th>Germany</th>
<th>Netherlands</th>
<th>Norway</th>
<th>Switzerland</th>
<th>United Kingdom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total arable</td>
<td>99</td>
<td>99</td>
<td>99</td>
<td>100</td>
<td>101</td>
<td>98</td>
<td>101</td>
</tr>
<tr>
<td>Total potato</td>
<td>109</td>
<td>103</td>
<td>101</td>
<td>99</td>
<td>86</td>
<td>101</td>
<td>102</td>
</tr>
<tr>
<td>Organic arable</td>
<td>167</td>
<td>169</td>
<td>131</td>
<td>108</td>
<td>356</td>
<td>117</td>
<td>129</td>
</tr>
<tr>
<td>Organic potato</td>
<td>146</td>
<td>120</td>
<td>111</td>
<td>130</td>
<td>189</td>
<td>113</td>
<td>154</td>
</tr>
</tbody>
</table>

Table 2. Acreage proportion of organic potatoes in terms of purposes (in %; 2000)

<table>
<thead>
<tr>
<th></th>
<th>Denmark</th>
<th>France</th>
<th>Germany</th>
<th>Nether-lands</th>
<th>Norway</th>
<th>Swiss-land</th>
<th>United Kingdom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table</td>
<td>76,2</td>
<td>89,5</td>
<td>Nd</td>
<td>76</td>
<td>100</td>
<td>72</td>
<td>80</td>
</tr>
<tr>
<td>Processing</td>
<td>2</td>
<td>0</td>
<td>Nd</td>
<td>4</td>
<td>0</td>
<td>16</td>
<td>10</td>
</tr>
<tr>
<td>Seed</td>
<td>21,8</td>
<td>11,5</td>
<td>Nd</td>
<td>20</td>
<td>0</td>
<td>12</td>
<td>10</td>
</tr>
</tbody>
</table>

Nd: no data

Data analysis by B. Janssens, LEI
Copper used in the last 5 years?

- Denmark
- Germany
- Norway
- United Kingdom

Percent

0 10 20 30 40 50 60 70 80 90 100

Exceptional use in 1998

no
yes
Late blight regulations in the Netherlands

• Obligation to cover waste piles

• Obligation to remove volunteer potatoes

• Obligation to destroy foliage as soon as
  -in a group of united potato-plants, visibly infected by Phytophthora infestans, within a radius of 20 square meters at minimum 1000 leaflets are infected by vital Phytophthora infestans, or
  -on scattered infected potato plant, within a surface of 100 square meters at minimum 2000 leaflets are infected by vital Phytophthora infestans.
Situation of organic potato growers

• Realistic agronomic measures in Phytophthora-control difficult to find

• Available varieties not good enough
• Development of new varieties takes 5 - 10 years
Variety-specific strategy

Each variety has specific characteristics and should be grown accordingly

Example: Bimonda & Remarka (2000)
Variety-specific strategy

On experimental plots in 2000:

- Stronger, more vital plants
- Blight-epidemic delayed

But:

- no yield differences

In 2001 effects less clear
Agronomy: realising an early crop

- **Avoidance strategy:**
  Realise an acceptable yield at the moment late Blight destroys the crop.

- **'Resistance' strategy:**
  Support a healthy, undisturbed plant growth.

A short juvenile fase (rel. susceptible for Blight), and a strong mature fase (more resistant to Blight) is preferred? (hypothesis and practical relevance to be tested)
Early crop establishment

- Variety choice
- Fysiologically older seed
- Chitting of seed
- Planting time as soon as soil is fit
- Ridge formation as late as possible
Early crop establishment

**Experiments:**

- Physiological age and chitting (LBI, 2002)
- Planting date and chitting (UNEW, 2001 & 2002; LBI, 2002)
Physiological age and chitting
(LBI, 2002)

- Varieties: Santé, Agria, Appell
- Storage: outside temperatures (→older seed), or cooled at 6 °C (→younger seed)
- Chitting: yes or no
Physiological age and chitting

Yield after 80 days, farm 1

Final yield, farm 1

Yield after 80 days, farm 2

Final yield, farm 2
Physiological age and chitting (LBI, 2002)

Conclusions:

• No differences in Blight-development
• Chitting gives higher yields & larger tubers
• A wider range of storage conditions is needed to find yield effects
Planting date & chitting

- Varieties: Santé & Nicola (UNEW 2001), Lady Balfour & Valor (UNEW 2002), Santé and Appell (LBI 2002)
- Planting: Early or late
- Chitting: not shortly (eye emergence) fully
Planting date & chitting

Results *(UNEW, 2001)*

![Disease development graph](image)

Nicola  Sante
Planting date & chitting

Results (UNEW, 2002) Lady Balfour
Planting date & chitting

Results (UNEW, 2002)
# Planting date & chitting

## Results (LBI, 2002)

<table>
<thead>
<tr>
<th>Planting date</th>
<th>Early</th>
<th>Late</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chitting</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Full</td>
<td>Short</td>
</tr>
<tr>
<td><strong>Appell</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Netto yield (ton/ ha)</td>
<td>43.77&lt;sup&gt;c&lt;/sup&gt;</td>
<td>40.23&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Yield 40-65 mm (ton/ ha)</td>
<td>38.95&lt;sup&gt;d&lt;/sup&gt;</td>
<td>36.17&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>Percentage 0-40 mm</td>
<td>10.71&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8.84&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Percentage 40-65 mm</td>
<td>89.21&lt;sup&gt;c&lt;/sup&gt;</td>
<td>90.15&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Percentage &gt;65 mm</td>
<td>0.08&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.01&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Santé</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Netto yield (ton/ ha)</td>
<td>28.26&lt;sup&gt;d&lt;/sup&gt;</td>
<td>21.87&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Yield 40-65 mm (ton/ ha)</td>
<td>23.08&lt;sup&gt;e&lt;/sup&gt;</td>
<td>12.69&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Percentage 0-40 mm</td>
<td>14.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>41.9&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Percentage 40-65 mm</td>
<td>83.2&lt;sup&gt;d&lt;/sup&gt;</td>
<td>58.1&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Percentage &gt;65 mm</td>
<td>2.34&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>
Planting date & chitting

Results (LBI, 2002)
Planting date & chitting

Conclusions

• Early planting can contribute to more Blight, or to less Blight
• Early planting gives higher yields than late planting
• Chitting gives higher yields, especially when planted late
• Stronger reactions to chitting for more sensitive varieties
• Higher dry-matter contents in chitted potatoes
Early crop establishment - conclusions

- More resistant varieties contribute to higher yields
- Chitting of seed contributes to higher yields
- Planting time as soon as soil is fit
- Effects of treatments are variety-dependent
- Yield effects are easier to achieve than effects on Blight-infection
Perspectives and research

**Short term:**

- Optimisation of practical tools for farmers (physiological age, chitting, planting date)

**Long term:**

- Development of resistant varieties
- Optimisation of field resistance
Conclusion

We can **not** stay free from Blight,

but we can **to** learn to live with it!