Testing of beet cyst nematode (Heterodera schachtii) resistant sugar beet varieties:

Neighbouring effects and interference of nematode population density in variety trials

Elma Raaijmakers (IRS), Christine Kenter (IfZ), André Wauters (IRBAB), Åsa Olsson (NBR) and Matthias Daub (JKI)

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H. schachtii in variety trials

• Three different kinds of varieties:
  – susceptible
  – tolerant
  – resistant
Hypotheses

- Hypothesis 1: Resistant varieties with low canopy suffer from shadowing effects displayed by tolerant and susceptible varieties in neighbouring plots.

- Hypothesis 2: Tolerant and susceptible varieties show increased yield in plots neighbouring resistant varieties in nematode infested fields.
Research question

Is yield of resistant varieties underestimated in variety trials?
Investigations

- 4 field trials with six-row plots, harvested row-by-row to investigate the effect of neighbouring rows on yield
- 2 field trials with six-row plots and alternating one-row plots to investigate the effect of neighbouring rows on *H. schachtii*
Investigations

• 4 field trials with six-row plots, harvested row-by-row to investigate the effect of neighbouring rows on yield

• 2 field trials with six-row plots and one-row plots to investigate the effect of neighbouring rows on *H. schachtii*
Neighbouring effects on yield

- **Three varieties:**
  - susceptible (medium leaf canopy)
  - tolerant (high leaf canopy)
  - resistant (low leaf canopy)

- **Four locations:**
  - Belgium  (2013 and 2014)
  - Sweden   (2013)
  - Germany  (2014)
# Neighbouring effects on yield

## Field trial plan

<table>
<thead>
<tr>
<th>Replicates</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
</tr>
<tr>
<td>Susceptible</td>
</tr>
<tr>
<td>Susceptible</td>
</tr>
<tr>
<td>Resistant</td>
</tr>
<tr>
<td>B</td>
</tr>
<tr>
<td>Tolerant</td>
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<tr>
<td>Resistant</td>
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<td>Resistant</td>
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<td>Resistant</td>
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<td>Susceptible</td>
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<td>Tolerant</td>
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<td>D</td>
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<tr>
<td>Susceptible</td>
</tr>
<tr>
<td>Tolerant</td>
</tr>
<tr>
<td>Tolerant</td>
</tr>
</tbody>
</table>

## Row numbers

1 2 3 4 4 3 2 1

[Field trial plan diagram]

Belgium (2013)

[Field trial plan image]
Susceptible vs. Resistant

Relative sugar yield

<table>
<thead>
<tr>
<th>Row number</th>
<th>Susceptible</th>
<th>Resistant</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 and 2</td>
<td>a</td>
<td>A</td>
</tr>
<tr>
<td>3</td>
<td>a</td>
<td>A</td>
</tr>
<tr>
<td>4</td>
<td>a</td>
<td>A</td>
</tr>
<tr>
<td>4</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>3</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>1 and 2</td>
<td>a</td>
<td>A</td>
</tr>
</tbody>
</table>

Ilsd 5% (susceptible) = 4.6
Ilsd 5% (resistant) = 4.5

no indication of shadowing effect on neighbouring plots
Susceptible vs. Tolerant

Clear effect on border row, row 3 is not influenced!
Canopy height was highest in tolerant variety
Tolerant vs. Resistant

Clear effect on border row, row 3 is not influenced!
Canopy height was highest in tolerant variety
## Effect of harvesting system on yield

<table>
<thead>
<tr>
<th></th>
<th>Resistant</th>
<th>Susceptible</th>
<th>Tolerant</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 rows out of 6</td>
<td>100</td>
<td>n.s.</td>
<td>100</td>
</tr>
<tr>
<td>4 rows out of 6</td>
<td>100</td>
<td>n.s.</td>
<td>101</td>
</tr>
<tr>
<td>6 rows out of 6</td>
<td>99</td>
<td>n.s.</td>
<td>105</td>
</tr>
<tr>
<td>3 rows out of 3</td>
<td>97</td>
<td>n.s.</td>
<td>109</td>
</tr>
</tbody>
</table>

100 = yield in the 2-rows-out-of-6 harvesting system.

Yield of resistant variety is underestimated.
Yield of tolerant variety is overestimated, especially in three-row systems.
Conclusions (1)

• Yield of resistant variety was underestimated (3%) and tolerant variety overestimated (9%) in three out of three rows harvesting system. No effect of system on susceptible variety.

• Neighbouring effect only visible in border row
Investigations

• 4 field trials with six-row plots, harvested row-by-row to investigate the effect of neighbouring rows on yield

• 2 field trials with six-row plots and alternating one-row plots to investigate the effect of neighbouring rows on *H. schachtii*
Neighbouring effects on *H. schachtii*

Field trial plan

Susceptible / resistant variety
Plots with alternating rows and pure stand
Number of nematodes in susceptible variety reduced by neighbouring a resistant variety...

2013

Pi = 1335 eggs and larvae/100 ml soil
...but not in 30-60 cm

2013
not significant

Varity

in alternating rows
in pure stand

Pi = 790 eggs and larvae/100 ml soil

Final population (number of eggs and larvae/100 ml soil)
Conclusions (2)

- *H. schachtii* population in plots with resistant variety was not significantly influenced by the susceptible neighbour.
- *H. schachtii* population in plots with susceptible variety was significantly lower when growing next to the resistant variety than in pure stand.
Main conclusion

- In systems where 3 rows are sown and all 3 rows are harvested, yield of the resistant variety was underestimated.
- This was mainly due to interference by canopy height. Interference by *H. schachtii* seemed to be of secondary importance but existing.
Thanks for making this possible

• Syngenta Crop Protection A.G.
  – Mr. S. Mittler
  – Mrs. C. Bonadei

• Colleagues from IfZ, NBR, IRBAB, JKI and IRS