Transferring clubroot resistance by intergeneric hybridizations between *Brassica napus* and *Raphanus sativus*

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Intergeneric transfer of Raphanus CR


- Akaba et al. (2009): Monosomic addition lines *B. napus* x *R. sativus*, CR was allocated to one Raphanus chromosome

- Zhan et al. (2017): ((*R. sativus* x *B. oleracea* spp. *alboglabra*) x *B. napus*), CR present in BC2 progeny
Introgression of CR from radish into oilseed rape

- CR from *Brassica napus* and *Raphanus* seems to be promising combination
- Cooperation HAU Wuhan, Norddeutsche Pflanzenzucht KG and FU Berlin
- Several back cross generations realized
- No embryo rescue needed from BC3F1 on
- Segregation and selection for CR in BC progeny, chromosome additions?
- BC progeny selected with combined CR against Mendel-virulent isolates and Raphanus-virulent isolate (ÜR14)
Oil radish is a major break or catch crop, usually only minor clubroot infections; virulent isolates are seldom, but present.

Increasing clubroot incidences in oilseed rape raise concerns about clubroot also in oil radish, no cash crop – no acceptance of disease incidences.

Reliable CR in oil radish, broaden genetic basis to avoid breakdown as with isolate ÜR14.

Intergeneric transfer of *B. napus* CR

- New-type *B. napus* × *R. sativus*
- Combination of ovary and subsequent ovule culture, MS medium
- Proof of hybrid character with SSR markers
- CR testing on clonal plants
Results of intergeneric crosses

<table>
<thead>
<tr>
<th>B. napus # maternal plants</th>
<th>R. sativus # pollinator genotypes</th>
<th># Pollinated buds</th>
<th># Siliques</th>
<th># Ovules</th>
<th># Seedlings</th>
<th># Plantslets in soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>56 (31)*</td>
<td>15 (11)*</td>
<td>ca. 2900</td>
<td>2297</td>
<td>377</td>
<td>130</td>
<td>130/ 112**</td>
</tr>
</tbody>
</table>

*= # successful parental accessions in brackets; **= confirmed hybrids

• Major bottle neck was the number of ovules, ca. 1/3 of ovules germinated in our culturing conditions

• Four maternal plants according to markers, sufficient plants to study CR and start BC programm on selected individuals
## Clubroot results of clonal plants

<table>
<thead>
<tr>
<th>Host</th>
<th>ÜR14 (1)</th>
<th>ÜR14 (2)</th>
<th>PbRaph2</th>
<th>Summary all tests</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean score (0 - 3)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radish</td>
<td>3</td>
<td>2.6</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Oilseed rape</td>
<td>0</td>
<td>2.6</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Yellow seeded Sarson (YSS)</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Number of</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Resistant</strong> hybrids (score &lt; 0.5)</td>
<td>33</td>
<td>43</td>
<td>28</td>
<td>24</td>
</tr>
<tr>
<td>Hybrids with medium reaction (0.6-1.5)</td>
<td>25</td>
<td>7</td>
<td>27</td>
<td>42</td>
</tr>
<tr>
<td><strong>Susceptible</strong> hybrids (1.6-3.0)</td>
<td>40</td>
<td>41</td>
<td>53</td>
<td>42</td>
</tr>
</tbody>
</table>

24 hybrids were showing resistant reactions in all tests and are now raised for back crosses. Segregation in hybrids might reflect genetic heterogeneity of Raphanus parent, effects of more than 1 locus likely
Outlook and conclusions

• Intergeneric incompatibility does not prevent the transfer of CR between Brassica and Raphanus when using embryo rescue

• CR from both species is expressed in intergeneric background, dominant CR?

• Relevance of introgression of *B. napus* CR into Raphanus will depend on further CR results on promising candidates from screening with compatible isolate

• Genetic analysis and mapping of CR will support the back crosses
Acknowledgements

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