Poplar clones differ in their resistance against insect feeding

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Background & Aims

Defoliation risk on short rotation coppices (SRCs)

• Several poplar species and clones are used for biomass production in SRCs
• In general, only a low number of clones are used in SRCs
  
  ➡️ Leading to a decrease of ecological variation
  ➡️ Thus, increasing the risk of insect attacks

Possible solutions to reduce the risk of defoliation

• Increasing the clone number for planting of mixtures enhances the genetic diversity
• Insect resistance breeding (new breeding technologies)

Aim of this study

• Assessment of resistance levels of poplar clones against herbivorous insects for reliable poplar breeding
Description of clones & study sites

- 20 different poplar clones comprised of four species (tri, max, del, nig)
- on eight study sites in Germany, in five different federal states

<table>
<thead>
<tr>
<th>Study site</th>
<th>Location</th>
<th>Setup</th>
<th>Years of assessment</th>
<th>1. harvest</th>
<th>2. harvest</th>
<th>Clones</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lehmbach (SPF)</td>
<td>Bavaria</td>
<td>2010</td>
<td>2012, 2013, 2014</td>
<td>2012/2013</td>
<td>2015/2016</td>
<td>AF2, Androscoggin, Hybride275, Matrix11, Matrix49, Max1, Max3, Muhle-Larsen, Trichobel, Weser4, Weser6, NW7-17C, NW7-177T, NW7-197S, NW7-204A</td>
</tr>
<tr>
<td>Stiedenrode’13</td>
<td>Hesse</td>
<td>2013</td>
<td>2015</td>
<td>2015/2016</td>
<td></td>
<td>AF2, Hybride275, Max1, Muhle-Larsen</td>
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<tr>
<td>Stölzingen</td>
<td>Hesse</td>
<td>2010</td>
<td>2014</td>
<td>2012/2013</td>
<td>2015/2016</td>
<td>AF2, Hybride275, Max1, Muhle-Larsen, NW7-17C, NW7-177T, NW7-197S, NW7-204A</td>
</tr>
<tr>
<td>Wallstawe’10</td>
<td>Saxony-Anhalt</td>
<td>2010</td>
<td>2014, 2015</td>
<td>2012/2013</td>
<td>2015/2016</td>
<td>AF2, Hybride275, Max1, Muhle-Larsen, NW7-17C, NW7-177T, NW7-197S, NW7-204A</td>
</tr>
</tbody>
</table>
Assessment of foliage damage & insects

**Number of examined trees**
- Study sites with 48 or 52 trees per plot (one clone)
- Each plot is repeated four to six times per study site
- Five trees per clone and repetition were examined

- 20 to 30 trees per study site and clone
- All together between 80 and 480 trees per clone

**Foliage damage (leaf area loss = LAL)**
- LAL assessed in 5% steps, where 0% means no damage and 100% total defoliation

**Assessment of insects**
- Determination of insect species on the trees
- Assessed as: none, low (< 10 specimens), medium (10 to 30), high (> 30) per species
- Once a year end of June / beginning of July
Defoliation level

- Calculation per clone: together for all study sites, all trees per clone, and all years
- Altogether low level of defoliation for the four years
- But, differences between the clones: (Leaf area loss) LAL between 5.8% and 13.5%

![Average LAL 2012-2015](chart.png)
Determined insect species

Moths (Lepidoptera)
- Low number of puss moth (*Cerura vinula*)
- But, when this moth is on a tree, the damage is high
- Few other caterpillars (e.g. *Orgyia antiqua*, *Scoliopteryx libatrix*)

Sawflies (Hymenoptera, Tenthredinidae)
- Seldom, but when, then a lot of specimens of *Pristiphora conjugata*

Beetles (Coleoptera)
- Main defoliators:
  - Poplar leaf beetle (*Chrysomela populi*)
  - Willow beetles (*Phratora* sp.)
  - Leaf rolling weevil (*Byctiscus* sp.)
- These three beetles will be presented in more detail
**Chrysomela populi**

- Detected on all but two clones with an amount of up to 35% of all trees per clone
- Mostly in a small to medium number of up to ten to lower than 30 beetles per tree
Phratora sp.

- Detected on all but one clone with an amount of up to 15% of all trees per clone
- Mostly in a small number of up to ten beetles per tree
Byctiscus sp.

- Not detected on seven clones
- Overall in a small number of up to ten beetles per tree

Assessed trees

<table>
<thead>
<tr>
<th>Tree</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rochester</td>
<td>100%</td>
</tr>
<tr>
<td>OP367</td>
<td>100%</td>
</tr>
<tr>
<td>Koreaana</td>
<td>100%</td>
</tr>
<tr>
<td>Max4</td>
<td>100%</td>
</tr>
<tr>
<td>Weser6</td>
<td>100%</td>
</tr>
<tr>
<td>Androscoggin</td>
<td>100%</td>
</tr>
<tr>
<td>NW7-204A</td>
<td>100%</td>
</tr>
<tr>
<td>NW7-17T</td>
<td>100%</td>
</tr>
<tr>
<td>Max1</td>
<td>100%</td>
</tr>
<tr>
<td>Hiba275</td>
<td>100%</td>
</tr>
<tr>
<td>Weser4</td>
<td>100%</td>
</tr>
<tr>
<td>NW7-17C</td>
<td>100%</td>
</tr>
<tr>
<td>Matrix11</td>
<td>100%</td>
</tr>
<tr>
<td>Max3</td>
<td>100%</td>
</tr>
<tr>
<td>NW7-1975</td>
<td>100%</td>
</tr>
<tr>
<td>Trichobel</td>
<td>100%</td>
</tr>
<tr>
<td>Matrix49</td>
<td>100%</td>
</tr>
<tr>
<td>AF2</td>
<td>100%</td>
</tr>
<tr>
<td>Muhle-Larsen</td>
<td>100%</td>
</tr>
<tr>
<td>Robusta</td>
<td>100%</td>
</tr>
</tbody>
</table>

- medium
- low
- none

Milan Zubrik, bugwood.org
Resistance ranking

- Due to the position of each clone in the four Figures before (LAL [including unassessed insects], and the three beetles), for each clone a sum was calculated.
- This sum was used to perform a ranking from low resistance (= high defoliation) to high resistance (= low defoliation).
Beetles

- The poplar leaf beetle was the most frequent insect on all but two clones
- This beetle is known to be the main defoliator of poplar all over Europe
- Willow beetles and leaf rollers have been found in a smaller number

Clones

- It is interesting that the clones of the group „MAX“ differ in their resistance level
- No beetles found on „Rochester“ – other insects responsible for LAL of 10%

Resistance

- There is a clear ranking of clones, possibly due to their resistance level against insect feeding
- This result will be used to perform transcriptome analysis of the most susceptible and most resistant clones (candidate genes)
Acknowledgement

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