RESULTS FROM SIX YEARS OF THE JOINT RESEARCH PROJECT PROLOC - CLONE-SITE INTERACTION AND YIELD DYNAMICS AFTER TWO ROTATION CYCLES

Christoph Stiehm, Martin Hofmann, Alwin Janßen

Northwest German Forest Research Institute Department C – Forest Genetic Resources
Prof.-Oelkers-Str. 6
34346 Hann. Münden
Mail: christoph.stiehm@nw-fva.de
Tel.: +49 5541 – 7004 62

Joint Research Project ProLoc
Assessment of Clone – Site Interaction of Poplar and Willow in Short Rotation Coppice on Agricultural Sites

Coordination:

With support from

Funding:

by decision of the German Bundestag

AP1
- Continued supervision of trial sites in a 3 year rotation cycle modus
- Model validation and improvement regarding yield dynamics
- 27 trial sites, established in 2008, poplar and willow clones

AP2a
- Modelling of yield dynamics of a 10 year rotation cycle with poplar
- 10 trial sites, established in 2012, poplar clones

AP2b
- Model implementation for spacing trials (3 and 10 year rotation cycle)
- 3 trial sites (each 8 spacings), established in 2012, poplar and willow clones

Funding:

Coordination:

Homepage: http://proloc-verbund.com
Tested Clones:
- Max 1 (P. nigra x P. maximowiczii)
- Hybride 275/NE42 (P. maximowiczii x P. trichocarpa)
- AF2 (P. deltoides x P. nigra)
- Inger (S. triandra x S. viminalis)
- Tordis ((S. schwerinii x S. viminalis) x S. viminalis)

Design of trial sites in each trial series based on uniform specifications:
- Randomized Design with 4 replications
- Rotation length 3 years
- Spacing: 0.5 m x 1.8 m
- 100 trees per plot with 48 trees in each plot's core, leaving a frame of 52 plants as margin for excluding border effects
- Measurement within plot's core; fixed sampling design (grid)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Cycle</th>
<th>n per plot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomass Fresh mass</td>
<td>[g]</td>
<td>At harvest during winter</td>
<td>24/16</td>
</tr>
<tr>
<td>Biomass Dry matter content</td>
<td>[%]</td>
<td>At harvest during winter</td>
<td>4</td>
</tr>
<tr>
<td>Increment No. of shoots</td>
<td>[n]</td>
<td>Annually during winter</td>
<td>24/16</td>
</tr>
<tr>
<td>Increment Shoot DBH</td>
<td>[mm]</td>
<td>Annually during winter</td>
<td>24/16</td>
</tr>
<tr>
<td>Increment Shoot length</td>
<td>[dm]</td>
<td>Annually during winter</td>
<td>8</td>
</tr>
<tr>
<td>Increment Tree height</td>
<td>[dm]</td>
<td>Annually during winter</td>
<td>8</td>
</tr>
<tr>
<td>Survival Survival rate</td>
<td>[%]</td>
<td>Annually during winter</td>
<td>100</td>
</tr>
<tr>
<td>Vitality Rust infestation</td>
<td>[%]</td>
<td>Annually calendar week 28, 33</td>
<td>8</td>
</tr>
<tr>
<td>Vitality Rust location</td>
<td>-</td>
<td>Annually calendar week 28, 33</td>
<td>8</td>
</tr>
<tr>
<td>Weeds Species</td>
<td>-</td>
<td>First year of each rotation</td>
<td>-</td>
</tr>
<tr>
<td>Weeds Coverage</td>
<td>[%]</td>
<td>First year of each rotation</td>
<td>-</td>
</tr>
<tr>
<td>Weeds Height</td>
<td>[dm]</td>
<td>First year of each rotation</td>
<td>-</td>
</tr>
</tbody>
</table>

Parameter Single Measurements [n]

- DBH: 234,828
- Shoot length: 170,389
- Fresh Mass: 18,092
- Dry matter content: 3,801

Fig. 2: Example of trial and plot design
Site characteristics

Full site survey in accordance to standards in German forestry/agriculture (Soil physics, soil chemistry, climate conditions)

ProLoc I
- 20 Sites selected as input for modelling
- Clustered by soil type
- 11 Sites excluded (Criteria: Post mining sites, wetland, acidic Soil, uncontrolled weed competition, low survival rate)

Fig. 3: Sum of precipitation during vegetation period (May – Sep.) at ProLoc sites

Fig. 4: Sum of temperature during vegetation period (May – Sep.) at ProLoc sites

Fig. 5: Absolute Frequency of soil classes at trial sites in ProLoc
Fig. 6: Mean single tree biomass per plot at the end of the first and second rotation cycle by clone

Fig. 7: Survival rate per plot at the end of the first and second rotation cycle by clone

Fig. 8: Mean annual increment of biomass per plot at the end of the first and second rotation cycle by clone
Fig. 9: Yield dynamics as development of mean annual increment of biomass per plot from first to second rotation by soil class for all clones.
### No. | Location          | Soil Class | Soil Type 0-30 cm | Group | 
--- | -----------------|------------|------------------|------| 
1   | Klein Altendorf  | Luvisol    | L 4 LÖ 72/76     | Lu   | 8  
2   | Lehmkaute        | Luvisol    | L 3 LÖ 80/85     | Lu   | 8  
3   | Potsdam Bornim   | Luvisol    | SI 3 D 36/35     | Su2  | 8  
4   | Dornburg         | Luvisol    | L 5 LÖ 62/58     | Tu4  | 78 
5   | Unterrieden      | Cambisol   | SI 3 D 39/39     | SI3  | 78 
6   | Hayn             | Luvisol    | L 4 V 50/42      | Lu   | 78 
7   | Werlte           | Luvisol    | S 3 D 33/37      | Su2  | 78 
8   | Aulendorf        | Histosol   | Mo 2 46/46*      | Mo (Org) | 78 
9   | Emmendingen      | Phaeozem   | L3 LÖ 77/89      | Ut 4 | 78 
10  | Pommritz         | Cambisol   | LS 5 DV 34/35    | SI2  | 678
11  | Borlinghausen    | Stagnosol  | T 6 V 34/28      | Lt3  | 678
12  | Bernburg         | Phaeozem   | L 1 LÖ 100/96    | Ut4  | 567
13  | Threnthorst      | Gleysol    | L 5 D 55/53      | Ls2  | 4567
14  | Kupferzell       | Stagnosol  | LT 5 V 50/45     | Lt3  | 3456
15  | Lilienthal       | Luvisol    | L 3 LÖ 72/76     | Ut 3 | 2345
16  | Kaisheim         | Luvisol    | L 5 LÖ 64/62     | Ut4  | 234
17  | Gülzow           | Cambisol   | SL 3 D 36/36     | Ss   | 23
18  | Grünewalde       | Regosol    | SI 3 Al 38/38 *  | St2  | 2  
19  | Forchheim        | Cambisol   | sL 4 Dg 26/30    | SI2  | 2  
20  | Bärenrode        | Stagnosol  | SL 4 V 55/44     | Lu   | 1  
21  | Kummerow         | Cambisol   | S 6 D 14/12      | St2  | 1  
22  | Iden             | Gleysol    | S 5 Al 19/22     | Ss   | 1  
23  | Welzow Süd       | Regosol    | S 7 Al 13/9 *    | SI4  | 1  

**Pairwise comparisons based on linear mixed-effects model**

![Graph](image)

**Fig. 10:** Mean annual increment of biomass per plot in second rotation by German Soil Quality Index separated by genus.
Growth Function
- Total Biomass:
  - AWC Class
  - Sum of precipitation VP
- MAI 2\textsuperscript{nd} Rot.
  - Poplar:
    - MAI 1\textsuperscript{st} Rot.
    - SQI
    - Mean temperature VP
  - Willow:
    - MAI 1\textsuperscript{st} Rot.
    - SQI
    - N-storage
- BA increment 10a rotation (Poplar)
  - Silt content
  - Sum of precipitation VP

Soil Class: Luvisol

Fig. 11: GGE Biplot Example based on ProLoc MAI values from 2\textsuperscript{nd} rotation for identifying genotype-environment interaction
Outlook:

- Model calibration and validation
- Implementation of growth simulator
- Integration of results from analysis of AP2a and AP2b trials (10a rotation cycle, varying spacings)
- Including new clones/cultivars into growth simulation
- Integration of results from other projects with ProLoc outcome (FastWood, CF)
- Reduced data acquisition for third rotation cycle within AP1
Thank you for your attention