**ELaN** – Developing an integrated land management scheme for sustainable use of water, nutrients and carbon in North-East Germany

**Work Package 7:** Short Rotation Coppice

# Growth performance and survival of poplar and willow in waterlogged soils – a comparison of two sites

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## Introduction

The predicted impacts of climate change for Central Europe consider rainfall to be distributed more unevenly throughout the year, although the total amount is not expected to decrease. In the State of Brandenburg in northeastern Germany, this could lead to a higher local occurrence of waterlogging as the landscape features mild elevations and depressions. After heavy or prolonged periods of rainfall, depressions with fairly high groundwater tables may waterlog for several weeks or may waterlog repeatedly for shorter periods of time, causing farmers to lose investments in annual crops. On these sites, short rotation coppice with fast-growing tree species represent a valid alternative land-use option as, in general, they are more tolerant to a temporary water surplus than annual cultures.

waterlogging started. Sites are located in the State of Brandenburg, northeast Germany. (Pictures: Holger Hartmann 07/2011 (left), Nils Freudenthal 05/2011 (right))

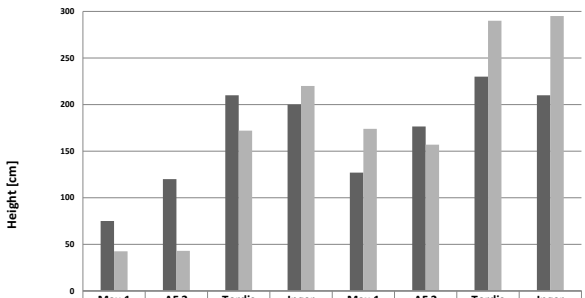
However, in 2011 and 2012, extreme reactions were observed in poplar clones that were exposed to prolonged waterlogging on two plantations in northern and southern Brandenburg (see Figure 1): a complete die-off (Site A), and the survival and even continued growth (Site B) of poplars located in waterlogged parts of the plantation (although it should be noted that this changed when the flooding lasted throughout a second vegetation period).

## Material & Methods

As the two plantations featured different poplar clones, an experimental trial was set up on the University compound in order to complement and verify the field observations. The same clones in both soils were used and willows were included in the trial. We used willow hybrids 'Tordis' (*Salix viminalis x Salix Schwerinii*) *x Salix viminalis*) and 'Inger' (*Salix triandra x Salix viminalis*) as well as poplar hybrids 'Max 1' (*Populus maximowiczii x Populus nigra*) and 'AF 2' (*Populus nigra x Populus deltoides*). As a planting substrate, soil was extracted from the two plantations in Brandenburg (Sites A and B) where the different reactions of poplar hybrids to waterlogging had been observed. With each hybrid featuring 36 repetitions, a total of 72 cuttings was planted in each soil. The hybrids were planted as cuttings of 20 cm length. During growth all shoots except one were removed to grant comparability in height which was measured every two weeks. At the age of nine months, half of the plants in each soil were exposed to induced flooding, which completely saturated the soil for more than 12 months. The other half was left growing in unchanged conditions without using surplus water.

## Results

Figure 2 displays the results of the experimental trial, indicating the differences in height growth of the four clones at 16 months of age in the two soils. Both poplars were affected by induced waterlogging in Soil A; in Soil B clone 'Max 1' was positively affected by the water surplus, clone 'AF 2' negatively. Both clones reached a greater average height in Soil B. The two willows grew to similar average heights in both soils when not flooded. In waterlogged soil the average height in Soil B increased compared to the non-flooded soil, in Soil A this was only true for clone 'Inger'. Plant mortality, which was not considered in this graph, occurred among both clones in Soil A in flooded and non-flooded conditions (overall average: 22%) and only in one case ('AF 2' without flooding) in Soil B. Overall tree survival rate was 87.5% among poplars and 97.2% among willows.




| | Max 1 Soil A | AF 2 Soil A | Tordis Soil A | Inger Soil A | Max 1 Soil B | AF 2 Soil B | Tordis Soil B | Inger Soil B |
|---|---|---|---|---|---|---|---|---|
| not flooded | 75,00 | 120,00 | 210,00 | 200,00 | 127,00 | 176,50 | 230,00 | 210,00 |
| flooded | 42,50 | 43,00 | 172,00 | 220,00 | 174,00 | 157,00 | 290,00 | 295,00 |

and willow clones planted in two different soils at 16 months of age. Flooding was induced at 6 months of age and to this point had uninterruptedly lastet 10 months, including during winter.

## Discussion & Conclusions

In this trial, the poplar clones that were tested showed a greater variation in growth performance and survival rates than the willow clones when exposed to waterlogging or induced flooding. The willow clones tested were, in general, less susceptible to waterlogging. The results suggest that site conditions such as soil and water chemistry may have a greater influence on growth performance and tree survival than the duration and intensity of waterlogging; this seems especially true for poplars. As seen above, growth performance and survival of poplar clones in Soil A was minor compared to Soil B even in non-flooded soil. This suggests that the induced waterlogging worsened growth conditions for poplars in Soil A, whereas the same clones in Soil B seemed to be unaffected, or even positively affected by the water surplus. Therefore it is likely to assume that if site conditions are suitable, water surplus does not necessarily result in increased die-back or impaired growth in the clones tested.

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