Impact of winter and spring flooding on silver and pubescent birch seedlings

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Introduction

Global climate change has significantly increased the amount of rainfall during winter and spring in Northern Europe. This trend will be further enhanced in the future. We studied the response of silver birch (*Betula pendula*) and pubescent birch (*Betula pubescens*) seedlings to winter and spring waterlogging.

Materials and methods

- One-year-old dormant silver and pubescent birch seedlings (144 seedlings of each) were replanted in pots in mineral soil and subjected to a four-week dormancy period and an eight-week growth period in growth chambers (Fig. 1).
- The seedlings were distributed in 48 containers with 6 seedlings in each and put in two growth chambers (12 containers/chamber of each species in three blocks). Each treatment and species had 6 replicate containers in total.
- Treatments were no flood (CTRL), four-week winter flood (WF), four-week spring flood (SF), and combination of winter and spring flood (eight weeks) (WFSF).
- Chlorophyll index of leaves was assessed at 1-week intervals. Root hydraulic conductance was assessed at four occasions.

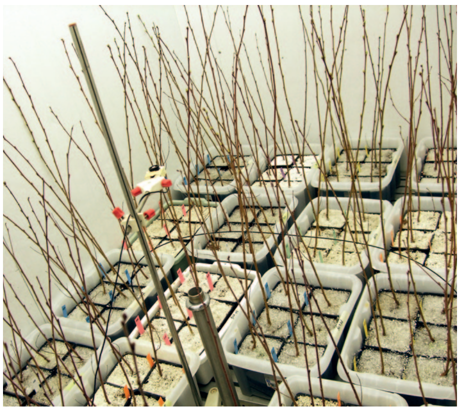

Fig. 1. Dormant birch seedlings in the growth chamber.

Results

- Chlorophyll index was higher in spring flood (SF, WFSF) than in CTRL and WF in silver birch. However, chlorophyll index was similar between spring flood (SF, WFSF) and CTRL in pubescent birch; winter flood (WF) had lower chlorophyll index (Fig. 2). Fig. 3 shows the picture of silver birch seedlings at the end of the experiment.
- Root color changed from brown to black in both species by spring flood (SF, WFSF), and less by winter flood (WF) (Fig. 4).
- Root hydraulic conductance decreased by flooding (SF, WF, WFSF) in silver birch but not in pubescent birch (Fig. 5).

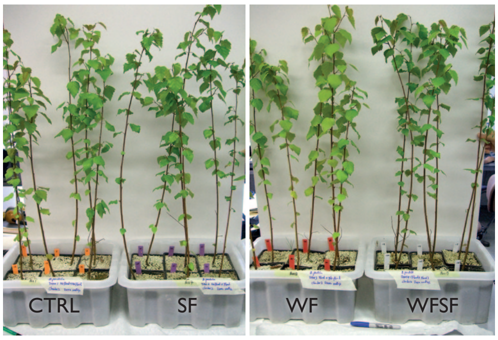

Fig. 3. Silver birch seedlings by treatments at the end of experiment.

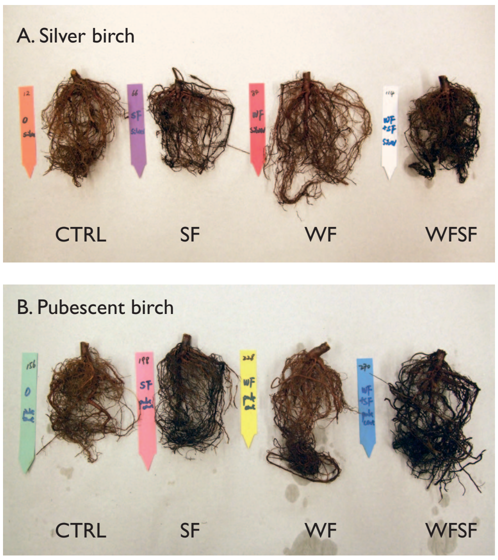

Fig. 4. Roots of silver birch (A) and pubescent birch (B) seedlings at the end of experiment.

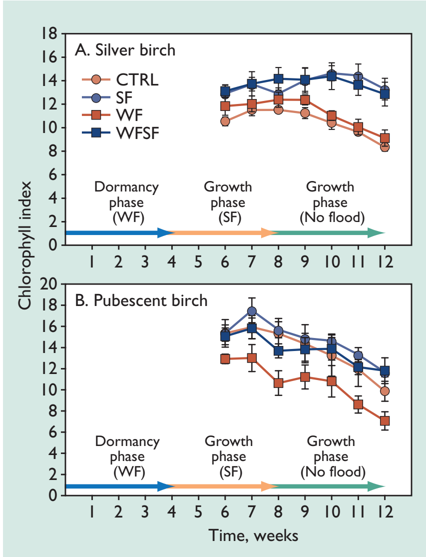

Fig. 2. Chlorophyll index of leaves of silver birch (A) and pubescent birch (B) by treatment. Bars indicate standard errors (n=6).

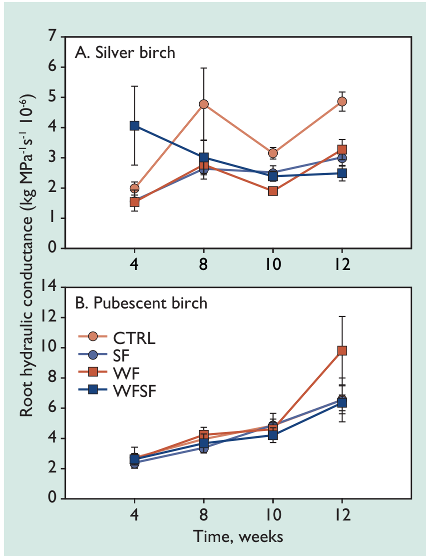

Fig. 5. Root hydraulic conductance of silver birch (A) and pubescent birch (B) by treatment. Bars indicate standard errors (n=6). 4W: after 4 weeks winter flood, 8W: after 4 weeks spring flood, 10W: after 2 weeks growth without flood, 12W: after 4 weeks growth without flood.

Conclusions

The two birch species responded differentially to flooding. Decreased root hydraulic conductance indicates impaired water transport in waterlogged silver birch but not in pubescent birch. Constantly higher level of chlorophyll index in silver birch with spring flood indicates changes in the photosynthesis machinery.

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