THE INFLUENCE OF ENVIRONMENT ON THE DEVELOPMENT OF *ABIES ALBA* AND *QUERCUS ROBUR* SEEDLINGS

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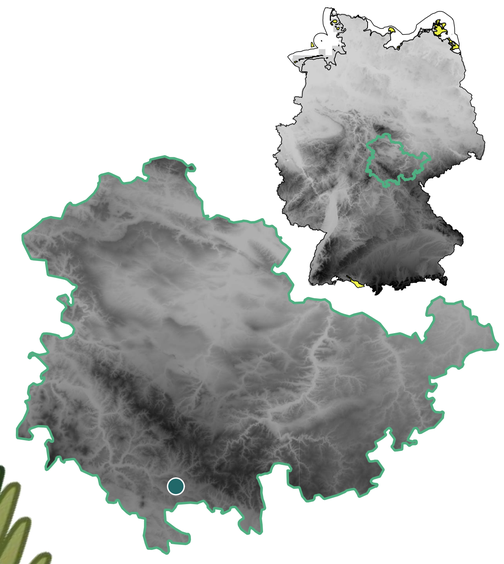
Introduction

Low mountain range forests in Germany are mostly dominated by Norway spruce (*Picea abies*) and are susceptible to climate change. Introducing additional tree species into these forests improves their ability to cope with climate change and may increase the biodiversity of flora and fauna.
Direct seeding is similar to natural regeneration and allows for the (re)introduction of species currently absent at a site. Additionally, direct seeding does offer multiple advantages over planting.

Research Question

Which microsite conditions influence the development of direct seeded *Abies alba and Quercus robur* seedlings?



Why fir and oak?

- Possible climate change winners
- Projected to cope well with climate change
- Drought tolerant (taproot)
- Stabilize existing forests
- High shade tolerance of seedlings under canopy
- Formerly widespread local species

Methods

- Location: Municipality forest Hildburghausen (Thuringian Forest mountain range)
- 3 sites on acidic soil, differently affected by bark beetle
- Soil sampling and harvesting of 4-year-old seedlings of *Abies alba* and *Quercus robur*
- Surveying of microsite conditions like PAR and soil moisture
- Analyzing plant growth, leaf traits and soil characteristics

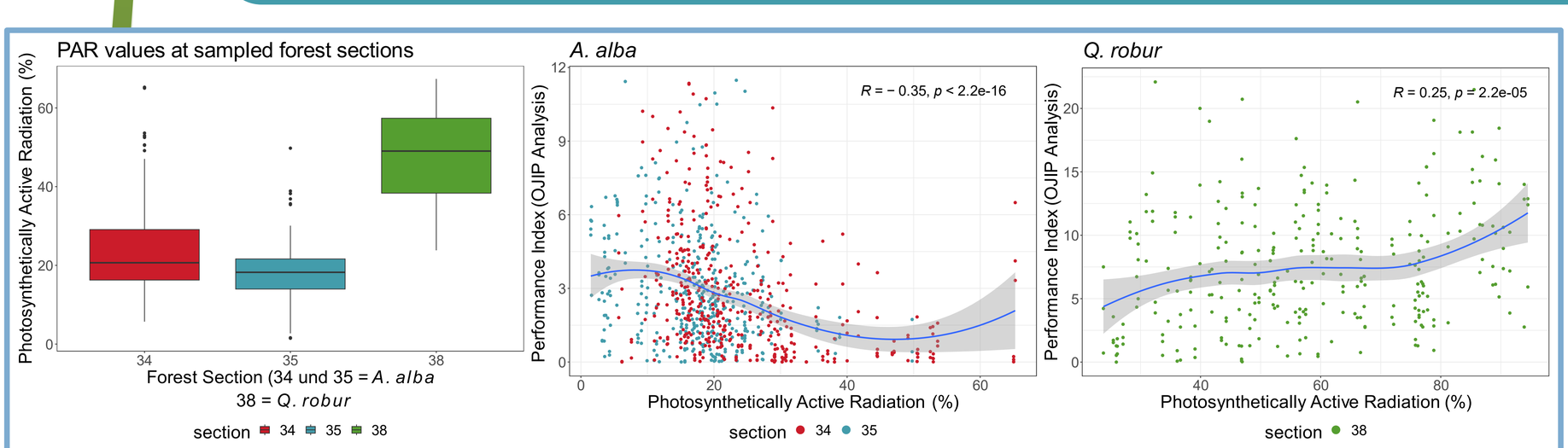
Direct seeded *A. alba* and *Q. robur* perform well in acidic spruce forest, depending on the light regime

Plant variables	Soil moisture		Soil pH		Soil buffer		PAR		Browsing		Grass		Litter		Moss	
	A. alba	*Q. robur*	*A. alba*	*Q. robur*	*A. alba*	*Q. robur*	*A. alba*	*Q. robur*	*A. alba*	*Q. robur*	*A. alba*	*Q. robur*	*A. alba*	*Q. robur*	*A. alba*	*Q. robur*
Shoot- / root-length									*** ↓				*** ↓		*** ↓	
Leaf / stem weight								* ↓	*** ↓							
SLA			** ↑		** ↓	** ↑	*** ↓	*** ↓								
Fv/Fm							*** ↓									
Performance Index (PI)								** ↑			* ↓		* ↓		* ↓	

Significance levels (* = P < 0.05,** = P < 0.01, *** = P < 0.001) and trends of the influence of environmental variables on the measured plant variables of *A. alba* and *Q. robur* seedlings at the surveyed forest sites.

Results and Discussion

- Fv/Fm (chlorophyll fluorescence) values of *A. alba* decreased with increasing PAR while *Q. robur* showed no relation.
- The PI of *A. alba* decreased with increasing PAR values, which, together with the Fv/Fm result, is in line with *A. alba's* preference and ability to develop in low light environments. For *Q. robur* the opposite trend was found
- This shows that *A. alba* is well suited for establishing the next forest generation if an intact canopy is present. At sites where damages already caused clearcuts, *Q. robur* is fitting better in forest restoration.
- SLA of both species decreased with increasing PAR values, potentially due to an increased cuticle thickness as a response to higher evapotranspiration.
- Biomass allocation of *A. alba* seedlings is mainly influenced by browsing pressure and the presence of bare soil at sowing, as a litter or moss layer negatively affects height growth.
- For *Q. robur* aboveground biomass allocation is strongly influenced by the level of PAR, with high levels increasing the number of side shoots formed.



PAR values of the three surveyed forest sites and correlations of both species' performance indices, with the percentage of PAR of the open field reference.

Outlook

- Nutrient analysis of plants and soil still ongoing
- Prediction of nutrient contents based on NIRS
- Formulating recommendations for practitioners

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