

The role of tree species diversity in drought resistance of oak and beech saplings

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Background

Changes in precipitation patterns due to climate change are most likely to expose European forests to drought during the growing season. It has been suggested that stands of higher tree species diversity might be more resistant and resilient to stress compared to monocultures. In this study, we will investigate whether oak and beech sapling performances and ecosystem functions are more resistant to growing season drought when planted in mixed stands.

Study questions:

- Can species mixtures improve oak and beech sapling performances under drought conditions?
- What are the mechanisms underlying ecosystem functioning and sapling performances in mixed species stands subjected to drought?

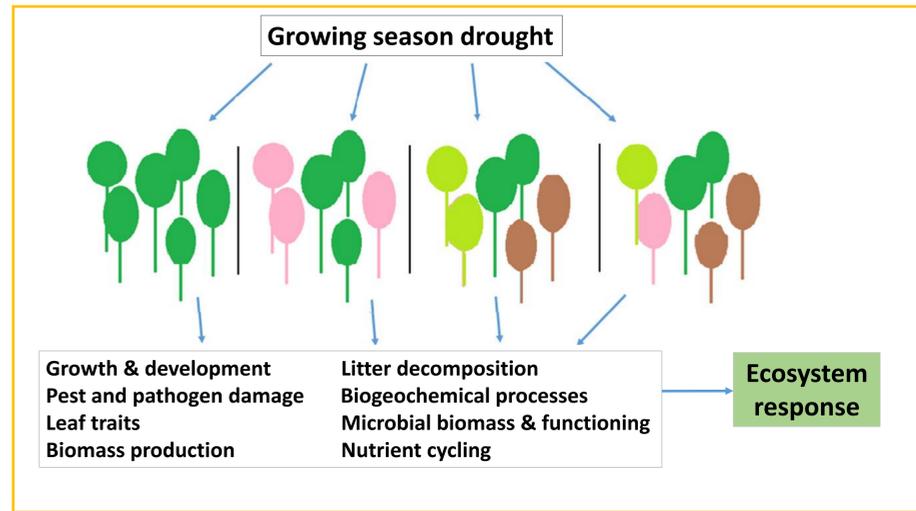


Figure 1: Oak and beech sapling performance in diverse stands and under drought condition will be investigated in this study.

FORBIO Experimental sites

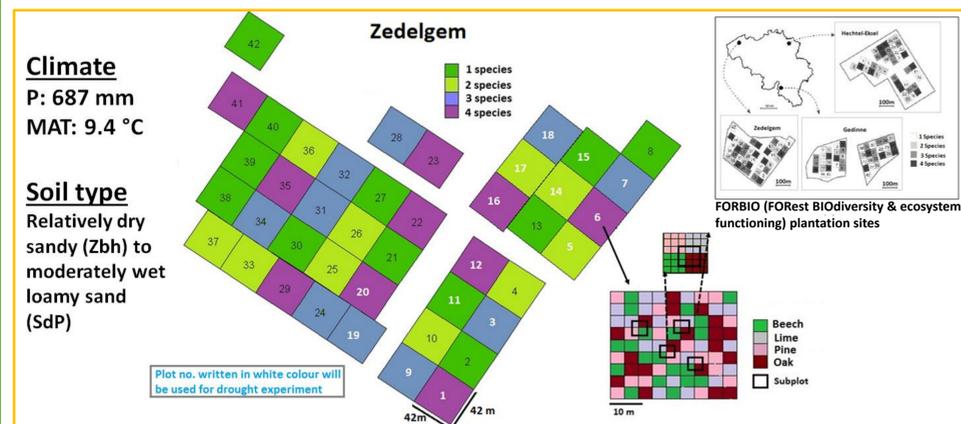


Figure 2: FORBIO Experimental sites and layout of the Zedelgem site. Detailed plantation design of a 4 species mixed plot is also shown. For details- Verheyen et al. 2013. Plant Eco. & Evo. 146(1): 26-35 or http://www.treedivbelgium.ugent.be/pl_forbio.html

Planting details of Zedelgem site

Species pool	: <i>Betula pendula</i> , <i>Fagus sylvatica</i> , <i>Pinus sylvestris</i> , <i>Tilia cordata</i> and <i>Quercus robur</i>
Diversity level	: 1, 2, 3 & 4 species
Planting design	: 3 × 3 monoculture patches in a checker board design
Density	: 784 trees in a plot (42m × 42 m); Plant to plant: 1.5 m
Planting year	: 2009-2010

Study 1: Aboveground performances of oak and beech saplings in species mixtures and under drought stress

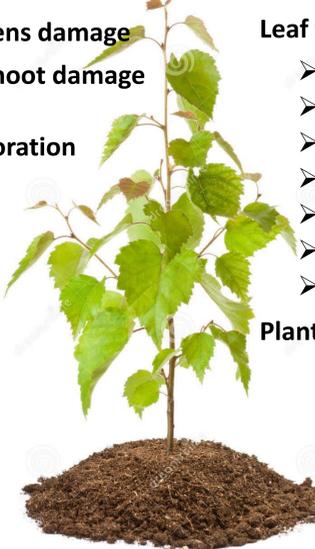
Following parameters will be measured for oak and beech saplings

Pests and pathogens damage

- Branch and shoot damage
- Defoliation
- Crown discoloration

Leaf traits and nutrient status

- Leaf area (LA)
- Specific leaf area (SLA)
- Leaf dry matter content (LDMC)
- Leaf toughness
- Chlorophyll a (chl.a) fluorescence
- Leaf C/N ratio
- Leaf C, N & P content



Plant height and diameter

Time of measurements:

Leaf and crown: June-July of each year.

Height and diameter: Apr., Sept. 2015 & Sept. 2016.

Precipitation manipulation

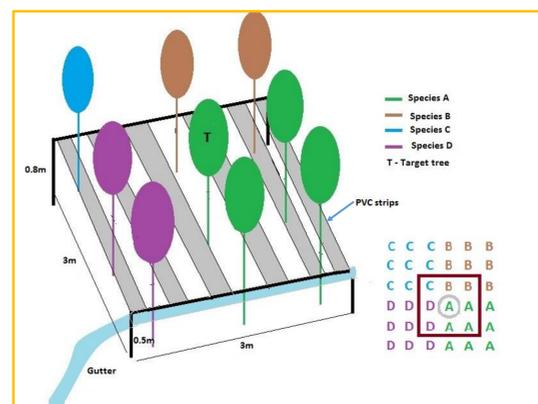
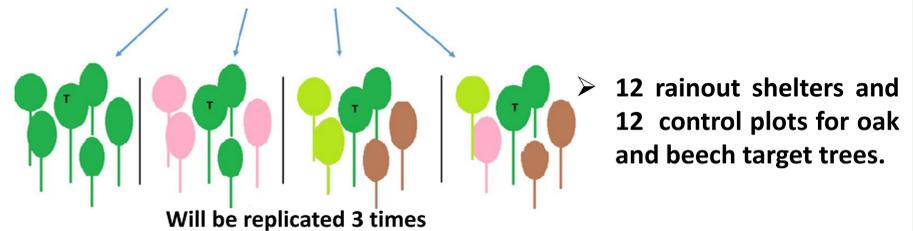
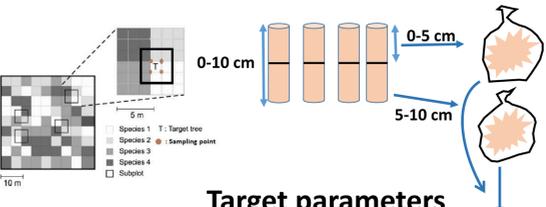


Figure 3: Sketch of a 3m×3m rainout shelter. The frame will be made of wood and about 50% rainfall will be cut off by PVC gutters.



- Location: 15 plots of Zedelgem (Fig. 2)
- Drought duration: April – September, 2015 & 2016
- Target measurements: Both aboveground (study 1) and belowground parameters (study 2)

Study-2: Soil microbial properties and soil biogeochemical processes in species mixtures and under drought stress



Target parameters

- Soil moisture
- Soil pH
- Soil organic matter (SOM) content
- Basal respiration
- N mineralization and nitrification
- Soil microbial biomass (C & N)
- Metabolic diversity of bacteria



Resin & tea bag

- Ion-exchange resin bags will be buried in soil to analyse *in situ* NH₄⁺ and NO₃⁻ availability.
- Green and rooibos tea will be buried and analysed to calculate Tea bag index (TBI) (Keuskamp et al. 2013)

Sampling time: April & September, 2015 & 2016

Figure 4: Different soil biogeochemical and microbial properties will be measured in 0-10 cm soils. (Keuskamp et al. 2013. Methods in Eco. & Evo. 11(4): 1070-1075)

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Perspectives

- This study will explore underlying mechanisms of ecosystem functioning under drought stress.
- Our results will lead to better understanding of the link between tree species diversity and oak and beech sapling performances under drought conditions