Xylem plasticity in larch, spruce and beech growing in different mixture sites: relations between wood anatomical features and environmental conditions.

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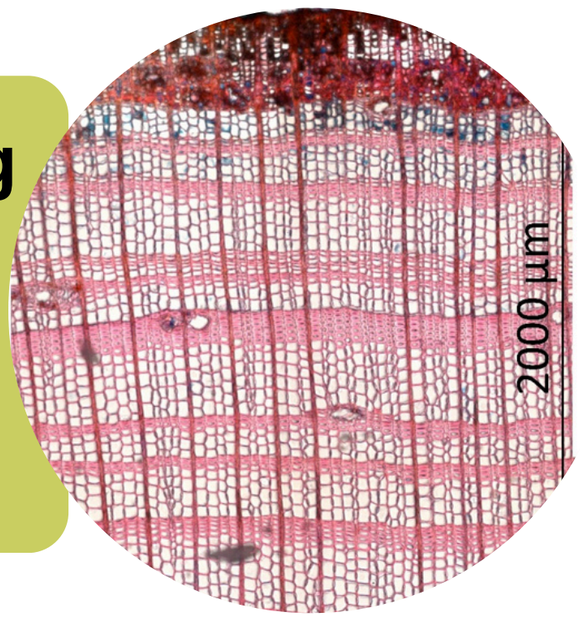
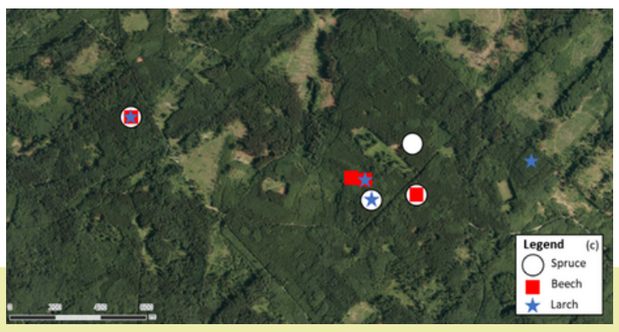


Our aim

Since the effects of mixing the less widespread European larch with the economically important Norway spruce and European beech remain largely unexplored, we investigated the response of wood anatomical features during a meteorologically defined Dry period compared to a favorable Control period across various mixed and monoculture stands of medium-aged forests in the highlands of Drahanská vrchovina.

What we expected?

- **Water stress during the Dry period will influence the anatomical traits/properties of the xylem,**
- **the differences between the Control and the Dry periods will be less significant in mixtures (with the presence of larch).**



What we measured?

Across a series of tree rings from five trees per species at each site, covering the years 2009–2010 (Control period) and 2017–2018 (Dry period) based on the SPEI7 index were measured: tree ring widths (TRW), tracheid/vessel lumen areas (LA), cell wall thickness (CWT), cell density (CD) as the number of conduit cells per square mm, the relative conducting area (RCTA) representing the percentage of the cumulative conductive area within the analysed area, hydraulically weighted mean cell diameter (Dh) and the potential hydraulic conductivity (Kp).

What we explored?

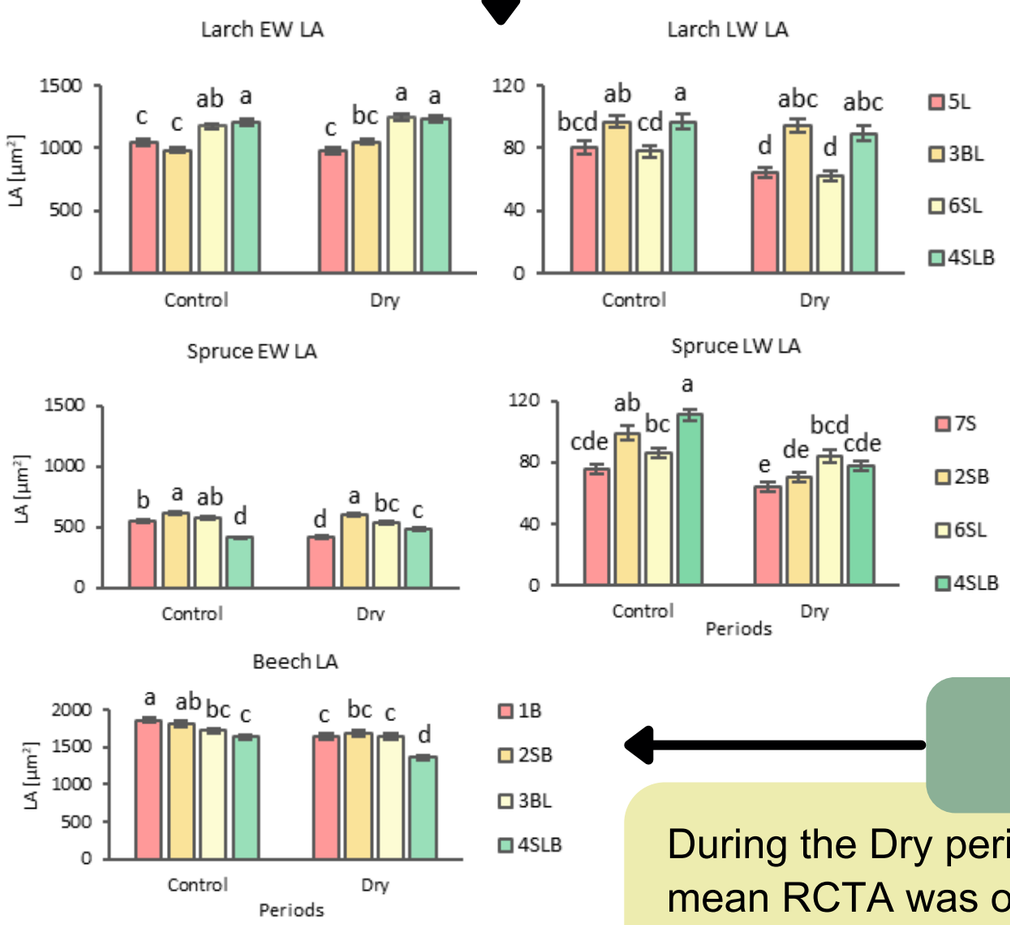
Even though trees exhibited ~ 39.3% increment reduction (significant for both spruce and beech, but non-significant for larch) during the Dry period, analyses of wood anatomical features do not necessarily indicate changes at the wood-anatomical level.

LARCH

The analysis of EW and LW LAs in larch showed non-significant differences between periods, with tracheid LAs remaining relatively stable even under dry conditions. Similarly, parameters related to water conductivity showed no significant changes between periods or sites. No notable impact of the presence of larch on the wood anatomical features or water conductance of other tree species was observed.

SPRUCE

The strongest influence of drought was observed in spruce latewood (LW), where LAs decreased by 20.3% and CWTs by 12.6% across all sites during the Dry period, associated with drier conditions in the late growing season. The monoculture exhibited the lowest values across all parameters. Surprisingly, the water conductivity was without significant changes between periods.



BEECH

During the Dry period, a significant increase in the mean RCTA was observed, closely associated with notably smaller LAs, reduced by 10.2%, and an 18% increase in CD. In monoculture, LA, CD, and RCTA were higher but associated with lower (non-significant) growth increments. Analyses of Dh and Kp revealed higher water conductance in monoculture and the lowest in the triple mixed stand, suggesting a safeguard mechanism in water conductance through reduced LA, likely due to decreased water availability resulting from increased interspecific competition.

Take-home message

The observed significant decrease in increment indicated that dry environmental conditions negatively affected tree radial growth. Spruce in LW and beech performed reduction of LA as the capacity for water transport under prolonged drought and prevented the onset of embolism. The trees prioritized water conservation over growth during drought. Contrary, larch with the lowest increments did not reduce anatomical features and remained relatively consistent.

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