BOOK OF
ABSTRACTS

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Assessing tree diversity effect on tree resistance to drought through hydraulic safety margins

T2.18 Mixed forest plantations as natured-based solutions for climate change mitigation and adaptation

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Abstract: Extreme droughts are increasing in frequency and intensity, leading to significant diebacks in forest ecosystems worldwide. Increasing species diversity in forests is often cited as a crucial factor in enhancing stand survival during droughts. Various processes, such as complementarity, facilitation, and competition release, could potentially alleviate water stress in individuals during drought events. However, there is limited available data, and existing data indirectly relate to water stress, with little consensus on this topic. Plant hydraulic ecophysiology provides a mechanistic understanding of how trees respond to drought. In this study, we relied on Tree Diversity Network experiments (i.e Experiments that manipulate woody plant diversity over wide diversity gradients and are designed to allow separation of diversity and identity effects) to explore the effect of species diversity on drought vulnerability of trees. We collected essential plant hydraulic traits related to water stress exposure (water potential) and vulnerability (vulnerability to cavitation) along diversity gradients during drought events. Our extensive measurement campaign took place between 2021 and 2023, primarily during the exceptional 2022 drought, at six network sites (Italy in 2021, France, Belgium, Austria, and Germany during the extreme drought of 2022, and Brazil in 2023). We analysed species richness and tree species composition using one-way ANOVA and observed a significant positive effect of species richness on HSM in approximately 25% of the studied species, which is concordant with existing literature. However, when considering species

composition of the stand instead of just species richness, more complex interspecific interactions emerged. This highlights the need for a deeper understanding of mechanisms that underlie tree interactions in such stressful dry conditions. By examining competition and diversity indices at the individual level, we gradually untangle the effects of individual neighbourhood structures on individual stress during drought events. Our findings indicate that species interactions, through yet-to-be-identify processes, or community size traits can better explain stress patterns than a species diversity index. This reinforces the notion that focal tree functional traits relative to neighbouring trees are key components in better understanding how mechanisms operate at the local neighbourhood scale in individual tree responses to drought.