Comparing the effect of artificial drought and crown reduction on tree ring response in sessile oak and Norway spruce seedlings

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Extreme climatic events such as hotter drought, compounded by biotic stressors, cause much of the forest mortality observed worldwide. Following extensive deforestation, it is essential to have robust regeneration material that can withstand the initial establishment shock and effectively restore the area. In this study, we investigated how the tree-ring anatomy of young seedlings responds to treatments that are intended to improve their fitness and increase their chance of survival under field conditions with limited soil water availability. Two widespread and economically important tree species with distinct anatomies, specifically sessile oak (ring-porous) and Norway spruce (conifer), were selected for this investigation. We treated 3-year-old plants with 50% crown reduction (CR) and hydrogel (H) application in soil, and followed their development in dry and wet conditions over a two-year period (2021-2022). We hypothesized that both CR and H application would have a beneficial or ameliorative effect on radial increment under dry conditions. Therefore, our aim was to test whether these modifications would lead to xylem adjustments that specifically support plant growth. The most recent two rings were evaluated to assess changes in wood structure by analyzing various xylem traits in the stem transverse section. Our preliminary results revealed distinct adjustments in wood anatomy of these two species. Regardless of the treatment, sessile oak exhibited a marked decrease in tree-ring growth under dry conditions, whereas hydraulic conductivity increased in all treatments, except CR. This implies the enhanced ability to transport water more efficiently. On the other hand, the tree-ring growth of Norway spruce responded positively to CR, as no notable decrease was observed under dry conditions. In wet conditions, radial cell wall thickness and radial tracheid diameter were positively impacted by both CR and H only in earlywood tracheids. This suggests contrasting biomass allocation patterns in the two species. Sessile oak appears better able to adjust its biomass partitioning to resource availability. However, confirmation of this would require additional research on the belowground components. Conversely, Norway spruce seedlings exhibit a greater response to treatments intended to facilitate their growth and development during the initial stages of their development.