ADAPTATION OF NORWAY SPRUCE MANAGEMENT TO CLIMATE CHANGE BY CHANGING THE INTENSITY OF THINNING

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INTRODUCTION

Episodes of widespread tree mortality due to drought stress are increasingly observed worldwide (e.g. Anderegg et al. 2016), and climate models predict more frequent and severe droughts (IPCC 2014). Forest management strategies to mitigate drought impacts include adjusting stand structure and promoting adaptive traits (D'Amato et al. 2013). One widely recommended approach is thinning, which reduces tree density to enhance resource availability for remaining trees. Thinning has been shown to improve soil water availability and reduce climate stress through lower transpiration and canopy interception (Moreau et al. 2022). However, thinning effects vary with intensity and may diminish over time (Duursma 2011). Despite its popularity, long-term empirical evidence remains limited (Erdozain et al. 2023). The objective of this article is to assess the effects of different thinning intensities of young Norway spruce (*Picea abies* [L.] Karst.) stand.

Fig. 1: The automatic point dendrometer model D2 installed in the unthinned control plot.

MATERIALS AND METHODS

The study was conducted at the School Forest Enterprise Křtiny, CZ (51° 55′ 55.2″ N and 18° 12′ 50.4″ E) during 2022-2024 season. At the selected site, thinning was carried out at two intensities in year 2022: 1) light (removal of 20% of trees) and 2) heavy (removal of 50% of trees). At the same time, part of the stand remained untreated (i.e., control area). Subsequently, 10 trees were selected in each plot for detailed daily and annual tree growth monitoring by automatic point dendrometer D2 (Tomst s.r.o.; Czechia) (Fig. 1). In each plot microclimate changes were determined using TMS-4 sensors (Tomst s.r.o.) that measure both air and soil temperature along with soil moisture, Four TMS-4 sensors were installed in each plot.

RESULTS AND DISCUSSION

Non-thinned plots had the lowest soil moisture availability (around 35%) (Fig. 2). Light thinning increased soil moisture by 74%, reaching approximately 61%, while heavy thinning resulted in a 96% increase, bringing availability close to 69% (Fig. 2). This confirms that thinning substantially improves water availability, with heavy thinning providing the greatest benefit, likely due to reduced stand transpiration and canopy interception. Non-thinned plots showed the smallest radial growth (about 6 mm). Light thinning increased growth by 34%, whereas heavy thinning boosted growth by 199% (Fig. 2). This dramatic improvement under heavy thinning suggests that reduced competition for resources strongly enhances tree vitality and growth potential. Non-thinned plots experienced the highest drought stress (around 75%). Light thinning reduced stress by 26%, lowering it to roughly 55%, while heavy thinning decreased stress by 96%, reducing it to only 3% (Fig. 2). This indicates that heavy thinning is highly effective in mitigating drought stress, almost eliminating its impact compared to non-thinned stands.

In conclusion, these findings support heavy thinning as a powerful strategy for enhancing drought resilience in young Norway spruce stands.

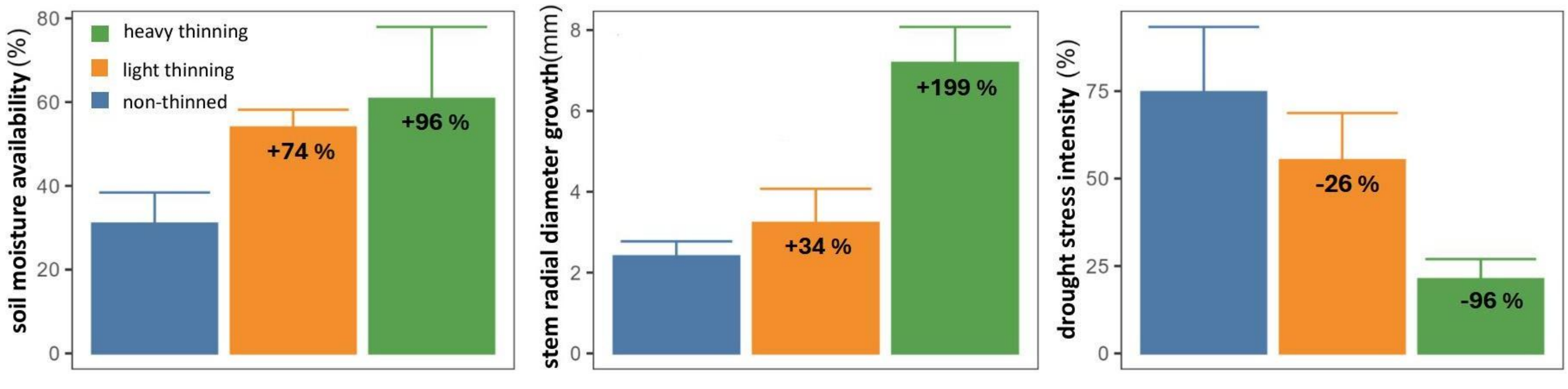

Fig.1: Overall effect of different thinning intensities on the soil moisture availability, stem radial diameter growth and drought stress intensity in the young Norway spruce stand during a period 2022–2024

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