Long-term mitigation of drought stress by thinning : insights from an Atlas Cedar plantation

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Résumé

With ongoing climate change, drought has become one of the major threat to forest ecosystems. Extreme drought episodes have been reported to induce substantial reductions in forest productivity and lead to dieback events accross various biomes. Several forest management strategies have been proposed to mitigate the adverse impacts of climate change. Among these, reducing stand density through thinning is one of the most popular as it reduces competition for water, thereby improving soil water availability at the tree level. This positive effect dampens over time after thinning as the remaining trees grow and their water demand increases. However, as most studies have focused on short-term response to thinning, the long-term effects of this strategy remain uncertain.
In this study, we focused on an Atlas cedar (*Cedrus atlantica*) stand established in 1968 near Avignon, in the south of France. In 1992, 4 different thinning treatments were applied : 1200 (control), 800, 600 and 400 stems/ha. To assess drought stress experienced by the trees, predawn and midday water potentials were measured on 12 trees per treatment on four dates in the summer of 2017, the driest year within the 1960-2020 period at this site. Additionally, measurements of native embolism were also performed on 5 trees of the 2 most extreme density treatments using x-ray tomography. Plant Area Index was calculated from 20 hemispherical photographs per treatment, taken at 1.3m above ground as a proxy of stand Leaf Area Index (LAI). To assess growth performance, the circumference of all trees (more than 1200) was measured at regular time intervals and _˜15 trees per treatment were cored in the end of 2017.
Our results show that 25 years after thinning, LAI had reached similar levels across all thinning treatments, suggesting a similar water demand and no remaining effect on water stress. Nonetheless, trees subject to reduced competition still exhibited higher growth performance and lower water stress than trees subject to higher competition. We explore several hypotheses to elucidate how changes in competition could have led to this outcome, including (i) the potential contribution of understorey to LAI, (ii) the development of more extensive individual root systems in the heavily thinned treatments, or (iii) differences in soil water holding capacity among treatments.

*Intervenant

Mots-Clés: water stress, Cedrus atlantica, mediterranean forest, competition, water potential, stand density