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Interactions of thinning and stem height on the drought response of radial stem growth and isotopic composition of Norway spruce (Picea abies)

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Radial stem growth and the isotopic composition of growth rings are commonly used to quantify the effects of droughts on trees. However, often these parameters are only quantified at one stem height, e.g. 1.3 m, and it is not known how representative this is for the whole stem. This study investigated radial growth at four stem heights (1.3, 5.5, 9.8 and 14 m), and wood D13C and d18O at two heights (1.3 and 14 m) of co-dominant Norway spruce trees from heavily (HT) and moderately thinned (MT) stands to assess whether thinning influenced the drought response of stems at different tree heights. Annual basal area increments (BAI) and stable isotopes in early and late wood were compared between thinning treatments and among the different stem heights. For BAI, first-order correlations with climate were analysed as well. The response of radial growth and isotopic composition to drought was similar at different stem heights in HT trees, but varied with height in MT trees, which were also more sensitive to climatic variations. Recovery of radial growth after drought was more rapid in trees from heavily thinned compared to moderately thinned stands, except for the topmost height. Basal area increments at breast height (1.3 m) provided good estimates of the volume growth response to drought for the whole stem, but not for its recovery. The faster recovery of radial growth at 1.3 m height of HT compared to MT trees after the 2003 drought was not accompanied by differences in recovery of isotopic composition. However, this is likely to be related to differences between treatments in remobilization of stored C and in tree structure (leaf area, root systems).