

Interactions between root and stem growth in *Pinus sylvestris* exposed to drought - assumptions based on tree ring analysis

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Radial stem growth indices of trees are frequently applied to identify the climatic factors limiting tree growth. Based on several tree-ring studies conducted within a dry inner Alpine valley it is well established that growth of Scots pine (*Pinus sylvestris* L.) is primarily limited by spring precipitation and severe drought results in increased tree mortality. To examine short-term influences of drought stress on growth processes more closely, we determined the influence of climate variables and soil moisture and temperature on intra-annual dynamics of tree ring development and stem radial growth in *Pinus sylvestris*.

We found that bud-break and shoot growth recommenced in May at the earliest. Root growth, however, is assumed to precede above ground growth for several weeks that is why we hypothesize that growth reductions seen in ring-width series, which coincide with drought periods in early spring, are related to an extensive growth inhibition or even damage of the fine root system and associated symbiotic mycorrhizal hyphae in the upper soil layer. Higher tree mortality and reduced growth of shallowly rooted trees support our reasoning.

Dendrometer records revealed that although fluctuations in stem radius were closely related to soil moisture throughout the growing season, an influence of soil temperature on initiation of radial stem growth was detected. These results suggest that in *Pinus sylvestris* exposed to severe soil dryness, a threshold root-zone temperature rather than soil moisture is involved in triggering onset of above ground stem growth in spring.

Hence, our results suggest a close linkage between root and stem growth in *Pinus sylvestris* exposed to drought. Therefore, we conclude that combined studies considering both, above and below ground growth processes are needed to elucidate more comprehensively the influence of environmental stresses on tree physiology and successional forests shifts in the course of climate change.

Keywords: cambial activity, drought, root-shoot interaction, Scots pine, tree ring