Less pronounced drought responses in ring-porous than in diffuse-porous temperate tree species

JournalArticle (Originalarbeit in einer wissenschaftlichen Zeitschrift)

ID 4657933
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Year 2022
Title Less pronounced drought responses in ring-porous than in diffuse-porous temperate tree species
Journal Agricultural and Forest Meteorology
Volume 327
Pages / **Article-Number** 109184
Tree species differ in their physiological responses to drought, but the underlying causes are often unclear. Here we explored responses of radial growth to centennial drought events and sap flow (Fs) to seasonal drought in four mixed forests on either moist or drier sites in northwestern Switzerland. While the diffuse-porous species (Fagus sylvatica, Prunus avium, Tilia platyphyllos) showed marked growth reductions in 1976 and 2003, two known marker years for severe drought, growth of the two ring-porous species (Quercus petraea and Fraxinus excelsior) was less severely affected. During a dry early to midsummer, diffuse-porous species strongly reduced Fs at the two drier sites but not (or less so) at the two moister sites. Regardless of soil moisture availability, the deep -rooting, ring-porous trees invariably down-regulated Fs to 60-70% of their maxima in response to vapour pressure deficit (VPD) and maintained similar fluxes across sites, irrespective of upper soil moisture conditions. A generalised additive model of normalised Fs as a function of VPD and soil matric potential yielded a drought -sensitivity ranking of Fs led by the two insensitive ring-porous species followed by the diffuse-porous trees (ordered by increasing sensitivity: Fraxinus excelsior < Quercus petraea < Prunus avium < Acer pseudoplatanus < Fagus sylvatica < Tilia platyphyllos). In conclusion, ring-porous tree species exhibited stronger VPD-driven sto-matal control over Fs, and tree-ring formation was less sensitive to severe drought than in their neighbouring diffuse-porous species. The Fs regulation explained the greater drought tolerance of the ring-porous trees.
Publisher Elsevier Masson
ISSN/ISBN 0168-1923 ; 1873-2240
edoc-URL https://edoc.unibas.ch/92303/
Full Text on edoc No;
Digital Object Identifier DOI 10.1016/j.agrformet.2022.109184
ISI-Number 000876524900003
Document type (ISI) Article