Species-specific differences in water uptake depth of mature temperate trees vary with water availability in the soil

JournalArticle (Originalarbeit in einer wissenschaftlichen Zeitschrift)

ID 4485356
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Year 2019
Title Species-specific differences in water uptake depth of mature temperate trees vary with water availability in the soil
Journal Plant biology (Stuttgart, Germany)
Volume 21
Number 1
Pages / **Article-Number** 71-81
Mesh terms Deuterium; Humidity; Linear Models; Models, Biological; Oxygen Isotopes; Rain; Soil, chemistry; Species Specificity; Trees, physiology; Water, metabolism; Xylem, metabolism
Temperate tree species differ in their physiological sensitivity to declining soil moisture and drought. Although species-specific responses to drought have often been suggested to be the result of different water uptake depths, empirical evidence for such a mechanism is scarce. Here we test if differences in water uptake depths can explain previously observed species-specific physiological responses of temperate trees to drought and if the water uptake depth of different species varies in response to declining soil moisture. For this purpose, we employed stable oxygen and hydrogen isotopes of soil- and xylem water that we collected over the course of three growing seasons in a mature temperate forest in Switzerland. Our data show that all investigated species utilize water from shallow soil layers during times of sufficient soil water supply. However, Fraxinus excelsior, Fagus sylvatica and Acer pseudoplatanus were able to shift their water uptake to deeper soil layers when soil water availability decreased in the top soil. In contrast, Picea abies, was not able to shift its water uptake to deeper soil layers. We conclude from our data that more drought resistant tree species are able to shift their water uptake to deeper soil layers when water availability in the top soil is becoming scarce. In addition, we were able to show that water uptake depth of temperate tree species is a trait with high plasticity that needs to be characterized across a range of environmental conditions. This article is protected by copyright. All rights reserved.
Publisher WILEY
ISSN/ISBN 1438-8677
edoc-URL https://edoc.unibas.ch/67116/
Full Text on edoc No;
Digital Object Identifier DOI 10.1111/plb.12907
PubMed ID http://www.ncbi.nlm.nih.gov/pubmed/30184305
ISI-Number WOS:000453080700008
Document type (ISI) Journal Article