The O-18-signal transfer from water vapour to leaf water and assimilates varies among plant species and growth forms

JournalArticle (Originalarbeit in einer wissenschaftlichen Zeitschrift)

ID 4601932
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Year 2020
Title The O-18-signal transfer from water vapour to leaf water and assimilates varies among plant species and growth forms
Journal PLANT CELL AND ENVIRONMENT
Volume 43
Number 2
Pages / **Article-Number** 510-523
Keywords carbohydrates; clouds; compound-specific isotope analysis (CSIA); fog; foliar water uptake; leaf wetting; precipitation; rain
Mesh terms Science & TechnologyLife Sciences & BiomedicinePlant SciencesPlant Sciences
The O-18 signature of atmospheric water vapour (delta O-18(V)) is known to be transferred via leaf water to assimilates. It remains, however, unclear how the O-18-signal transfer differs among plant species and growth forms. We performed a 9-hr greenhouse fog experiment (relative humidity >= 98%) with O-18-depleted water vapour (-106.7 parts per thousand) on 140 plant species of eight different growth forms during daytime. We quantified the O-18-signal transfer by calculating the mean residence time of O in leaf water (MRTLW) and sugars (MRTSugars) and related it to leaf traits and physiological drivers. MRTLW increased with leaf succulence and thickness, varying between 1.4 and 10.8 hr. MRTSugars was shorter in C-3 and C-4 plants than in crassulacean acid metabolism (CAM) plants and highly variable among species and growth forms; MRTSugars was shortest for grasses and aquatic plants, intermediate for broadleaf trees, shrubs, and herbs, and longest for conifers, epiphytes, and succulents. Sucrose was more sensitive to delta O-18(V) variations than other assimilates. Our comprehensive study shows that plant species and growth forms vary strongly in their sensitivity to delta O-18(V) variations, which is important for the interpretation of delta O-18 values in plant organic material and compounds and thus for the reconstruction of climatic conditions and plant functional responses.
Publisher WILEY
ISSN/ISBN 0140-7791
edoc-URL https://edoc.unibas.ch/78130/
Full Text on edoc No;
Digital Object Identifier DOI 10.1111/pce.13682
PubMed ID http://www.ncbi.nlm.nih.gov/pubmed/31732962
ISI-Number 000500151900001
Document type (ISI) Article