



HAL
open science

Unveiling stomata 24/7: can we use carbonyl sulfide (COS) and oxygen isotopes (^{18}O) to constrain estimates of nocturnal transpiration across different evolutionary plant forms?

Teresa Gimeno Chocarro, Jérôme Ogée, Alexandre Bosc, Bernard Genty, Steven Wohl, Lisa Wingate

► To cite this version:

Teresa Gimeno Chocarro, Jérôme Ogée, Alexandre Bosc, Bernard Genty, Steven Wohl, et al.. Unveiling stomata 24/7: can we use carbonyl sulfide (COS) and oxygen isotopes (^{18}O) to constrain estimates of nocturnal transpiration across different evolutionary plant forms?. EGU 2015, European Geosciences Union General Assembly, Apr 2015, Vienne, Austria. Geophysical Research Abstracts, 17, 2015. hal-02742041

HAL Id: hal-02742041

<https://hal.inrae.fr/hal-02742041v1>

Submitted on 3 Jun 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Unveiling stomata 24/7: can we use carbonyl sulfide (COS) and oxygen isotopes (^{18}O) to constrain estimates of nocturnal transpiration across different evolutionary plant forms?

Teresa E. Gimeno (1), Jerome Ogee (1), Alexander Bosc (1), Bernard Genty (2), Steven Wohl (1), and Lisa Wingate (1)

(1) INRA, UMR 1391, France (teresa.gimeno@bordeaux.inra.fr), (2) Laboratoire d'Ecophysiologie Moléculaire des Plantes, UMR 7265 CNRS-CEA, Aix-Marseille Université, CEA Cadarache, 13108 St Paul-lez-Durance, France

Numerous studies have reported a continued flux of water through plants at night, suggesting that stomata are not fully closed. Growing evidence indicates that this nocturnal flux of transpiration might constitute an important fraction of total ecosystem water use in certain environments. However, because evaporative demand is usually low at night, nocturnal transpiration fluxes are generally an order of magnitude lower than rates measured during the day and perilously close to the measurement error of traditional gas-exchange porometers. Thus estimating rates of stomatal conductance in the dark (g_{night}) precisely poses a significant methodological challenge. As a result, we lack accurate field estimates of g_{night} and how it responds to different atmospheric drivers, indicating the need for a different measurement approach. In this presentation we propose a novel method to obtain detectable and robust estimates of g_{night} . We will demonstrate using mechanistic theory how independent tracers including the oxygen isotope composition of CO_2 ($\delta^{18}\text{O}$) and carbonyl sulfide (COS) can be combined to obtain robust estimates of g_{night} . This is because COS and CO_2 exchange within leaves are controlled by the light insensitive enzyme carbonic anhydrase. Thus, if plant stomata are open in the dark we will continue to observe COS and CO_2 exchange. Using our theoretical model we will demonstrate that the exchange of these tracers can now be measured using advances in laser spectrometry techniques at a precision high enough to determine robust estimates of g_{night} . We will also present our novel experimental approach designed to measure simultaneously the exchange of CO_2 and COS alongside the conventional technique that relies on measuring the total water flux from leaves in the dark. Using our theoretical approach we will additionally explore the feasibility of our proposed experimental design to detect variations in g_{night} during drought stress and across a variety of plant types that have evolved diverse strategies to control water loss from leaf tissues.