

Foliar water uptake in *Pinus* species depends on needle age and stomatal wax structures

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May 12, 2022

Abstract

The uptake of water through leaves is commonly referred to as foliar water uptake (FWU). The phenomenon has been documented in many species and is increasingly recognized as a non-trivial factor in plant-water relations. However, it remains unknown whether FWU is a wide-spread phenomenon in *Pinus* species, and how it may relate to needle traits such as the form and structure of stomatal wax plugs. Here we studied these questions in current-year and one-year old needles of seven *Pinus* species. We analyzed the surface and stomatal structure with cryo-scanning electron microscopy. Additionally, we considered the effect of artificial wax erosion by application of the surfactant TritonTM X-100, which is able to alter wax crystals. The results show for all species 1) that FWU occurred, 2) that FWU is higher in old needles compared to young needles, and 3) that there is substantial erosion of stomatal wax plugs in old needles. Additionally, FWU in young needles was enhanced by the surfactant treatment, and was highest in *P. canariensis* showing a thin wax plug. The results of this study provide evidence 1) for widespread FWU in *Pinus* and 2) for the influence of age-related needle surface erosion on FWU.

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