The Ant and the Grasshopper: contrasting responses and behaviors to water stress of riparian trees along a hydroclimatic gradient

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Résumé

Riparian trees are particularly vulnerable to drought because they are highly dependent on water availability for their survival. River anthropiztion reinforces the contrasted wtaer availability among riparian forest stand: incision of the river channel can decrease groundwater access to phreatophyte species. However, the response of riparian tree species to water stress varies depending on regional hydroclimatic conditions, making them unevenly vulnerable to changing drought patterns. Understanding this spatial variability in stress responses requires a comprehensive assessment of water stress across broader spatial and temporal scales in riparian forest, which may be addressed by remote-sensing. Yet, the precise ecophysiological mechanisms underlying these responses remain poorly linked to remotely sensed indices in riparian environments, which are heterogeneous and dynamic ecosystems. To address this gap, the implementation of remote sensing methods coupled with in situ validation is essential to obtain consistent results across diverse spatial and temporal contexts. We conducted a multi-tool analysis combining multispectral and thermal remote sensing indices with in situ ecophysiological measurements at different temporal scales to analyze the responses of white poplar (Populus alba) to seasonal changes in drought along a hydroclimatic gradient. Moreover, we assessed the impact of groundwater availability along this gradient.
Using this approach, we demonstrate that white poplars along the Rhône River (France) exhibit contrasting responses and behaviors during drought depending on the latitudinal context. White poplars in a Mediterranean climate show rapid stomatal closure to reduce water loss and maintain high minimum water potential levels, although this results in a

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decrease in remotely sensed greenness. Conversely, white poplars located upstream in a temperate climate show high transpiration and stable greenness but lower minimum water potential and water content. A site in the middle of the gradient has intermediate responses. These results demonstrate that white poplars along a climate gradient can have a range of responses to drought along the iso/anisohydricity continuum.
These results are important for future climatic conditions because they show that the same species can have different mechanisms of drought resilience, even in the same river valley. This raises questions regarding how these riparian tree populations will respond to future climatic and hydrological conditions.

Mots-Clés: Populus alba, remote sensing, thermal infrared, water content, water potential, hydraulic stress, NDVI