A global meta-analysis of Water Use Efficiency proxies reveals that UV radiation decreases transpiration without improving WUE

Marcel A.K. Jansen[1], Alexander Ac[1], John Grace[1], and Otmar Urban[1]

[1]Ustav vyzkumu globalni zmeny Akademie ved Ceske republiky

February 21, 2025

Abstract

Plant water use efficiency (WUE) links physiological processes to ecosystem-scale carbon and water cycles, making it a crucial parameter for climate change adaptation modelling. Climate and stratospheric ozone dynamics expose plants to varying intensity of ultraviolet-B radiation (UV-B), which affects stomatal function and transpiration. This meta-analysis evaluates UV-B effects on WUE using gas exchange and isotopic proxies. While UV-B radiation reduces stomatal conductance and transpiration, it also suppresses photosynthesis, particularly under non-saturating light. As a result, WUE remains unchanged or declines in UV-B exposed plants, depending on the measurement method. Instantaneous gas exchange-based WUE proxies indicate a decrease, whereas isotope-based proxies, integrating long-term fluxes, show no significant UV-B effect. Notably, UV-B suppresses photosynthesis only in studies using supplemental UV radiation, while UV exclusion in field settings has no significant impact on WUE. Some field studies even report improved WUE under ambient UV-B, suggesting potential adaptive benefits. These findings challenge the assumption that UV-B-induced decreases in transpiration enhance WUE. Instead, they highlight a complex interplay between UV radiation, photosynthesis, and stomatal regulation, emphasizing the need to reconsider UV-B's role in plant water relations under future climate conditions.

Hosted file

`Jansen_UV-WUE_PCE.docx` available at https://authorea.com/users/696615/articles/1271114-a-global-meta-analysis-of-water-use-efficiency-proxies-reveals-that-uv-radiation-decreases-transpiration-without-improving-wue