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January 6, 2023



NAPPN Annual Conference Abstract: Integrating Live Confocal Microscope Imagery of Stomata with Measurement of Leaf-Level Photosynthetic Gas Exchange

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Keywords: stomata, gas exchange, stomatal conductance, CO₂ assimilation.

Stomata are the microscopic pores on plant leaves that open or close to regulate the flux of water from leaves. Guard cells of stomata are known to react to environmental conditions such as light and CO₂ in order to optimize CO₂ uptake and water loss. Stomatal anatomy (aperture, length, width, etc.) influences leaf-level physiology traits including conductance to water. Stomatal anatomy can be visualized in situ by microscopy, but the difficulty of regulating the atmospheric environment of a microscope stage means that the conditions under which imaging is done are rarely physiologically relevant. Alternatively, portable photosynthesis measuring instruments offer a non-destructive estimate of leaf gas exchange, including stomatal conductance, while the leaf experiences tightly controlled steady-state or dynamic environmental conditions. However, these measurements reflect stomatal characteristics in aggregate on a leaf area basis, which are heavily influenced by the mesophyll as well as epidermal structure and function. Observing the behavior of stomata by microscopy simultaneous to controlling the leaf environment and measuring gas exchange fluxes would allow advances in the understanding of leaf structure-function relationships. To reconcile the microscopic stomatal characteristics with leaf-level gas exchange we have combined laser scanning confocal microscopy and gas exchange instruments to simultaneously observe stomatal characteristics (e.g. stomatal aperture, pore depth, closing speed) and leaf-level traits like photosynthesis, transpiration, and stomatal conductance. Results are presented for the use of this approach on diverse plant species.