

The Productivity of Perennial Crops Miscanthus and Switchgrass is More Resistant to Vapor Pressure Deficit Stress than Maize

Background/Objective

Rising atmospheric vapor pressure deficit (D) with warming is an increasingly important driver of crop productivity loss, but the relative sensitivity of conventional seed crops and alternative perennial crops remains poorly understood.

Approach

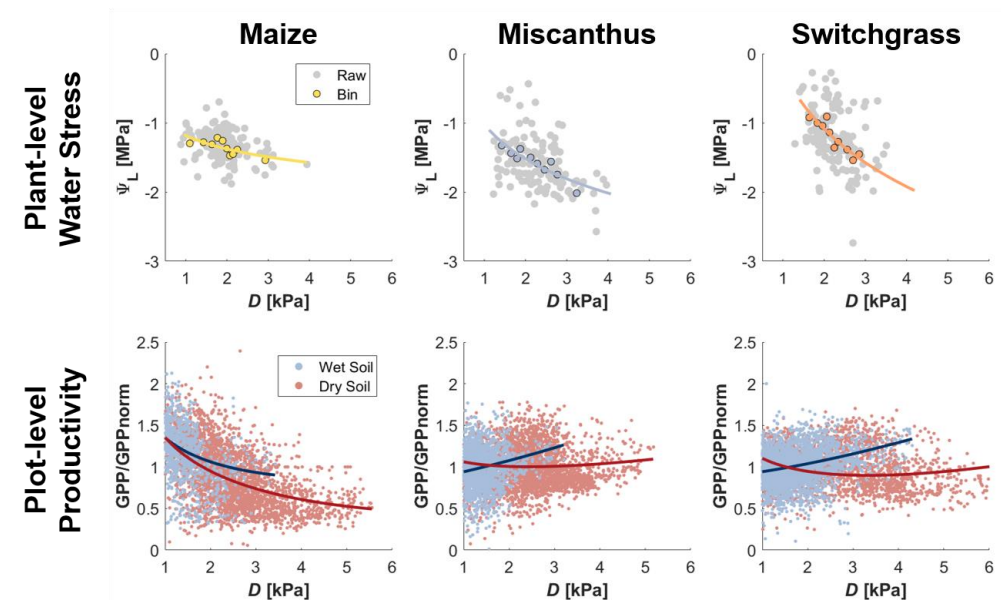
Researchers combined a 9-year eddy covariance carbon flux record (2008-2016) with 600+ midday leaf water potential (ψ_L) measurements (2024-2025) from adjacent maize, miscanthus, and switchgrass plots to quantify the limitations of elevated D on crop-specific productivity and evaluate how these responses vary as a function of soil moisture status (Θ).

Results

Maize strictly regulated ψ_L and its gross primary productivity (GPP) was strongly reduced by increasing D . In contrast, miscanthus and switchgrass allowed larger ψ_L declines and sustained higher GPP under similar moisture. D exerted a larger limitation on maize GPP than Θ , but D -driven declines were less severe when accompanied by high Θ . GPP sensitivity to D was also influenced by Θ for miscanthus and switchgrass but the buffering effect was stronger compared to maize. Specifically, high D paired with high Θ were the most productive conditions for the perennials, reflecting temperature-driven gains in photosynthetic efficiency when evaporative stress was mitigated by sufficient soil water supply.

Significance/Impacts

Miscanthus and switchgrass displayed greater overall resistance to atmospheric drought and more stable GPP across hydroclimatic variability than maize, highlighting that maize is more vulnerable to future projections of rising vapor pressure deficit than miscanthus or switchgrass.



Plant- and plot-level responses to increasing vapor pressure deficit (D). Top row shows midday leaf water potential (ψ_L); bottom row shows normalized gross primary productivity (GPP/GPPnorm) for maize, miscanthus, and switchgrass.

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