Leaf water relations in epiphytic ferns are driven by drought avoidance rather than tolerance mechanisms

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Abstract

Opportunistic diversification has allowed ferns to radiate into epiphytic niches in angiosperm dominated landscapes. However, our understanding of how ecophysiological function allowed establishment in the canopy and the potential transitionary role of the hemi-epiphytic life form remain unclear. Here, we surveyed 39 fern species in Costa Rican tropical forests to explore epiphytic trait divergence in a phylogenetic context. We examined leaf responses to water deficits in terrestrial, hemi-epiphytic, and epiphytic ferns and related these findings to functional traits that regulate leaf water status. Epiphytic ferns had reduced xylem area (-63%), shorter stipe lengths (-56%), thicker laminae (+41%), and reduced stomatal density (-46%) compared to terrestrial ferns. Epiphytic ferns exhibited similar turgor loss points, higher osmotic potential at saturation, and lower tissue capacitance after turgor loss than terrestrial ferns. Overall, hemi-epiphytic ferns exhibited traits that share characteristics of both terrestrial and epiphytic species. Our findings clearly demonstrate the prevalence of water conservatism in both epiphytic and hemi-epiphytic ferns, via selection for anatomical and structural traits that avoid leaf water stress. Even with likely canalized physiological function, adaptations for drought avoidance have allowed epiphytic ferns to successfully endure the stresses of the canopy habitat.

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