

Saturday, October 10, 2:10-3:00 p.m.

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The remarkable convergence of alternative photosynthetic syndromes in plants

CAM and C₄ photosynthesis are two carbon-concentrating mechanisms (CCMs) that increase photosynthetic efficiency, and together have evolved hundreds of times in flowering plants over the past 30 million years. Although most of the biochemical components that have been recruited into both CCMs are identical, they have been implemented differently, with repercussions: CAM plants exhibit much higher water use efficiencies than C₄ plants, but C₄ plants can achieve higher photosynthetic capacities. A common assumption is that CAM evolved in drought-adapted, slow growing succulents and C₄ evolved in fast growing herbs. Yet the many intermediate phenotypes between C₃ and 'fully optimized' CAM and C₄ phenotypes suggests that the evolution of both syndromes requires a great number of changes that do not happen all at once. What are the evolutionary starting points for CAM and C₄ syndromes, and how similar are they? A preliminary view of available data suggests that many of the genetic precursors and environmental drivers of C₄ and CAM syndromes are shared, and that slight anatomical differences may act as evolutionary filters, elevating phenotypic accessibility to one syndrome while simultaneously limiting accessibility to the other. Identifying the earliest stages in the evolution of both syndromes can explain the clustered nature of C₄ and CAM origins, and may also inform current efforts to bio-engineer these syndromes into crops.