A shady business in legumes: Identification of a lutein epoxidase in soybean

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Leaves rapidly adjust their xanthophyll pool in response to changes in light to funnel absorbed excitation energy toward either photochemistry or photoprotective energy dissipation. In roughly 60% of species surveyed, α-xanthophylls are converted between shade-enriched lutein epoxide (Lx) and photoprotective lutein (L), forming the lutein epoxide cycle (LxL cycle). Despite its prevalence, the enzyme involved in the epoxidation reaction of the LxL cycle is unknown. Using pigment profiling and canopy-specific RNA-Seq, we detect Lx throughout the middle and lower canopy of soybean and link its accumulation to the expression of a mono-oxygenase we call *lutein epoxidase* (*LEP)*. We confirm LEP activity in a transient assay in *Nicotiana benthamiana*. Lastly, we show that *LEP*s are distinct from *zeaxanthin epoxidases* (*ZEP*s) and are conserved across many legumes. The discovery of an enzyme involved in α-xanthophyll biosynthesis provides us with new opportunities to explore how plants optimize photosynthesis in deeply shaded environments.