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Regulation of Rubisco activity by light in tomato

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Rubisco is the most abundant protein in the chloroplast, fixing CO₂ into sugars during photosynthesis. Its activity is finely adjusted in response to changes in the environment. The regulation of Rubisco by its chaperone Rubisco activase (Rca) during shade-sun transitions in Arabidopsis is a good example of this fine-tuning. Rca promotes the ATP-dependent release of inhibitors that bind to Rubisco catalytic sites under shade. As most plants, Arabidopsis has a shorter redox-insensitive β isoform and a longer redox-sensitive α Rca isoform which shows higher sensitivity to ADP inhibition. Arabidopsis mutants expressing only Rcaβ showed faster induction of CO₂ assimilation after transition from low to high irradiance and enhanced growth under fluctuating light. In contrast, Solanaceae species such as tobacco and tomato naturally express only Rcaβ. Tobacco Rcaβ shows high sensitivity to ADP inhibition, but how other changes in the chloroplast environment affect Rubisco regulation in this species and Solanaceae crops is still enigmatic. In the framework of the CAPTALISE project, we are studying how Rca regulates Rubisco under changing chloroplast conditions in response to light in tomato. These studies advance our understanding of Rubisco regulation to inform the improvement of photosynthetic productivity in crop plants that experience dynamic light environments including shade-sun transitions.

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