Salt stress slows down dynamic photosynthesis mainly through osmotic effects on dynamic stomatal behavior

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Abstract

Salt stress affects stomatal behavior and photosynthesis, by a combination of osmotic and ionic components, but it is unknown how these components affect photosynthesis dynamics under fluctuating light. Tomato (*Solanum lycopersicum*) plants were grown using a reference nutrient solution (Control, EC: 2.3 dS m⁻¹), the reference containing extra macronutrients (only osmotic effect; EC: 12.6 dS m⁻¹), or the reference containing an additional 100 mM NaCl (osmotic and ionic effects; EC: 12.8 dS m⁻¹). Steady-state and dynamic photosynthesis along with leaf biochemistry were characterized throughout leaf development. Osmotic effects resulted in increased leaf chlorophyll content per unit leaf area, induced stomatal closure along with rapid stomatal responses to changes in light intensity, and limited dynamic but not steady-state photosynthesis. Ionic effects were barely observed in plant growth and dynamic photosynthesis, but led to a reduction in leaf chlorophyll content and photosynthetic capacity in old leaves. Steady-state and dynamic photosynthesis traits decreased with leaf age, due to increases in stomatal and non-stomatal limitations. With increasing leaf age, rates of light-triggered stomatal movement decreased across treatments, which is more strongly for stomatal opening rather than closure. We conclude that osmotic effect strongly impacts dynamic stomatal and photosynthetic behavior under salt stress.

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