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Declining soil-root hydraulic conductance drives stomatal closure of tomato under drought

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The fundamental question as to what triggers stomatal closure during soil drying remains contentious. Thus, we urgently need to improve our understanding of stomatal response to water deficits in soil and atmosphere. Here, we investigated the role of soil-plant hydraulic conductance (K_{sp}) on transpiration (E) and stomata regulation. We used a root pressure chamber to measure the relation between E, leaf xylem water potential ($\psi_{leaf\text{-}x}$) and soil water potential (ψ_{soil}) in tomato. Additional measurements of $\psi_{leaf\text{-}x}$ were performed with unpressurized plants. A soil-plant hydraulic model was used to simulate E($\psi_{leaf\text{-}x}$) for decreasing ψ_{soil}. In wet soils, E($\psi_{leaf\text{-}x}$) had a constant slope while in dry soils the slope decreased, with $\psi_{leaf\text{-}x}$ rapidly and nonlinearly decreasing for moderate increases in E. The $\psi_{leaf\text{-}x}$ measured in pressurized and unpressurized plants matched well, which indicates that the shoot hydraulic conductance did not decrease during soil drying and that the decrease in K_{sp} is caused by a decrease in soil-root conductance. The decrease of E matched well the onset of hydraulic nonlinearity. Our findings demonstrate that stomatal closure prevents the drop in $\psi_{leaf\text{-}x}$ caused by a decrease in K_{sp} and elucidate a strong correlation between stomatal regulation and belowground hydraulic limitation.