ABA explains the soil water threshold of stomatal regulation during drought

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Abstract

By regulating carbon uptake and water loss by plants, stomata are not only responsible for productivity but also survival during drought. The timing of stomatal closure is crucial for preventing excessive water loss during drought, yet has high ecological variability between species. An aspect of stomatal response that remains disputed is the mechanism driving the trigger for stomatal closure during drought. We investigated this in a highly embolism resistant tree species *Umbellularia californica.* We tracked leaf endogenous abscisic acid (ABA) levels and determined the predawn and midday leaf water potential and gravimetric soil water content (gSWC) thresholds for stomatal closure and transpiration decline during a progressive drought. We found that while *U. californica* plants have a peaking type ABA dynamic where ABA levels rise early in drought then decline under prolonged drought conditions. The early increase in ABA levels corresponded to the closing of stomata and reduced transpiration. Furthermore, we found that the gSWC at which transpiration declines occurs before any large decreases in soil and predawn plant water status and could best be explained by declines in midday water potentials along with increased ABA levels. Our results indicate that ABA mediated stomatal regulation is an integral mechanism for delaying whole plant dehydration and can occur with minimal changes in bulk soil and plant water status.

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