Abscisic Acid–Mediated Suppression of Systemic Acquired Resistance Signaling

Systemic acquired resistance (SAR) is a response to pathogen infection that renders plants more resistant to subsequent infection (reviewed in Grant and Lamb, 2006). It is characterized by salicylic acid (SA) accumulation both at the initial point of infection and throughout the plant and involves the induction of certain pathogenesis-related (PR) genes. The plant hormone abscisic acid (ABA) is involved in adaptation to environmental stresses and is generally thought of as negatively regulating disease resistance (reviewed in Mauch-Mani and Mauch, 2005).

Yasuda et al. (pages 1678–1692) elegantly examined the interactions of ABA with SA-mediated SAR signaling by separating them from pathogen-induced defense responses. To do this, they used two chemical inducers of SAR: BIT and BTH. Chemically induced SAR rendered the plants resistant to infection by Pseudomonas syringae pv tomato, and treatment with ABA reversed this effect (see figure). The authors then used SA synthesis mutants in combination with chemical treatments to show that negative regulation of SAR signaling by ABA occurs both upstream and downstream of SA.

Since ABA is produced in response to environmental stress, the authors asked whether environmental stress inhibits SAR. They found that, just as ABA treatment had, salt stress suppressed SAR both upstream and downstream of SA. As expected, ABA levels were elevated under those conditions, so it appears that environmental stress can activate the ABA-mediated signaling that leads to SAR suppression. By contrast, a mutant that had lowered ABA levels, even in the face of salt stress, showed increased SAR induction in response to BIT and BTH. In these plants, salt stress did not suppress SAR induction, PR gene expression, or SA accumulation. These experiments nicely isolated the effects of ABA levels from other effects of salt stress and showed that the suppression of SAR in wild-type plants by salt stress likely was mediated by ABA.

After detailing the suppression of SAR by ABA, the authors asked whether SAR affects ABA signaling. They found that SAR suppressed ABA signaling in response to salt stress and that this suppression occurred from more than one point in the ABA and SAR signaling networks. Thus, SAR and ABA signaling are mutually antagonistic. This work emphasizes the complexity of both hormone signaling and stress responses in plants and makes it abundantly clear that these are properly thought of as networks rather than as pathways. The fact that responses to biotic and abiotic stresses are mutually antagonistic suggests that the precise regulation of these responses is vital to the plant.

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