ABSTRACT

Plants open stomata to facilitate gas exchange required for photosynthesis, but microbial pathogens take advantage of stomata to intrude into plants. Plants close stomata upon recognizing microbe-associated molecular patterns (MAMPs) thereby restricting pathogen entry. The foliar bacterial pathogen *Pseudomonas syringae* pv. *tomato* DC3000 (*Pto*) produces coronatine (COR), a structural mimic of bioactive jasmonate (JA), to inhibit MAMP-triggered stomatal closure for invasion. However, the molecular mechanism by which COR inhibits stomatal closure remains unclear. Here, I found that stomatal invasion by *Pto* requires *CYP707A1*, which encodes an abscisic acid (ABA)-catabolizing enzyme and is predominantly expressed in guard cells in the model Brassicaceae plant *Arabidopsis thaliana*. *Pto* induced *CYP707A1* expression dependently on COR and *COI1* encoding the plant JA receptor. The induction of *CYP707A1* by COR is directly regulated by and requires the major transcriptional regulator of JA signaling MYC2. Importantly, *CYP707A1* was essential for COR to inhibit stomatal closure triggered by the MAMP flg22, ABA, and salicylic acid. Furthermore, *Pto* required *CYP707A1* to reopen stomata and to invade leaves via stomata. These results indicate that *Pto* exploits the host JA-COI1-MYC2-CYP707A1 pathway for stomatal invasion in *A. thaliana*. Interestingly, comparative analysis of Brassicaceae species revealed that COR inhibits stomatal closure and *Pto* reopens stomata of *Arabidopsis lyrata* and *Cardamine hirsuta* but not *Capsella rubella* and *Eutrema salsugineum*, albeit that all of these Brassicaceae species possess *CYP707A1*. The pattern for the ability of COR to inhibit stomatal closure was incongruent with their phylogenetic relationship: i.e. *A. thaliana* is more closely related to *C. rubella* than *C. hirsuta*, implying that *C. rubella* and *E. salsugineum* have independently lost the functional JA-CYP707A1 pathway. This loss provided plants with an advantage against this host exploitation by *Pto*. Thus, *C. rubella* and *E. salsugineum* are resistant against COR-mediated stomatal invasion by *Pto* in contrast to the other tested Brassicaceae species such as *A. thaliana*. Noteworthy, I found that *A. thaliana*, *A. lyrata*, and *C. hirsuta*, in which COR mediates stomatal opening, fully open stomata in the morning within one hour after light turned on when *CYP707A1* expression is transiently induced. On the other hand, *C. rubella* and *E. salsugineum* wild-type plants as well as *A. thaliana* mutants defective in JA and *CYP707A1*, which were resistant against COR-mediated stomatal opening, showed delayed stomatal opening in the morning. Together, I propose an evolutionary tradeoff at stomatal aperture regulation: JA-mediated ABA catabolism via CYP707A1 allows plants to rapidly open stomata in the morning, which likely contributes to photosynthesis and plant growth, but it has an undesirable effect that is being exploited by pathogens. Considering that various leaf-infecting pathogens activate JA signaling by various means, this Brassicaceae JA-*CYP707A1* pathway may be under evolutionary selection arising from pathogen pressure.