Investigating the Role of AtPIEZO as a Possible Mechanoreceptor During Plant Defense

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Plants are sessile and therefore face many challenges from biotic or abiotic environmental stresses. It is necessary to comprehend the mechanism by which plants defend themselves against stress. PIEZO is one of the mechanisms plants use to recognize and sense mechanical stress. PIEZO is an evolutionarily-conserved mechanoreceptor and mechanosensitive ion channel that recognizes mechanical stimuli and converts these stimuli into biological signals, thereby increasing signal amplification in cells. Recent studies show that unlike in mammals, PIEZO is localized to the tonoplast or vacuolar membrane in plants and is required for efficient root penetration through medium. In this study, we investigated the role of PIEZO in plant defense. Given that PIEZO is involved in the suppression of the systemic movement of plant viruses in Arabidopsis thaliana, we hypothesized that PIEZO is involved in defense against bacteria and fungi. Publicly available RNAseq data reveal that the expression of Piezo increases during the defense response to bacterial phytopathogens. We, therefore, performed infection assays on homozygous piezo mutants. We found that piezo mutants were more susceptible to Pseudomonas syringae pv. tomato DC3000 and Alternaria brassisicola compared to the wild type (Col-0). Our findings indicate that PIEZO plays an important role in plant defense against bacterial and fungal attack. We then investigated the role of PIEZO in plant defense with a root growth inhibition assay using the immunogenic peptide flg22 as an elicitor. Our results showed that piezo mutants were less sensitive to flg22 treatment, with less MAMP-induced inhibition of root growth when compared to wild type. These results suggests that PIEZO plays a role in defense-mediated growth inhibition. In addition, we investigated whether PIEZO is upstream of the main NADPH-oxidase, RBOHD, and the associated oxidative burst that occurs in early defense. There was no significant reduction in Reactive Oxygen Species (ROS) production between piezo mutants and the wild type in a ROS assay with MAMP elicitors (flg22, chitin) and DAMP elicitors (Pep1). These findings allow us to understand that PIEZO modulates plant defense against bacteria and fungi. More research is needed to determine the role of PIEZO in pattern-triggered immunity (PTI) and effector-triggered immunity (ETI). This project is funded by the EMBRIO Institute (NSF-BII; DBI-2120200).