Signaling in plant immunity

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Plants detect potential pathogens in their environment via pathogen-associated molecular patterns (PAMPs) that are recognized by plant plasma membrane receptors. Typical PAMPs include the bacterial flagellin-derived flg22 peptide, the elf18 peptide of the bacterial elongation factor EF-Tu, bacterial peptidoglycans and lipopolysaccharides, as well as fungal chitin oligomers and glucan fragments from oomycetes. PAMP-binding to their receptors initiates complex signaling networks that activate a multi-component defense response and thereby establish PAMP-triggered immunity.

One of the earliest detectable responses after PAMP perception is the activation of ion channels at the plasma membrane. Using a transgenic Arabidopsis line with the calcium reporter, aequorin, increases in cytosolic calcium levels are detected after PAMP application. To identify signaling network components, seeds of aequorin-expressing lines were mutagenized and the population screened for mutants with changed calcium elevation (cce) in response to different PAMPs. Among several receptor complex components, a lectin S-domain receptor kinase was identified, which mediates lipopolysaccharide sensing in *Arabidopsis thaliana*.

MAPK cascades are essential for controlling defense responses. The elements that prevent erroneous signaling crosstalk may include expression patterns of the MAPK cascade components, the presence of pathway-specific protein complexes or the MAPK substrate diversity. Different strategies have been employed to isolate MAPK interacting proteins. Several VQ-motif containing proteins and tandem zinc finger proteins are MAPK substrates and regulate immune responses.

Pathogen effectors interfere with PAMP recognition and signaling to suppress PAMP-triggered defense responses. Some effectors of the bacterial pathogen *Pseudomonas syringae* pv. *tomato* specifically interfere with MAPK cascades and thereby attenuate plant resistance.