

Biochemical studies of plant defense responses against pathogens

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Abstract

Plants are continuously exposed to attacks from pathogenic, or disease-causing, organisms. To combat these, plants protect themselves with a variety of static defense structures and inducible responses. The most effective weapons in the plants defense arsenal are deployed upon the perception of an invading parasite. The result of pathogen recognition is a dramatic cellular response commonly involving a programmed cell death of the affected tissue. This response as a whole, termed the hypersensitive response, effectively halts the pathogen and prevents disease as a consequence.

Understanding the intricate mechanisms behind plant resistance and susceptibility to disease-causing agents has important theoretical and practical implications. Hence, plant pathology remains an area of intense research. However, there is still much we can learn about the molecular mechanisms and biochemical processes accompanying plant-pathogen interactions.

The work described in this thesis was dedicated to studying signaling events and the downstream immune responses initiated by the plant perception of a pathogen. To this end we employed biochemical tools and an experimental system designed to mimic the plants inducible defense responses. Three aspects of the plant innate immune system were addressed in our work: i) involvement and role of lipid molecules in resistance signaling and response (**papers I-III**); ii) transcriptional reprogramming and its regulation (**paper IV**); and iii) the plant defense proteome. Among the outcomes of this research was the confirmation of the important role of phosphatidic acid (PA) as a second messenger in plant resistance signaling. We suggest that PA signal is likely to be produced via the sequential activity of two enzymatic systems: phospholipases C and phospholipases D (**Paper I**). In addition, we identified novel factors in the plant defense signaling network, including two oxylipin-containing galactolipids, arabidopsides E and G (**Papers II and III**). We suggest that these compounds play a direct antipathogenic function and a potential indirect signaling role (**Paper III**). Transcriptomic and proteomic screens revealed many genes and corresponding proteins with a putative, but so far unknown role in resistance signaling or downstream response regulation (**Papar IV**). Taken together, the results of this work provide a more detailed picture of the early biochemical and molecular events associated with specific plant immune responses, highlighting those questions remaining unresolved as well as new avenues to pursue in the future.

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