Lipopolysaccharide (LPS) and Galactose Induce Cell Death in Prothallial Cells of Gametophytes of Ceratopteris richardii

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To combat pathogens, plants have evolved a battery of defense mechanisms that first require recognition of Microbe-Associated Molecular Patterns (MAMPs). These macromolecules are conserved essential structures found in a wide range of pathogens. Failure to recognize MAMPs enhances the susceptibility of plants to pathogen infection. In seed plants, MAMPs such as LPS can induce defense responses (e.g. PTI) but can suppress the Hypersensitive Response (a form of cell death). Perception of LPS by different species of plants is not well understood due to highly variable responses. This study investigates how prothallial cells of gametophytes of the fern Ceratopteris richardii respond to MAMPs. When 10-day-old gametophytes were treated with LPS, Flg22, or chitin, LPS induced a Hypersensitive-like Response (HLR) in prothallial cells. This HLR involved a reduction in cell division and chlorophyll content. Increases in ROS production and the expression of PR1 and MPK6 genes were also observed and were followed by cell death. A more severe and novel response was observed in prothallial cells when treated with galactose, one of possible sugars in LPS. Galactose showed a different gene expression prolife than LPS, suggesting possibly different mechanisms for cell death. The responses seen in prothallial cells are more similar to responses in some animal cells than in plants. This study described novel responses of gametophytes to LPS and galactose and proposed a model system that can be used to screen for new LPS receptors and elucidate the various signaling mechanisms for cell death in plant cells (e.g. galactose induced) without tissue manipulation.

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