Expansins: Cell Wall Remodeling Proteins with a Potential Function in Plant Defense

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Cell wall (CW) performs a number of important functions. This distinctive feature of plants determines cell structure, and plays major roles in intercellular communication and plant-microbe interactions, including defense responses against potential pathogens. Expansins are novel plant CW loosening proteins, are mainly involved in the pH-dependent extension of plant CWs that is called acid growth [1,2]. These plant CW remodeling proteins have important roles in plant cell growth, fruit softening, abscission, and emergence of root hairs, pollen tube invasion of the stigma and style, meristem function, pathogenicity and developmental processes. Expansins are linked with cell growth and CW changes that are induced by a number of plant hormones.

In plants, two main families of expansin genes have been discovered: -expansins (EXPA) and β-expansins (EXPB). Other expansin-like genes, such as expansin-like A (EXLA) and expansin-like related (EXLB), have also been identified in plants. For example, in the genome of Arabidopsis thaliana and rice (Oryza sativa), 26 and 33 genes of EXPA, 6 and 18 of EXPB, 3 and 4 of EXLA, in addition to one EXLB gene, respectively, were identified. Thus the function has not been well-studied [2-5]. Recently, the Arabidopsis expansin-like A2 (EXLA2) gene has been reported to link plant development and defense [6].

Expansins are well-known in loosening CWs via a nonenzymatic mechanism by inducing the slippage of cellulose micro fibrils in the plant CW [2]. The recent study of the role of EXLA2 in plant defense has uncovered a different mechanism of action from that of other expansins [6]. Mutations in EXLA2 enhance not only resistance to necrotrophic fungi, but also tolerance to phytoprostane A4. AbuQamar and his group demonstrate that down-regulation of EXLA2 alters the expression of cyclopentenone-regulated genes in response to B. cinerea. There appears to be a common regulation between electrophilic oxylipins and B. cinerea that is associated with EXLA2. On the other hand, EXLA2 is induced by salinity and cold, and by abscisic acid (ABA) treatment. In addition, the exla2 mutant showed hypersensitivity to increased salt and cold that is mediated by ABA. The work of EXLA2 presents convincing data that expansins contribute significantly to plant response to stress and impact signaling pathways that regulate gene expression. Future investigations into the mechanism of action of expansins open a new line of research in the field of plant responses to biotic and abiotic stresses at the biochemical, molecular and physiological levels.

References

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