Perception and transduction of damage-associated molecular patterns (DAMPs) in plant immunity

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In an environment full of harmful microbes, an efficient sensing of danger and a rapid mounting of defence responses are crucial for the survival of plants as well as of animals. Protective mechanisms, collectively referred to as innate immunity, include the perception of conserved pathogen- or microbe-associated molecular patterns (PAMPs or MAMPs) by germline-encoded pattern recognition receptors (PRRs) [1]. In plants, the activation upon PAMP recognition of a complex array of defence responses that eventually terminates microbial infection [2] has been indicated as PAMP-triggered immunity (PTI) [3]. Successful pathogens need to suppress PTI to express their full virulence potential, and do so by using effectors or toxins leading to the so-called effector-triggered susceptibility (ETS). Many plants then evolve the ability to sense specific pathogen effectors through the so-called resistance (R)-proteins and mount a second level of defence called effector-triggered immunity (ETI) [3]. ETI leads to a defence response that is stronger than PTI and normally accompanied by a form of programmed cell death called hypersensitive response. Like in animals, plant immunity also relies on the ability to sense invading microbes by means of endogenous molecular patterns that are present only when the tissue is infected or damaged (damage-associated molecular patterns or DAMPs); also the discrimination between self and altered self leads to the activation of the immune system.

An important class of DAMPs is represented by oligogalacturonides (OGs), fragments released from the homogalacturonan of the plant extracellular matrix upon wounding or by the action of microbial endopolygalacturonases (PGs), which instead behave as MAMPs [4]. The formation of OGs may be favoured by the interaction of fungal PGs with specific LRR recognition proteins present in the apoplast (Polygalacturonase-inhibiting Proteins or PGIPs) [5]. Both at the structural and the functional level, OGs are reminiscent of the hyaluronan fragments of the animal extracellular matrix, a well-known class of DAMPs involved in wound response and healing [6]. OGs induce a complex response that largely overlaps the typical response activated by MAMPs and induce protection against the necrotrophic fungus *Botrytis cinerea*. Our group has made the substantial contribution of identifying the long-awaited receptor of these signal molecules. Using an innovative approach in the plant field based on the construction of chimeric receptors, the wall-associated kinase 1 (WAK1) was demonstrated to function in perception and transduction of the OG signal [4, 7]. The *WAK* family in Arabidopsis includes five tightly clustered genes (*WAK1–WAK5*). WAKs display an ectodomain containing a pectin/OG binding-site and several EGF-like repeats; so far, lethality and redundancy have hampered the study of WAKs by genetic approaches. Current work aims at investigating the biological significance of the interaction between WAKs and OGs and at elucidating the role of WAKs in alerting cells of pathogen attack and mechanical damage. Furthermore, novel chimeric receptors derived from WAKs and other PRRs are being constructed to engineer resistance to pathogens in crop plants.

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