Disentangling metabolic- and defense-control of cell death in plant root-fungal interactions

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Colonization by the beneficial root endophyte Serendipita indica follows a biphasic strategy. After a biotrophic phase the fungus switches to a cell death phase which is needed for the establishment of symbiosis in barley and Arabidopsis. Using genomics, transcriptomics and proteomics we have identified two symbiosis factors that act synergistically in the apoplast, the enzymatically active ecto-5-nucleotidase (SiE5NT) and nuclease A (SiNucA). During early colonization, extracellular ATP accumulates in the apoplast and mediates defence responses. At this stage, S. indica secrets SiE5NT which is capable of hydrolysing nucleotides in the apoplast. Arabidopsis lines producing extracellular SiE5NT are better colonized, have reduced eATP levels, and altered responses to biotic stresses, indicating that SiE5NT functions as a compatibility factor. At later colonization stages the synergistic actions of SiE5NT and SiNucA lead to production of deoxyadenosine. Apoplastic dAdo activates a previously undescribed regulated cell death (RCD) mechanism in Arabidopsis with activation of the 26S proteasome, induction of cell death marker genes expression, electrolyte leakage and decreased photosynthetic activity. A genome-wide association study for dAdo triggered plant cell death identified candidate genes associated with a single locus. Functional characterization of this RCD will be discussed.