The clubroot pathogen *Plasmodiophora brassicae* controls plant hormone homeostasis by degradation, conjugation and methylation to alter plant defense responses

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The clubroot disease of Brassicaceae results in the formation of large root galls induced by the obligate biotrophic protist *Plasmodiophora brassicae*. The recently published genome sequence of this unique organism helped to shed light on mechanisms how the protist controls the hormone homeostasis of the host plants. The growth promoting hormones auxin and cytokinin have been linked to gall size. Indole-3-acetic acid (IAA) is conjugated to various amino acids by a protein from the GH3 family of auxin conjugate synthetases identified in *P. brassicae* (PbGH3) and thereby reversibly inactivated. The genome of the protist also encodes, next to two genes for isopentenyltransferases, a gene for a cytokinin oxidase. The respective enzyme is able to degrade various cytokinins *in vitro*. It was hypothesized, based on previous microarray datasets, that the defense responses of the host plant are altered by the clubroot pathogen. We found that the PbGH3 protein is also able to conjugate jasmonic acid (JA) to various amino acids. However, the activity with isoleucine is very low, indicating that the active JA-Ile conjugate that is recognized in the host *Arabidopis thaliana* for defense induction is formed only to a small extent. Formation of other JA conjugates by the pathogen might prevent the formation of the active conjugate by the host. Finally, salicylic acid (SA) is methylated by a specific methyl transferase of *P. brassicae* that includes a secretion signal. This indicates that the enzyme might be active in the host cell and not in *P. brassicae*. We showed that Me-SA is the major transport form in clubroot infected *Arabidopsis* plants from roots to inflorescences. These biochemical findings on the manipulation of the host plant's hormone homeostasis by *P. brassicae* will be discussed in a biological model.