Coupling evolutionary dynamics of fungal effectors and functional genomics : towards understanding mechanisms of Venturia inaequalis virulence and identifying durable resistance genes in apple

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Résumé en anglais	During infection, pathogens secrete small secreted proteins (SSPs), called effectors, that promote disease. Plant receptors encoded by resistance R genes might recognize such effectors (also called avirulence factors AVRs), resulting in plant immunity. Pathogens evade recognition thanks to the emergence of virulent alleles present in populations. It has been demonstrated that avirulent effectors are crucial for the pathogen infection cycle and that their loss-of-function may induce a substantial fitness cost. This kind of effector is expected to be under purifying selective pressure. Here, we aim at identifying the effector repertoire of Venturia inaequalis, the agent of apple scab, assessing its evolutionary dynamics and studying the role of candidate effectors in virulence. We sequenced de novo 90 strains, collected on apple and on their wild relatives and differing in their host range or virulence to study allelic polymorphism at 880 putative effector loci. The top-20 hits for highly conserved sequences were selected as candidates for further functional analyses. In planta gene expression showed a significant induction of these conserved SSP at the early stage of plant infection. Their functions were investigated using targeted deletion mutants. Remarkably, loss of two conserved SSPs resulted in reduced aggressiveness without any alteration in growth in vitro. GFP-tagged protein and heterologous expression were used to assess their sub-cellular localization in infected apple leaves. Involvement of theses SSP in the modulation of host defence was also investigated using an apple full-transcript microarray. Highly conserved effectors will be used to screen for novel R genes in Malus genotypes characterized for their high resistance to scab. This combined knowledge should enable us to understand strategies used by the pathogen to overcome defences in apple and consequently to build more durable resistance towards apple scab.
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