STIMULATION OF PLANT IMMUNITY BY BENEFICIAL BACILLI : MECHANISTICS OF SURFACTIN PERCEPTION

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Some strains of the plant-associated Bacillus velezensis (formerly B. amyloliquefaciens subsp. plantarum clade) are of particular interest regarding their potential to combat a range of phytopathogenic microbes for the sake of crop health. Like other groups of the Bacillales, these bacteria are excellent producers of a wide variety of antimicrobials either ribosomally synthesized such as bacteriocins and lantibiotics or enzymatically formed via multi-modular mega-enzymes like polyketides (PKs) and non-ribosomally synthesized peptides (NRPs) (Aleti et al. 2015; Zhao and Kuipers 2016). Among these last compounds, cyclic lipopeptides (CLPs) are of particular interest since they retain crucial functions for biocontrol activity of the producing strains i.e. rhizosphere fitness, direct antagonism of pathogens and host resistance stimulation. In this last context, the CLP surfactin (SF) has been identified as main Bacillus product triggering the so-called Induced Systemic Resistance (ISR), a layered innate immunity process that first involves the perception of such elicitors referred as Microbe-Associated Molecular Patterns (MAMPs) at the plant cell membrane level. MAMPs from pathogens are typically perceived by dedicated pattern recognition receptors (PRRs) functioning as Receptor-Like Kinases. By contrast, the mechanistics underlying perception of ISR elicitors typically secreted by beneficial bacteria still remain much more obscure.

In this work, we combined functional and biochemical assays together with in silico and experimental biophysics to deeply investigate the molecular mechanisms of surfactin perception by tobacco cells. Our results indicate that SF recognition does obviously not involve dedicated PRRs but primarily rely on an unsuspected process at the lipid phase of root cell plasma membrane. We hypothesize that SF insertion into or at the border of specific nanodomains induces some re-organization of this lipid bilayer, which could in turn affect the localization/recruitment, and thereby activate key proteins involved in early signaling processes. Such a peculiar PRR-independent mechanism of recognition may explain why this CLP acts as a real priming agent of plant immunity with no impact on fitness upon elicitation but with clear stimulation of antifungal phytochemicals upon infection.

Key words: B. velezensis - lipopeptide – priming - lipid bilayer – proteomics - lipid binding – lipid specificity - molecular interactions