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Poster #38: Establishment of phage-based biocontrol strategies against phytopathogens for sustainable plant disease management

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In the search for sustainable agricultural practices, bacteriophages have emerged as promising modulators of plant–microbe interactions and biocontrol agents against bacterial plant pathogens. Phages are very host specific viruses of individual bacterial species, and as such can lead to targeted decrease of a known bacterial population.

Our initial work investigated the tripartite interaction between Arabidopsis thaliana, the bacterial pathogen Xanthomonas campestris pv. campestris (Xcc), and lytic bacteriophages Seregon. Using transcriptomic profiling combined with non-invasive phenotyping approaches, we show that single-phage application significantly reduces disease severity without fully eliminating the pathogen, leading to restoration of plant growth within 14 days post-inoculation. This recovery is associated with the modulation of plant immune responses, alongside a downregulation of bacterial virulence genes associated with the type III secretion system, effector proteins, and flagella biosynthesis genes. Notably, while Xcc rapidly evolved resistance to the phage under in-vitro conditions, the emergence of resistance in planta was comparatively delayed.

To address the limitations associated with single-phage treatment, we isolated and de-novo characterized an additional lytic phage targeting Xcc, confirming its suitability for biocontrol through genomic and morphological analyses. Additionally, to limit the emergence of bacterial resistance, we applied an experimental evolution approach to develop trained phages with improved infectivity. These evolved phages demonstrated a significant reduction of bacterial populations in planta, highlighting their potential for sustained pathogen suppression.

Together, our findings provide mechanistic insight into how bacteriophages reshape plant–pathogen interactions, highlighting their potential to enhance plant resilience.

Reference #1

Reference #2

Reference #3

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