The role of toxin-triggered immunity in shaping host microbe interactions

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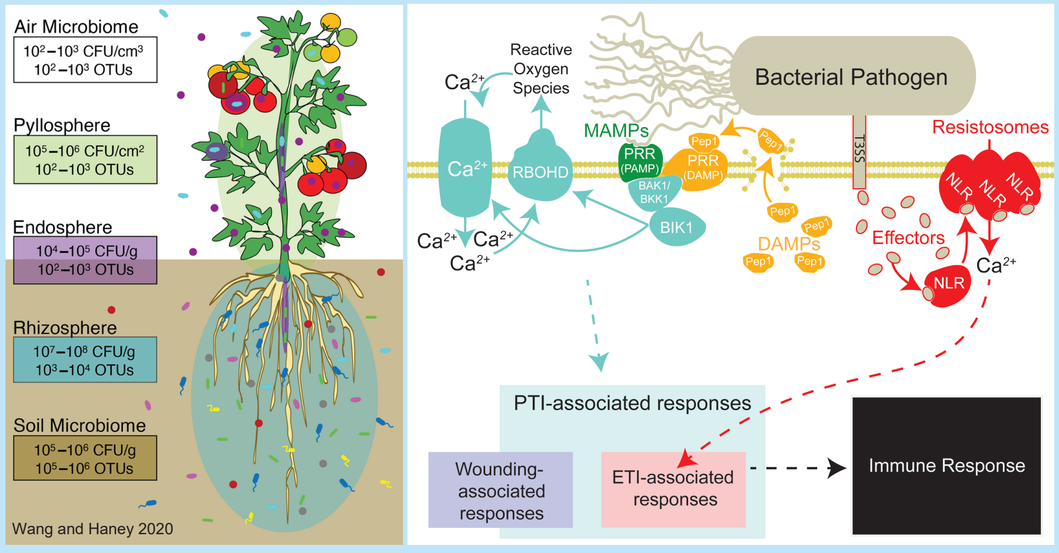
Introduction

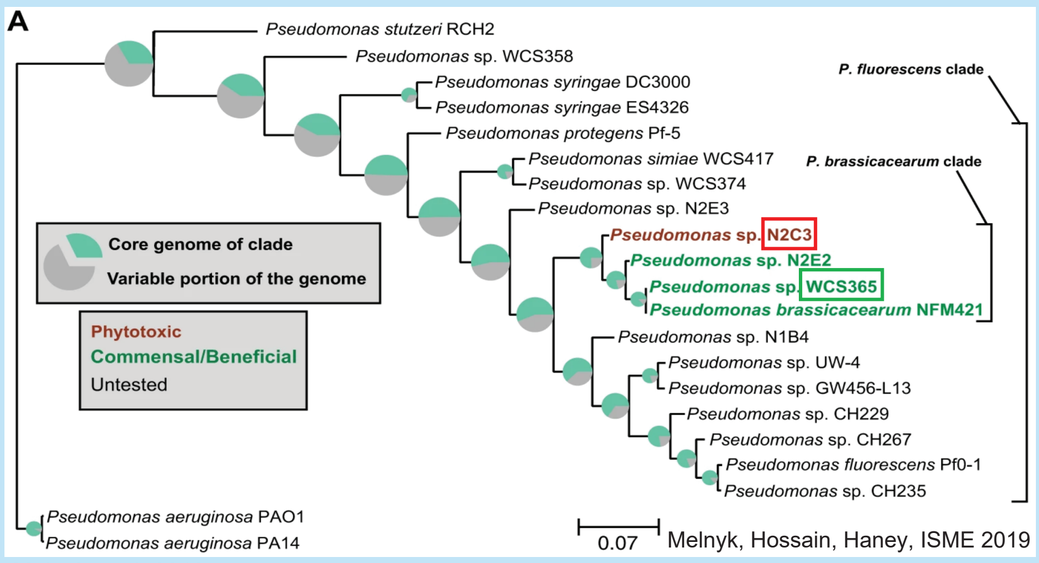
How do hosts distinguish friend from foe?

Plants select for microbes from their surrounding environment. As proximity to the rhizoplane increases, microbial density increases while microbial diversity decreases.



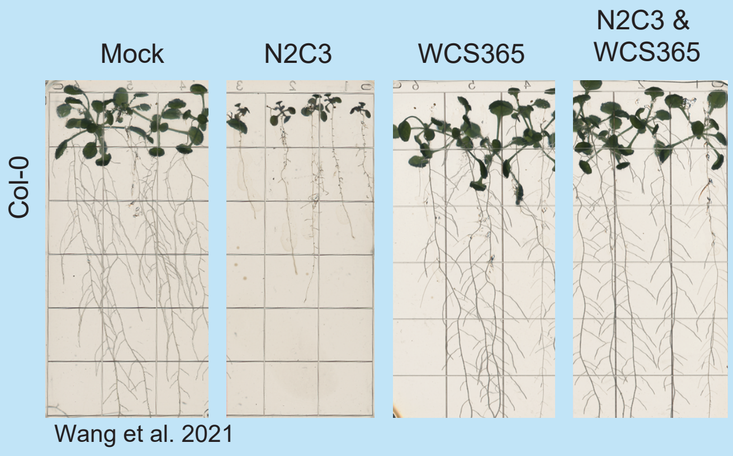
Microbes contain evolutionarily conserved microbe-associated molecular patterns (MAMPs) that plant extracellular pattern recognition receptors (PRRs) can recognize. Detection of MAMPs induces plant immunity. However, it is poorly understood how MAMPs alone can distinguish pathogens from commensals. Other mechanisms, such as plant recognition of host-derived damage associated molecular patterns, have been proposed as ways plants can detect and select against pathogens.

Model System:



Melnyk et al. 2019

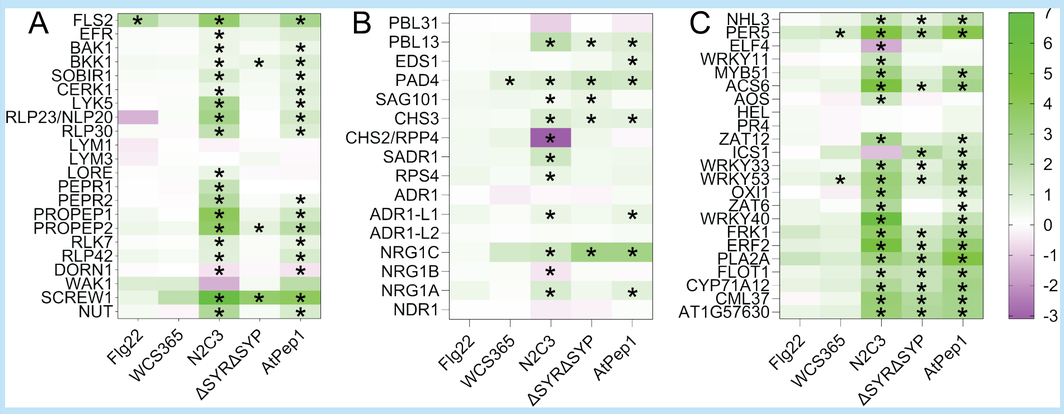
We have previously identified two phylogenetically similar strains with distinct rhizosphere lifestyles. *P. fluorescens* N2C3 is an opportunistic pathogen, while WCS365 is a plant growth promoting strain. We aim to determine whether plant immunity can distinguish these two strains and select for the commensal while eliminating the pathogen.



Wang et al. 2021

The pathogenic N2C3 inhibits root growth in monoculture, while the beneficial WCS365 strain is plant growth promoting in monoculture. Co-inoculation of N2C3 with WCS365 prevents root growth inhibition.

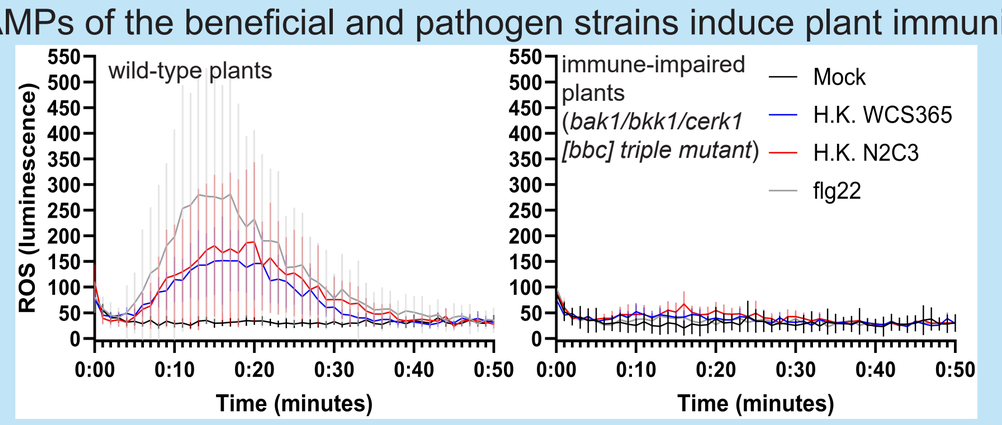
Preliminary findings



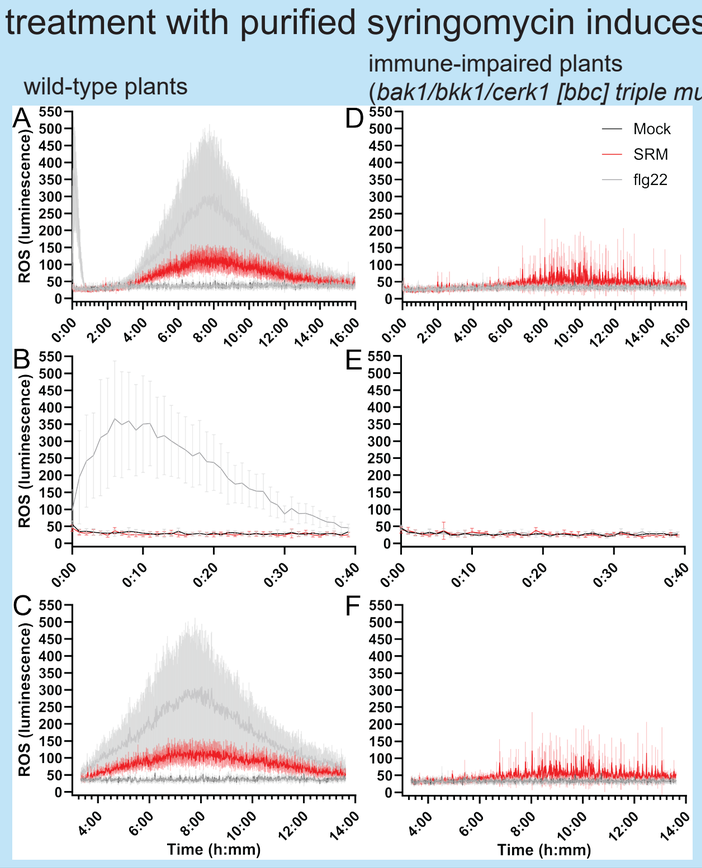
We found that beneficial WCS365 weakly induces innate immunity, while pathogenic N2C3 strongly induces immunity. We showed that the immune response to N2C3 is depenent on the prescence of two pore-forming toxins. Knock out of both toxin biosynthesis strongly inhibits the response to N2C3. This suggests that the plants can distinguish between pathogenic and commensal bacteria based on the presence or abscence of pore-forming toxins. **However, it is unknown whether a toxin-triggered immune response can balance the growth between pathogen and beneficiail strains.**

Results

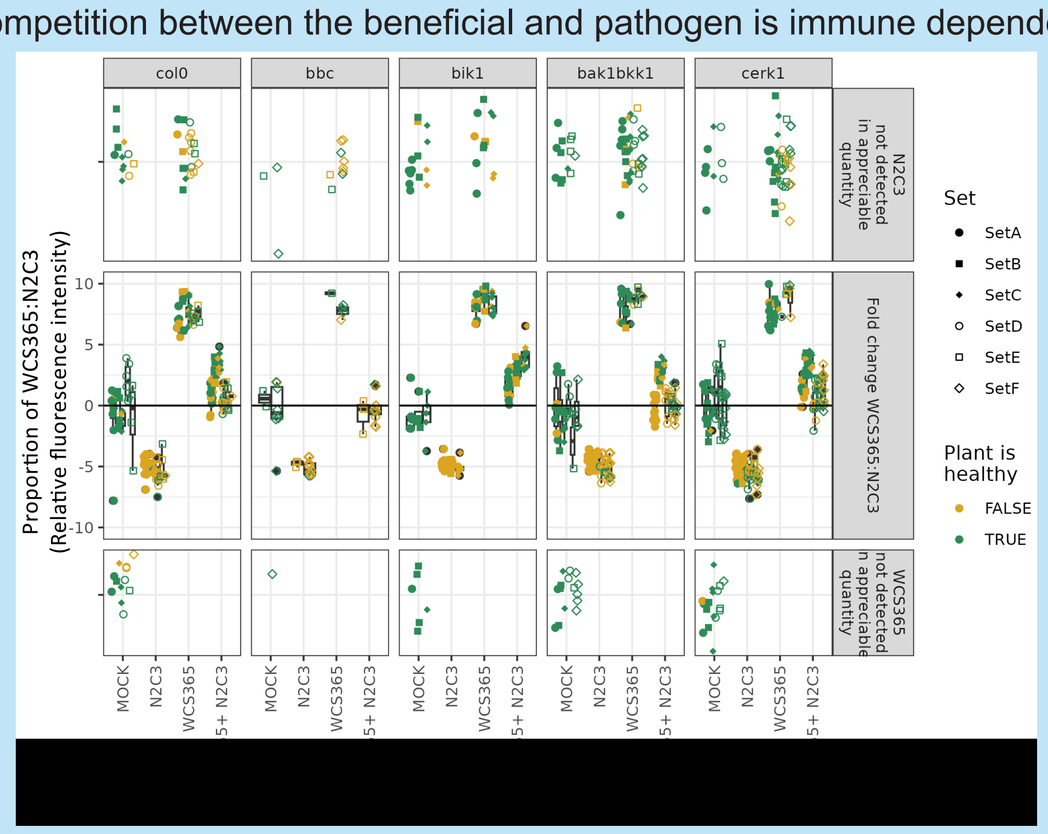
MAMPs of the beneficial and pathogen strains induce plant immunity



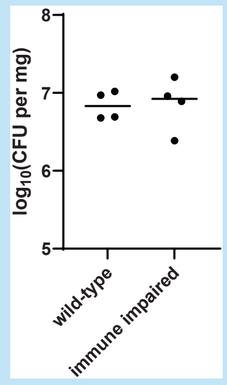
Exogenous treatment with purified syringomycin induces immunity



Competition between the beneficial and pathogen is immune dependent



MAMP-triggered immunity does not impair beneficial WCS365 growth



immune-impaired plants = (*bak1/bkk1/cerk1 [bbc] triple mutant*)

Conclusions and Future Directions

- *The beneficial and pathogenic strains have MAMPs with similar immunogenicity*
- *Purified pore-forming toxin is sufficient for inducing immunity via MAMP-dependent pathways*
- *Balance between beneficial and pathogenic strains in vivo is dependent on MAMP-dependent pathways*
- *Suprisingly, MAMP-triggered immunity has no influence beneficial growth*

- *Future work will determine how MAMP-triggered immunity and toxin-triggered immunity influence bacterial evolution into beneficial or pathogenic lifestyles*
- *Future work will identify the mechanisms by which toxin-triggered immunity balances the growth between beneficial and pathogenic bacteria.*

Acknowledgements: I would like to thank Dr. Philip Carella at the John Innes Centre for donating purified syringomycin samples. I would also like to thank the CRC at FSU for funding this work via the First Year Assistant Professor (FYAP) Award.