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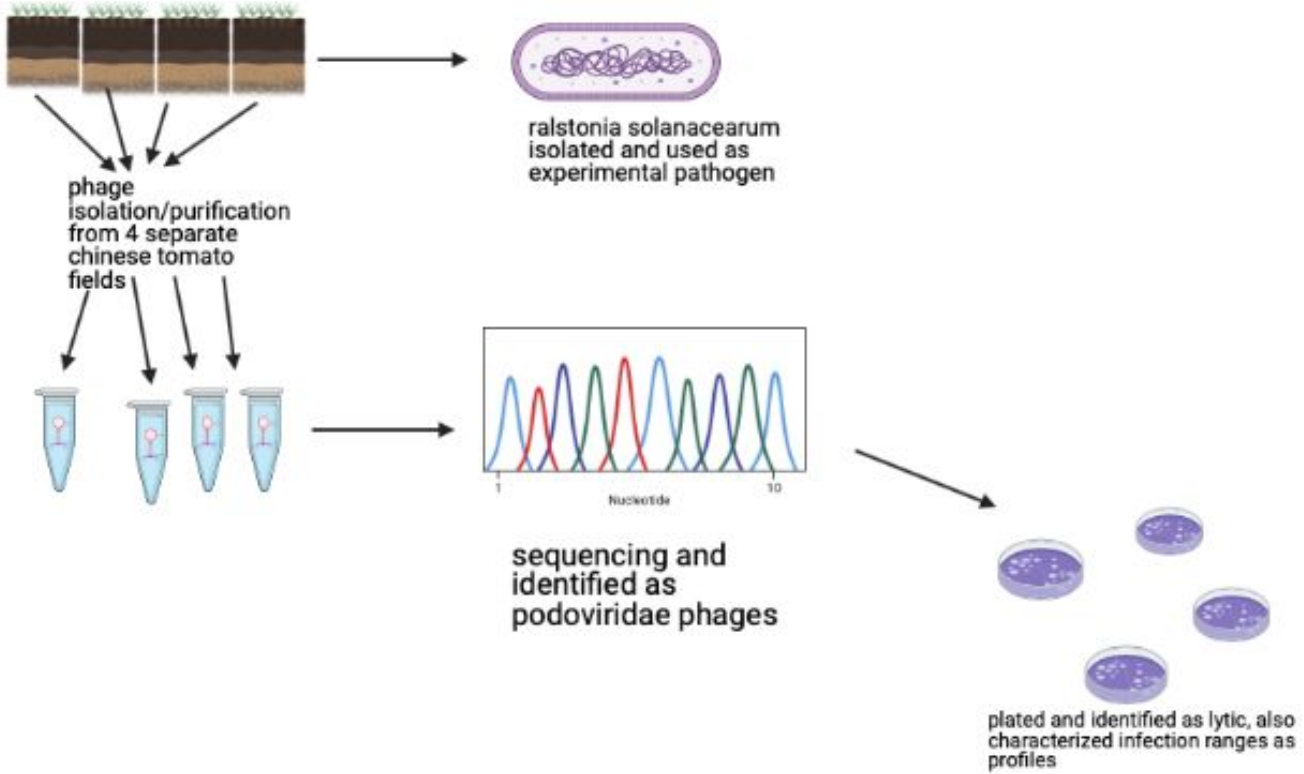
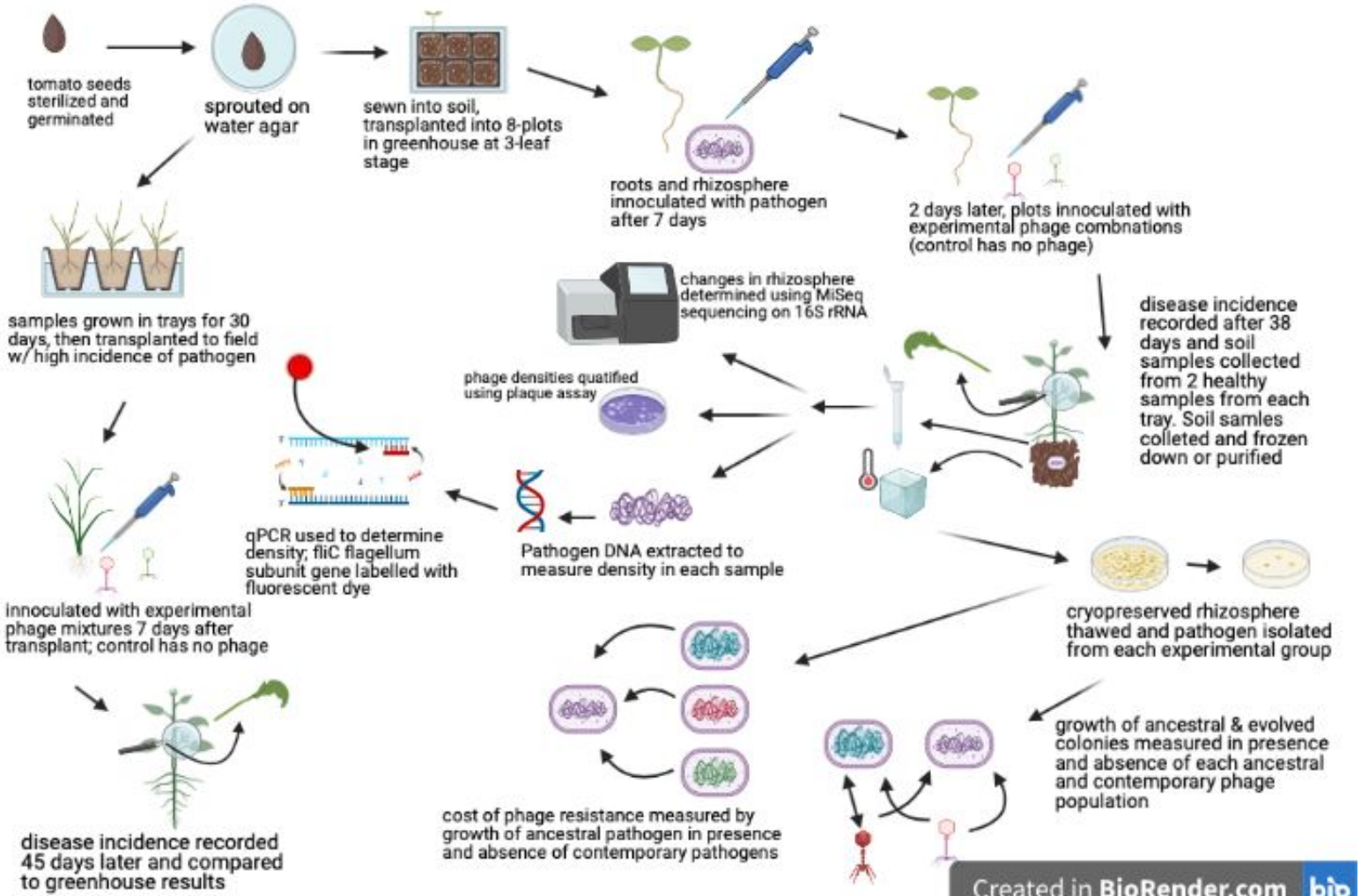
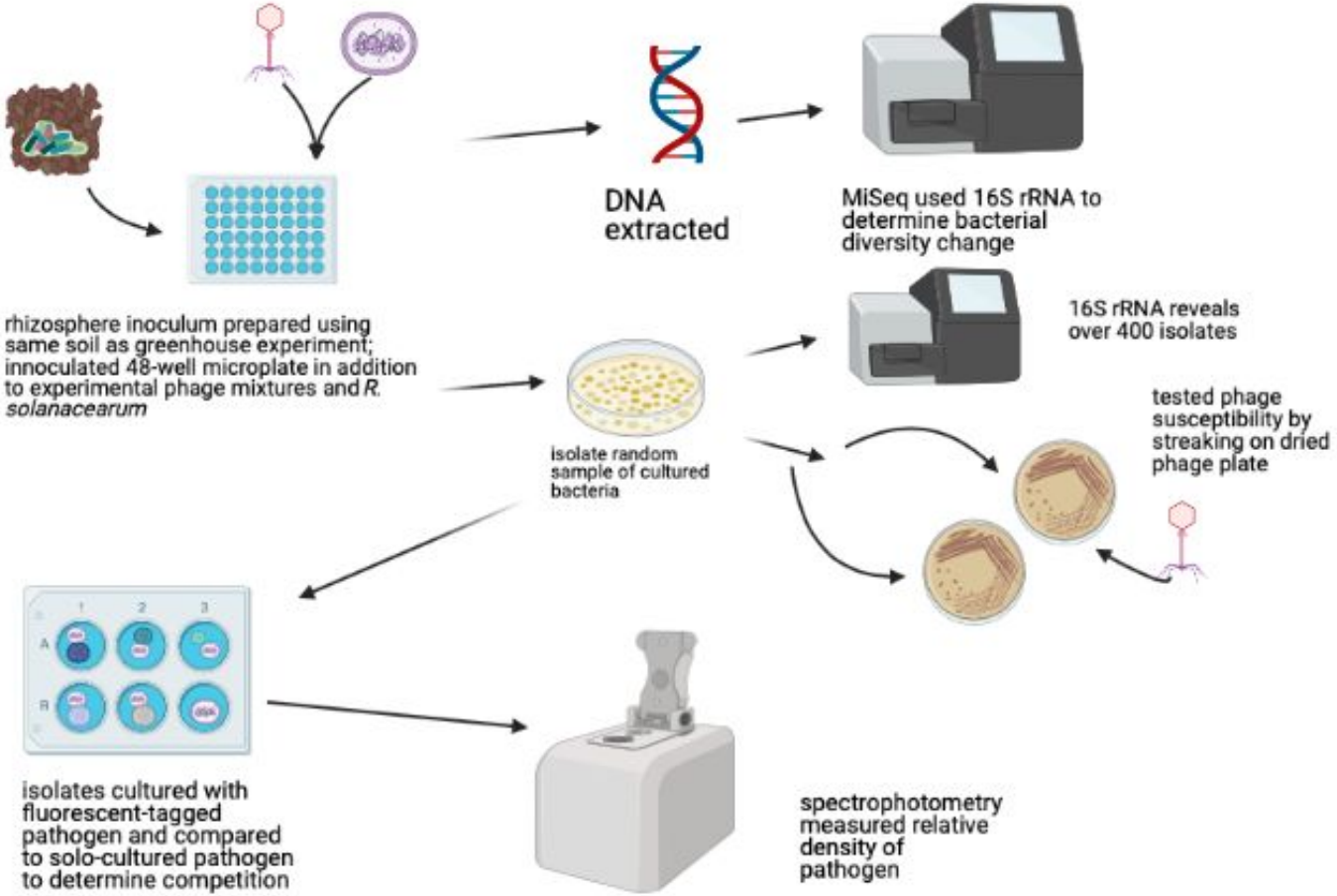



tomato seeds sterilized and germinated
sprouted on water agar
sewn into soil, transplanted into 8-plots in greenhouse at 3-leaf stage
roots and rhizosphere innoculated with pathogen after 7 days
2 days later, plots innoculated with experimental phage combnations (control has no phage)
samples grown in trays for 30 days, then transplanted to field w/ high incidence of pathogen
changes in rhizosphere determined using MiSeq sequencing on 16S rRNA
phage densities quatified using plaque assay
disease incidence recorded after 38 days and soil samples collected from 2 healthy samples from each tray. Soil samles colleted and frozen down or purified
innoculated with experimental phage mixtures 7 days after transplant; control has no phage
qPCR used to determine density; fliC flagellum subunit gene labelled with fluorescent dye
Pathogen DNA extracted to measure density in each sample
cryopreserved rhizosphere thawed and pathogen isolated from each experimental group
growth of ancestral & evolved colonies measured in presence and absence of each ancestral and contemporary phage population
cost of phage resistance measured by growth of ancestral pathogen in presence and absence of contemporary pathogens
disease incidence recorded 45 days later and compared to greenhouse results
Created in BioRender.com bio



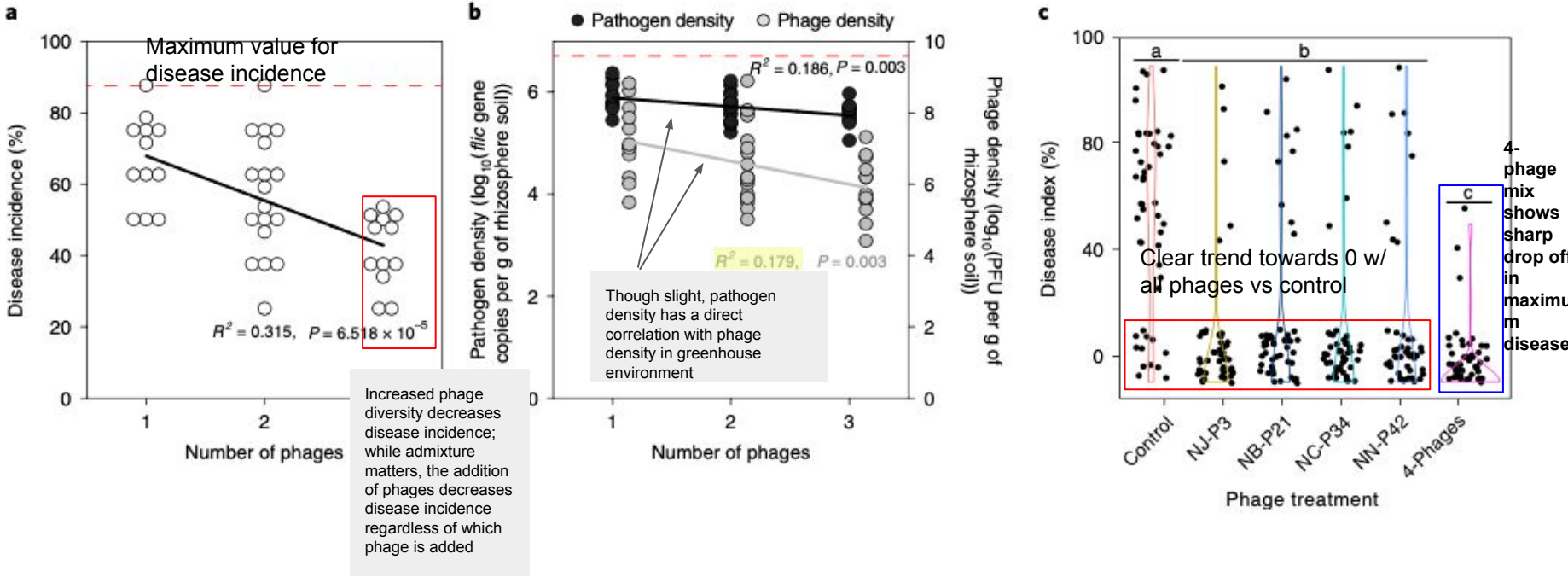
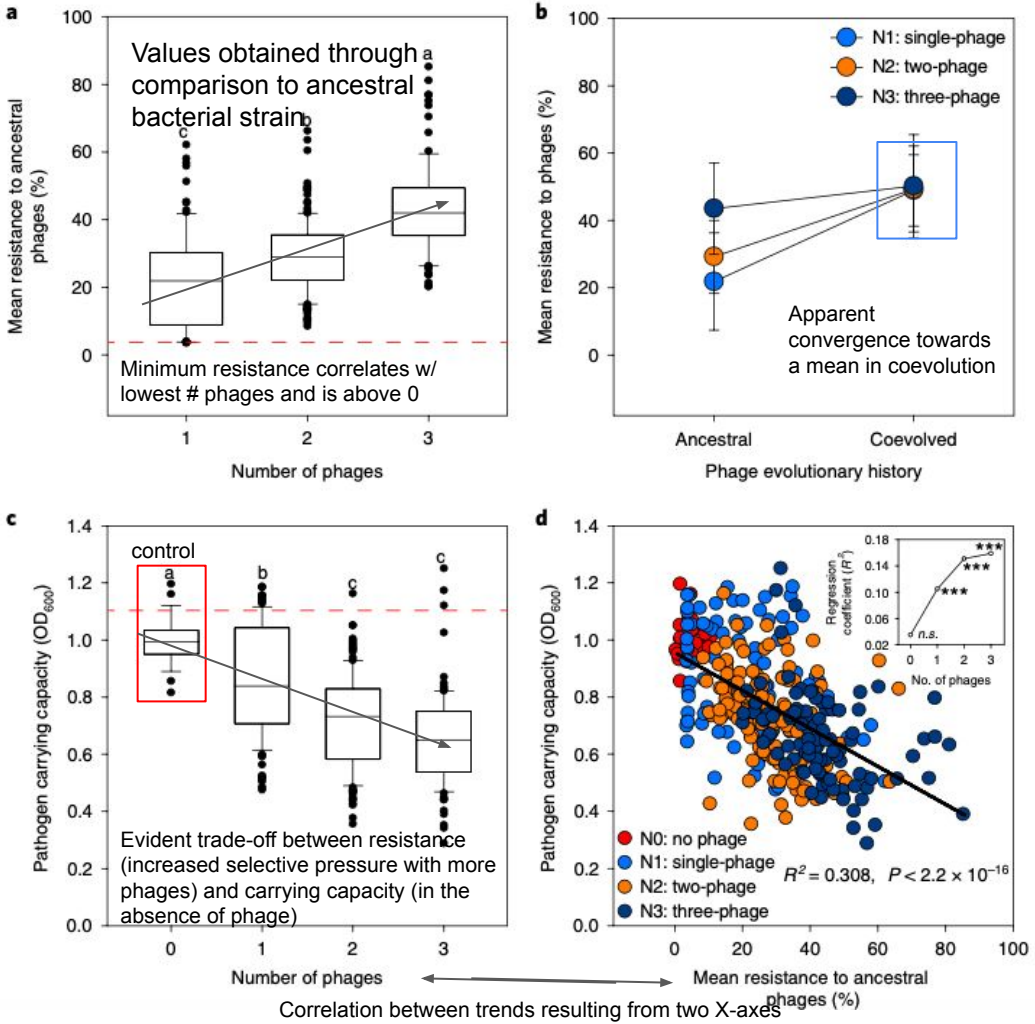
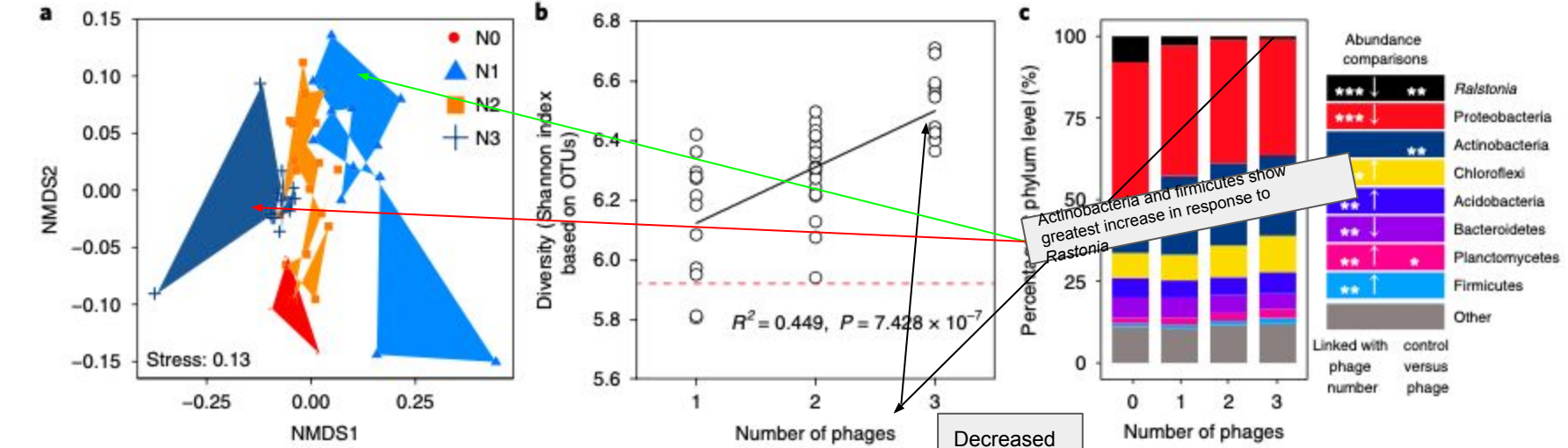
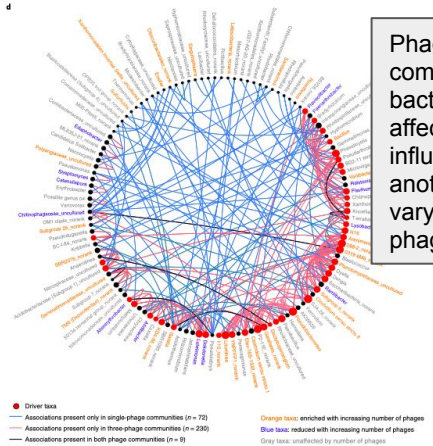


Figure 1 shows the disease incidence results from the greenhouse experiment measuring the effect of different phages and phage mixtures on the ability of the pathogen to infect the plant host. Each figure shows clearly how phages are an effective tool against the pathogen. Importantly, it can be seen that the combination of phages shows a strong increase in effectiveness (decrease in disease incidence/pathogen density), indicating that the use of multiple phages in phage therapy have a complementing effect rather than a competitive one.



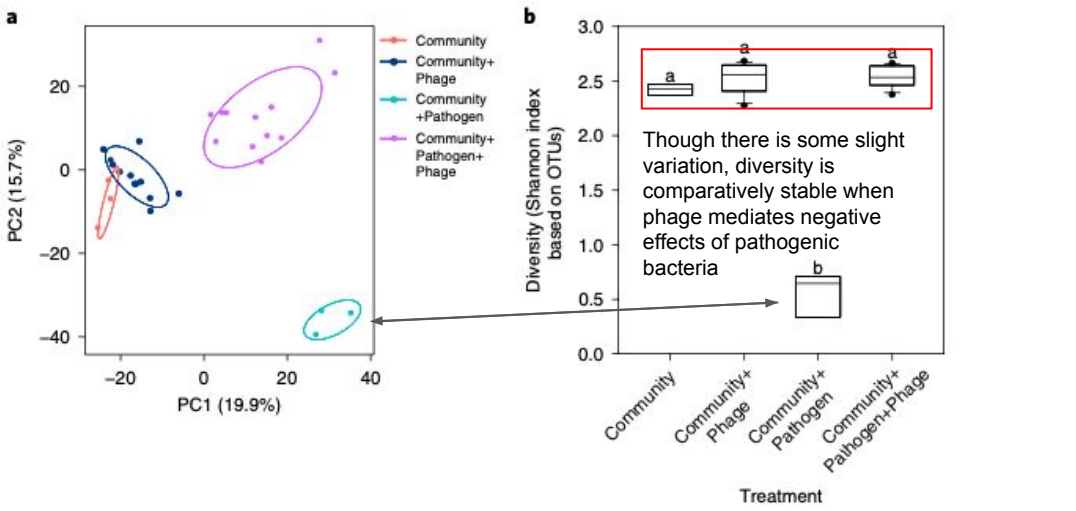
This figure demonstrates evolutionary trade-offs associated with increased phage resistance. It is clear that there is a strong selection for the evolution of increased phage resistance when coevolved in the presence of increased phage density, and this also demonstrates that this same resistance comes at the cost of decreased carrying capacity. Based on later results, the researchers hypothesized that this is due to some decrease in metabolic function or nutrient uptake that was sacrificed in favor of phage resistance.

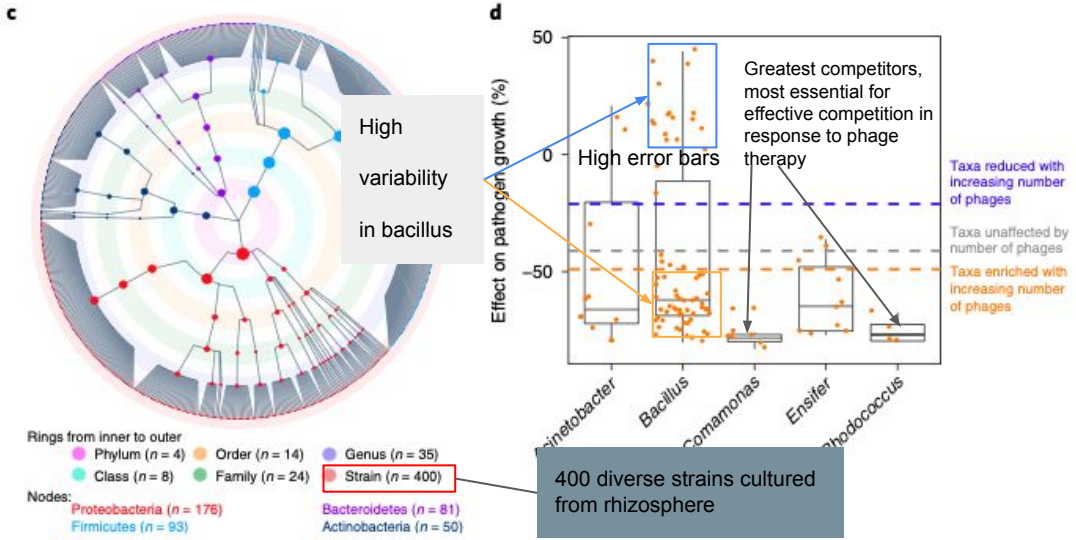




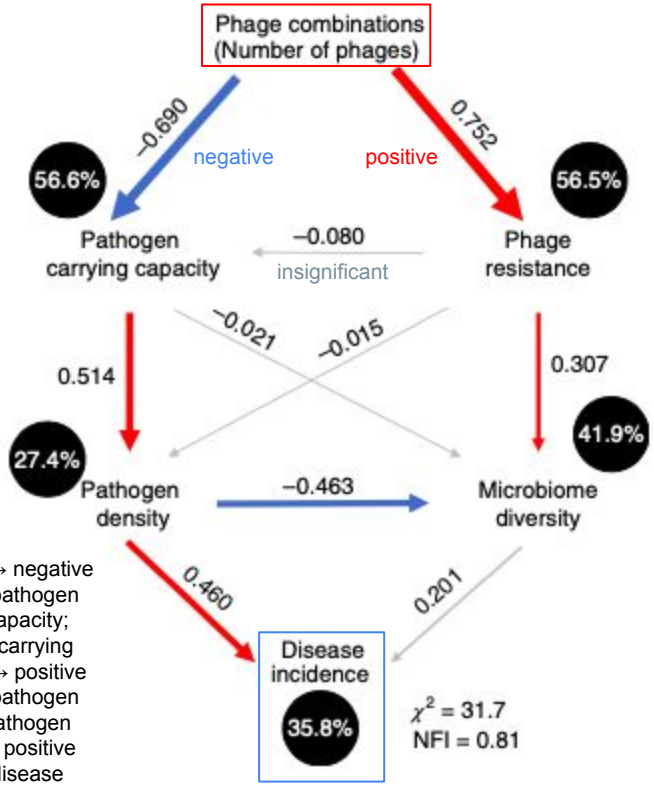
Phages have a complex effect on bacterial interactions, affecting their influence on one another which can vary in response to phage number

This figure shows the ecological effects phage interference in bacterial communities can have. While these results are demonstrating the increased bacterial diversity in response to increased phage and decreased pathogen, the results are indicative of the complex role phages have in ecosystem interactions and the immense cascading effect microorganismal interactions can have on higher trophic levels.





This figure demonstrates the effects on diversity in response to the introduction of the pathogenic strain and how it can be mediated by the introduction of phage. Phage is a strong mediator of pathogen population and sharply decreases its ability to compete with the other microbes in the rhizosphere of the tomato plant, creating a synergistic effect that decreases disease incidence.



phage # → negative effect on pathogen carrying capacity; pathogen carrying capacity → positive effect on pathogen density; pathogen density → positive effect on disease incidence; therefore, phage number has negative effect on disease incidence!

This figure is a statistical summary of the results from all the experiments run in this study. The results demonstrate the mechanism by which phage influences different aspects of rhizosphere ecology, particularly the negative correlation between phage number and disease incidence, showing phage therapy as a potentially potent tool against bacterial wilting!