Evaluating the 'Kill-the-Winner' Hypothesis in Soil Ecosystems: Do Soil Viruses Disproportionately Lyse Fast-Growing Soil Bacteria?

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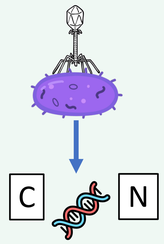
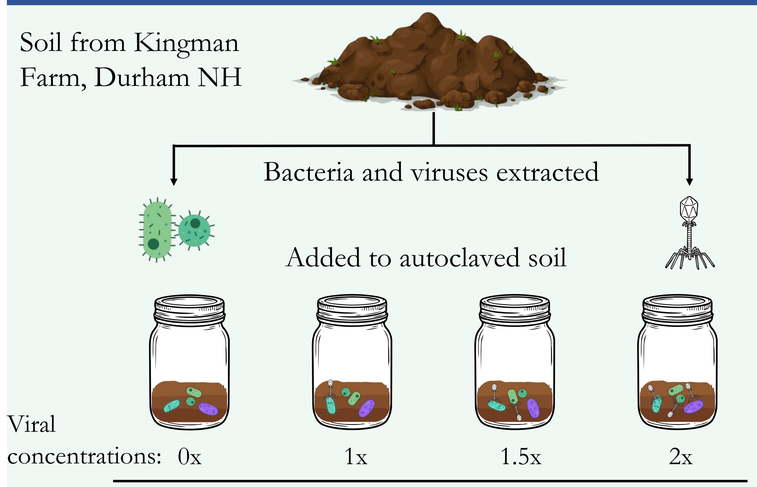
Introduction

- Billions of bacteria drive essential biogeochemical processes that influence soil fertility and plant growth[1,2]
- Viruses infect and burst open these bacteria, acting as ecosystem regulators[3]
- Understanding these viral-bacterial interactions is crucial for building accurate climate models and optimizing soil fertility
- The Kill-the-Winner (KTW) hypothesis is thought to be one of these mechanisms of control

The Kill-the-Winner hypothesis posits that viruses lyse fast-growing soil bacteria, allowing slower-growing bacteria to coexist.



Methods



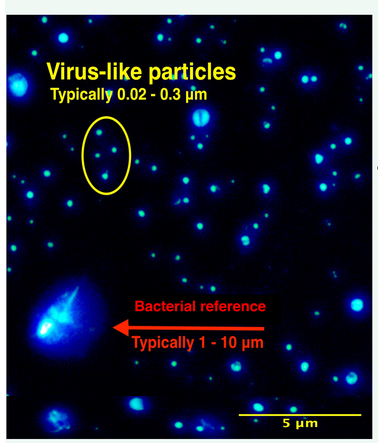


Figure 1: Virus-like particles under epifluorescent microscopy

Results and Discussion

Fast-growing bacteria decrease in abundance with an increase in viral addition

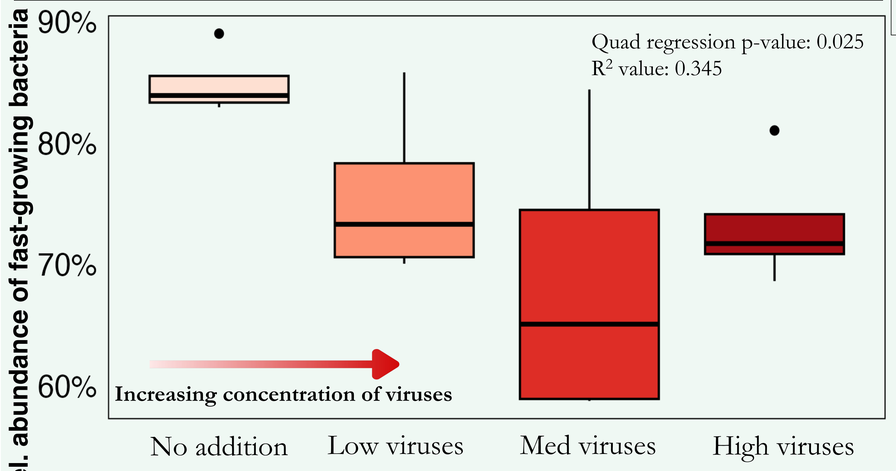


Figure 2: Relative abundance of fast-growing bacteria across different treatments at 1.5 weeks.

Microbial respiration follows similar trends, but is not correlated

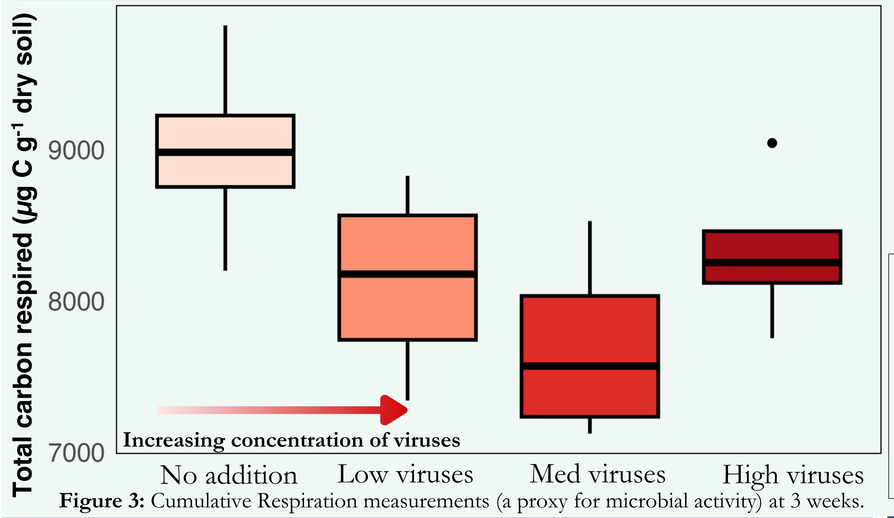


Figure 3: Cumulative Respiration measurements (a proxy for microbial activity) at 3 weeks.

The 'viral shunt' redirects organic matter away from the traditional food web – explains results at high viral concentration

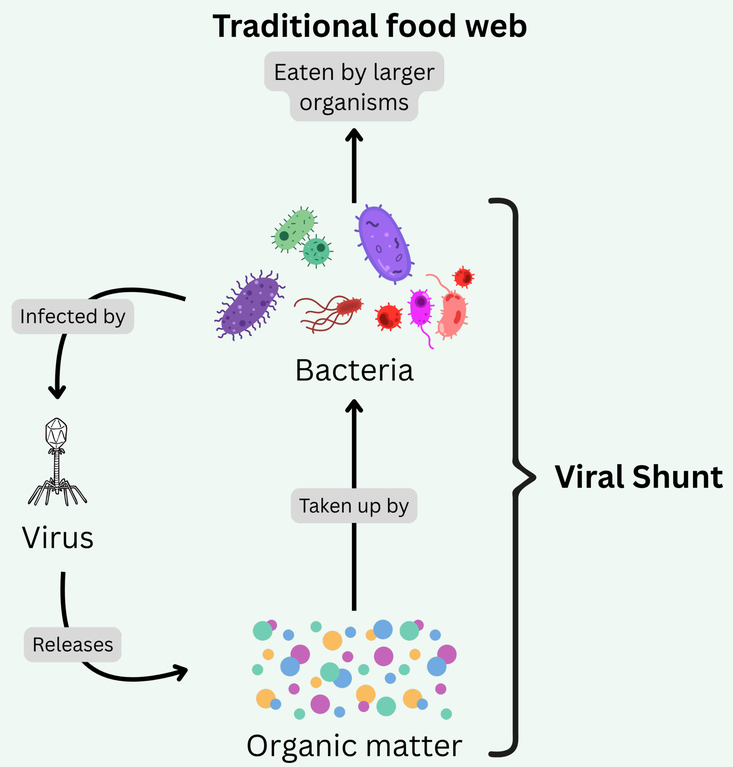


Figure 4: Traditional food web and the viral shunt.

Increased release of organic matter stimulates the remaining microbial community – increasing bacterial abundance and respiration

Conclusions

- Viruses are essential regulators of bacterial diversity and help maintain ecosystem functionality
- Understanding viral-bacterial interactions that drive decomposition (and greenhouse gas emissions) can help improve climate prediction models

Next steps

- Extract dissolved organic carbon from the soil
- Perform a longer incubation to understand bacterial population dynamics on a longer time scale
- Experiment with different soil types to understand the KTW mechanism across varying levels of organic matter

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Scan to use my pipeline and predict bacterial growth rates!