

Exploration of bacteriophage as biocontrol against acute oak decline

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Background

Acute oak decline (AOD) is a disease of native oak species across the south and midland regions of the UK.

Importance: death of infected mature trees can occur within 5-10 years of initial infection^[1].

Symptoms: bleeding lesions on trunks, and presence of larval galleries close to the lesions (Fig. 1).

Cause: a polymicrobial consortium of *Brenneria goodwinii*, *Gibbsiella quercinecans* and *Rahnella victoriana*.

Management: none so far. One potential biocontrol is bacteriophage (phage), viruses that infect and kill bacteria.

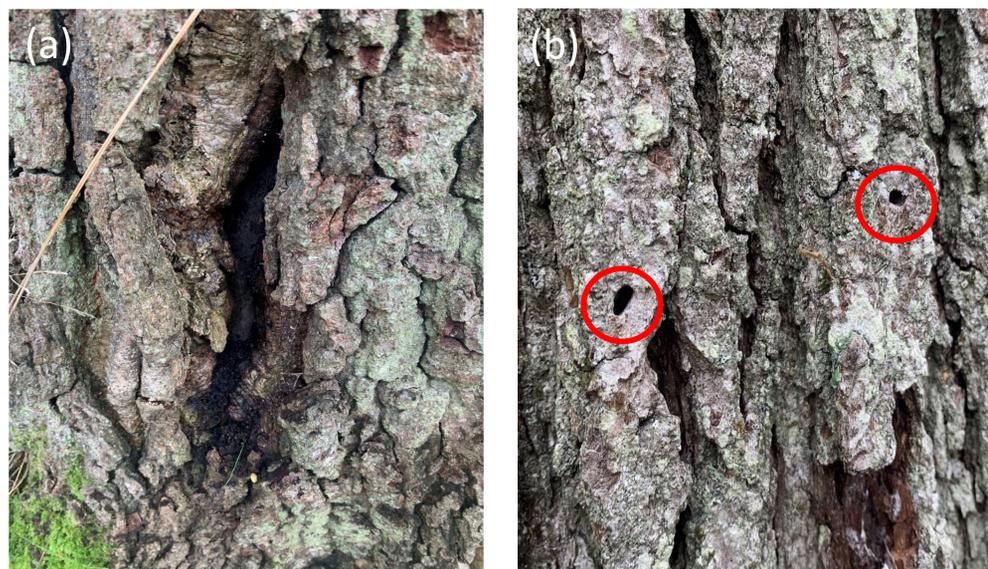


Figure 1. Common symptoms of AOD: **(a)** dark vertical lesions on bark; **(b)** D-shaped larval galleries caused by the insect *Agrilus biguttatus*.

Aims

To isolate and characterise phages that infect AOD-associated bacteria, and to examine:

1. Their potential as biocontrol agents.
2. Their *in vitro* and *in planta* coevolutionary dynamics with their hosts.

Methodology

- **Phage isolation** from 3 sites in the UK.
- **Phage characterisation**, via:
 - Host range assays
 - Electron microscopy
 - DNA extraction and sequencing
 - Temperature and UV sensitivity assays
- **Phage-bacteria coevolution dynamics assays** *in vitro* and *in planta*.

Current work: 1) phage-bacteria coevolutionary dynamic

Previously characterised MR phages that infect the cherry canker pathogen *Pseudomonas syringae* pv. *syringae* (*Pss*)^[2] are being coevolved over a 7-day period to observe any arms race/fluctuation selection dynamics *in vitro* (Fig. 2) and *in planta*.

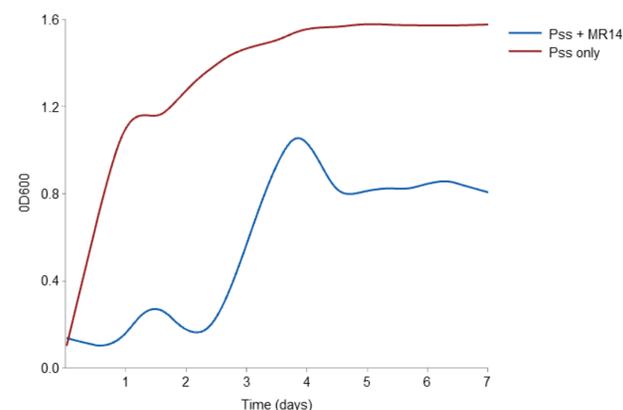


Figure 2. *In vitro* killing curve showing the impact of phage MR14 on *Pss* populations over 7 days.

2) Phage isolation and characterisation

5 phages that lyse *G. quercinecans* have been isolated from diseased oak tissues. Their lytic abilities against their host (Fig. 3) and host ranges are being tested to determine their specificity and safety.

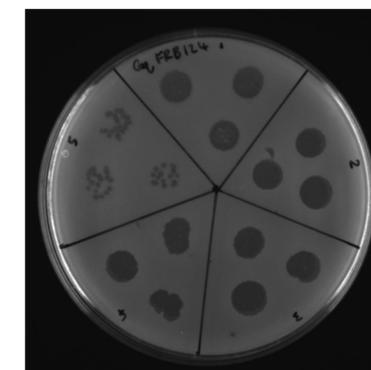


Figure 3. Spot assay of 5 isolated phages on their host *G. quercinecans* FRB124.

References

- [1] Denman et al. (2018). *The ISME Journal*, 12, 386-399.
[2] Rabiey et al. (2020). *Microbial biotechnology*, 13(5), 1428-1445.