



Bacterial
Plant Diseases
Programme



Healthy oak leaves

IDENTIFYING HEALTH-PROMOTING MICROBES TO TREAT ACUTE OAK DECLINE



FUTURE OAK

Understanding the microbiome could help combat tree disease

In the UK, oak trees are increasingly under threat from Acute Oak Decline (AOD), a complex disease arising from a combination of factors including environmental stress, insects, and pathogenic bacteria. Currently, there is no effective means of managing the disease. Symptoms include stem bleeds, rotting stem tissue and often death.

All trees have a microbiome and host a diverse range of microbes, including bacteria, fungi and viruses. These microbes are vital for tree health, as they are involved in many of the processes trees need to survive. They can also provide protection from tree pathogens. It may be possible to use microbes to boost the microbiome and protect against diseases like AOD. The first step is to identify microbial species which promote oak health or suppress the pathogenic bacteria associated with AOD.



An oak tree with stem bleeds characteristic of AOD



Culturing microbes collected from a healthy oak tree



Collecting oak microbiome samples

This research surveyed the oak microbiome to identify potentially beneficial microbes

We surveyed the microbiomes of 300 oak trees at 30 woodlands across Britain, both in areas where AOD is currently found and where it is not. We built statistical models to understand the environmental factors that determine which microbial species are found on each tree, and the association of each microbial species with disease.

We collected microbes from each tree, resulting in a collection of more than 20,000 microbial strains. We tested most of these strains for their ability

to suppress the growth of pathogenic bacterial species involved in causing AOD. Species with suppressive activity are being tested for their ability to suppress the development of AOD symptoms in live saplings.

To understand whether a microbial treatment would be viewed as an acceptable intervention, we spoke with small woodland owners to learn about their understanding of the tree microbiome, and to understand whether they would be willing to apply such a treatment.

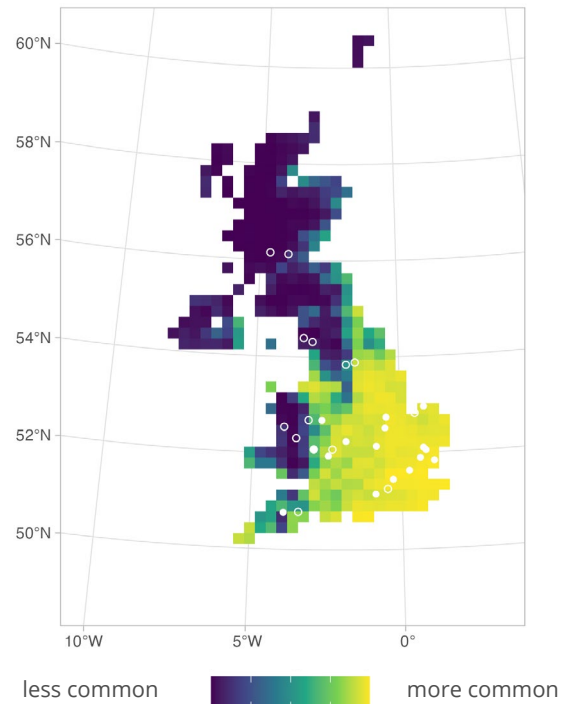
Discoveries

We have identified hundreds of microbes with the potential to suppress disease

- 🔍 The microbiomes of 300 oak trees across the UK were characterised, constructing an atlas of the oak microbiome.
- 🔍 Rainfall and humidity are the most important determinants of which microbial species are found living on oak leaves.
- 🔍 Microbial species that are strongly associated with healthy oak trees have been identified and will be studied further.
- 🔍 341 microbial strains with the ability to suppress at least one of the pathogenic bacterial strains have been isolated.
- 🔍 Small woodland owners showed a general awareness of the microbiome, and a willingness to use microbial treatments to maintain tree health.



Distribution map of *Vishniacozyma heimaeyensis*, a fungus from oak leaves which has a strong preference for dryer environments



Recommendations

Our research has identified microbes which have the potential to suppress AOD, but more research is needed.

- 🌿 Further research to understand how environmental factors (e.g. drought, temperatures) impact the oak microbiome and its ability to promote oak tree health.
- 🌿 Consider plant-associated microorganisms as a vital component of resilient trees for the future.
- 🌿 Explore the potential for disease-suppressive microorganisms to be used as treatments for plant diseases.

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To explore the underlying research visit <https://bacterialplantdiseases.uk/future-oak/>



An interdisciplinary research consortium working together to understand bacterial plant diseases to protect UK farms, forests and gardens.

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