Climate change and tree diseases

How are root pathogens likely to be influenced by climate change?

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Introduction

Root pathogens infect and damage the root systems of trees, impacting water and mineral uptake; this can reduce tree growth and may lead to tree death which will reduce the benefits that trees provide, including their key role in climate-change mitigation. The changing climate of the UK is predicted to increase the growth or spore release of many of these widespread, common pathogens leading to increased infection, and may also extend the active period of pathogens, allowing them to cause successive years of damage to a host species. Since trees may become more vulnerable to infection if they experience drought stress, latent pathogens (those that infect but do not cause symptoms, sometimes for many years) could become more prevalent with more frequent hot, dry summers. Root damage may increase instability in trees, making them more liable to wind-throw.

The three main fungal root pathogens already present in the UK, causing significant damage in forestry, are described below along with the likely impact of climate change on their spread and severity.

Honey fungus disease caused by *Armillaria* species

- A number of *Armillaria* species are found throughout the UK. *Armillaria gallica* and *A. cepistipes* take advantage of weakened trees while *A. mellea* and *A. ostoyae* are more aggressive and can kill healthy broadleaves and conifers, respectively. *Armillaria ostoyae* has also been found in oak.
- White mycelial sheets are commonly found at the root collar between the outer and inner bark. The fungus can also form rhizomorphs (commonly known as 'bootlaces'), which enable it to spread through soil and from tree to tree. Once established at a site, *Armillaria* can persist and increase in prevalence with successive forest rotations.

'Boot-laces' (rhizomorphs) of Armillaria.

Fruiting bodies of Armillaria.

- Damage is likely to increase due to more frequent drought periods which predispose trees to *Armillaria* infection.

Root rot caused by *Heterobasidion annosum*

- *H. annosum* infects the stumps of recently felled trees and grows into the roots of adjacent living trees.
- Symptoms in Sitka spruce (*Picea sitchensis*), Norway spruce (*Picea abies*), Scots pine (*Pinus sylvestris*) and other conifers include resin bleeds, root and butt rot, discoloration and rot of the heartwood; fruiting bodies may be seen at and around the stem bases of infected trees.

Fruiting body of H. annosum.

- Disease is most prevalent in low rainfall areas and on sites with free draining, well-aerated soils. Warmer, drier summers will increase the aeration of soils with poor drainage, thus enabling spread of the fungus onto sites that were previously too wet. Spore production by *H. annosum* increases greatly above 5°C, so milder winters will extend the period when stumps are likely to be colonised, and warmer summers will increase the occurrence of the 25°C optimum temperature for *H. annosum* growth. A higher frequency of infection of trees is therefore likely and mortality of younger trees may become more common.

Oak decline caused by *Gymnopus fusipes* (previously *Collybia fusipes*)

- Seedlings and mature trees of common oak (*Quercus robur*) and red oak (*Q. rubra*) are more susceptible than sessile oak (*Q. petraea*). In the UK, although there are records from across England, most are from the South-east.
- Spores infect the collar region of roots and the pathogen slowly colonises the deep roots causing rot. Lesions form at the root collar under the bark but the disease is largely hidden until the advanced stage when supporting roots are damaged, which often results in wind-throw of the tree.
- Disease severity is greater in trees growing on lighter soils that dry out quickly. Increased droughts may increase infection incidence in oak species growing in sandy, well-draining soils, as commonly observed in southern Europe. *Q. robur* and *Q. rubra* require more water than *Q. petraea* and will be more susceptible as rainfall decreases.

International trade

Increasing trade in live plants on a global scale presents a serious risk of accidental introduction of pathogens into the UK, particularly within soil and potting media and asymptomatic plants. Experience shows that by the time a new disease is identified, the pathogen is often already well-established in the environment, which can make eradication and containment very difficult. With climate change, any new pathogens imported on plants from warmer countries might be more likely to establish in the UK although there is so far only a little evidence to support this.

Indirect effects of climate change on soil pathogens

In addition to the direct impacts outlined in the introduction, climate change may also have indirect effects on tree health through impacts on soil micro-organisms but it is not yet possible to predict the consequences for root diseases.

More information:

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Version 01: 20 May 2021

FR(GB-HM)PDF/MAY21/0004