

Climate change and tree diseases Phytophthora diseases likely to increase with climate change

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Milder and wetter winters, followed by increased spring rainfall, are likely to enhance the survival and infection potential of many tree pathogens. Hotter, drier summers leading to drought stress in trees will also increase their susceptibility to disease and expand the distribution range of some pathogens. The increased incidence and severity of diseases caused by *Phytophthora* species reduces the benefits that trees provide, including climate change mitigation.

What are phytophthoras?

Phytophthoras are fungus-like pathogens that survive in their hosts overwinter or as dormant resting spores in soil and plant debris. Phytophthoras produce spores that swim in water films and are carried in water courses. Increased rainfall, waterlogged soil, flooding and water run-off increase their opportunities for infection and disease spread. Mycelia and spores can be transported in soil and plant debris. Some species, e.g. P. ramorum, produce spores that are adapted to aerial dispersal in mists and wind-driven rain.

Damage caused by phytophthoras

Many phytophthoras are root killers, some infecting primary roots and the root collar, extending into the lower stem to cause cankers and lesions. Others destroy fine feeder roots. Several phytophthoras are aerial pathogens, attacking above-ground tissues and causing a range of symptoms: lesions on leaves, bark and branches; withering of shoots, defoliation and dieback; and stem and branch infections with resin bleeds.



Lesion of P. austrocedri on juniper stem. Cutting into a lesion may reveal discoloration of infected, dying (D) phloem tissue under bark next to healthy (H) tissue.

Implications of climate change

Increased rainfall and flooding will enhance infection by phytophthoras such as *P. austrocedri*, *P. alni* and *P. lateralis* that attack roots and extend into the root collar and trunk. Warmer water temperatures in winter are associated with increased activity of *P. alni*. Milder winters, warm summers and summer droughts are also likely to favour species adapted to higher temperatures, e.g. *P. cinnamomi* which is most damaging above 25°C and frost intolerant. *P. ramorum* infections increase following mild winters and spring rainfall, both of which assist disease development and the spread of spores of this aerial pathogen. Opportunities for long-distance dispersal of other aerial phytophthoras, such as *P. pseudosyringae* and *P. kernoviae*, are also more likely with increased episodes of heavy rainfall with high winds.

Phytophthoras likely to increase with climate change include:

P. austrocedri

- The major host is juniper; Nootka cypress, Lawson cypress, Leyland cypress and *Cupressus* species are occasional hosts.
- Roots and stem bases of juniper are attacked. Lesions may extend up to 50 cm with redbrown discoloration of phloem below the outer bark at the stem base. Progressive bronzing of foliage occurs.

P. ramorum

- The most commonly affected trees are larch species (Japanese, European, Japanese x European hybrids), European sweet chestnut and beech.
- On larch, foliage and mature bark can be affected. Infected needles turn pink to brown with bark infections revealed by resin bleeds; progressive shoot death, branch and crown dieback follow. On broadleaved trees, the most obvious symptoms are bleeding lesions on stems.

P. alni

- *P. alni* is specific to alder trees including native common (black) alder, Italian alder, grey alder and green alder across the UK.
- Tarry or rusty spots with resin bleeds occur towards the base of the trunk.

P. cinnamomi

- The most frequent host is sweet chestnut. It is also common on cypress, oak and yew and is occasionally found on cedar, beech, larch and Douglas fir.
- Known as ink disease due to the black coloration of roots and soil, symptoms include: death of fine roots and lesions on main roots; collar rot,

extending into the lower stem; and crown dieback and decline.

P. lateralis

- The major host is Lawson cypress, with occasional findings on cedars (*Thuja* species) and Sawara cypress.
- Infection is mainly via roots with occasional aerial crown infections. Root infection can result in rapid disease progression as the root collar is girdled and foliage turns rusty-red to dull bronze.

P. pseudosyringae

- The main hosts are beech, southern beech, larch and bilberry.
- On beech, the roots and root collar are affected with bleeding cankers on the lower stem. In contrast, on southern beech it causes aerial bleeding or resinous cankers on branches and stem, and infected leaves suffer necrosis.

P. plurivora

- *P. plurivora* is most commonly found on beech, sycamore and lime; occasionally it occurs on southern beech and horse chestnut with sporadic findings on alder, cypress, fir, oak and spruce.
- Root and collar rot with bleeding cankers on the root collar and lower stem; on mature sycamores, may also cause aerial cankers not connected to root infection.

More information:

Detailed species information is available on the **Phytophthora** and **Phyto-threats** research pages of Forest Research.

For information of the recent discovery of *P. pluvialis* in the UK, see the **symptom guide**.

Use the Forest Research **TreeAlert** to report any suspected cases of Phytophthora and for further guidance.

Further details of our work on trees, forests and forestry are available at:

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