EXOTIC PEST ALERT

Phytophthora ramorum

Sudden Oak Death

Forestry Commission

Phytophthora ramorum is a new species of *Phytophthora*. It was first identified in California in 2000 and then later in Oregon, USA: in both these states it causes a highly damaging tree disease known as Sudden Oak Death. The same *Phytophthora* has also been found to cause a new disease of rhododendrons and viburnums, which was first reported in Europe from the Netherlands and Germany. However, the form of *P. ramorum* in North America is of a different sexual mating type to the fungus in Europe.

P. ramorum has since been found on nursery stock in a number of other European countries including Belgium, the Czech Republic, Denmark, France, Ireland, Italy, Spain (including the Balearics), Slovenia, Sweden and the UK. The main hosts are rhododendron and viburnum, but other genera can be hosts, including *Camellia*, *Kalmia*, *Pieris*, *Hamamelis* and *Syringa.* It has also been recorded once on small pot-grown yew plants (*Taxus baccata*) growing close to infected viburnums in a UK nursery. The first record of *P. ramorum* on a mature tree outside the USA occurred in the UK in November 2003. The affected tree was a 100-year-old *Quercus falcata* (southern red oak). Also in November 2003, an infected *Q. rubra* (northern red oak) was reported in the Netherlands. Subsequently, infected examples of *Fagus sylvatica* (beech), *Castanea sativa* (sweet chestnut), *Q. cerris* (Turkey oak), *Q. ilex* (holm oak) and a single *Aesculus hippocastaneum* (horse chestnut) have been found in southeast England. This alert is to raise awareness of the disease and describe the symptoms on potentially susceptible hosts in the UK.

Known hosts

Disease symptoms caused by *P. ramorum* can vary markedly depending on the host. On some trees the infection is a lethal stem canker, but on other hosts only foliage and shoots are affected. In the USA infected plants have been found in both forests (Fig.1) and urban plantings. They include:

- Stems of oak species such as
  - tanoak (*Lithocarpus densiflorus*)[1]
  - coast live oak (*Q. agrifolia*)[1]
  - black oak (*Q. kelloggii*)[1]
  - interior live oak (*Q. parvula* var. *shrevei*)[1]
- Leaves of
  - bay laurel (*Umbellularia* sp.)[1]
- Needles and shoots of
  - Douglas fir (*Pseudotsuga menziesii*)
  - coastal redwood (*Sequoia sempervirens*)

Fig.1 Dying coast live oak in California

Apart from forest trees, numerous understorey shrubs can be hosts although often only foliage is affected. In all, around 40 plant species have been found to be susceptible to infection.
Details of these host plants can be found at www.suddenoakdeath.org

In Europe known hosts include the trees and ornamentals described above. Beech and red oak are the most susceptible tree species so far; infection on these takes the form of extensive bleeding cankers on the trunk. Infected individuals of holm oak (Fig.2) and sweet chestnut have also been reported, but only the foliage is colonised by *P. ramorum*. With some ornamental species, particularly *Rhodo-dendron* and *Pieris*, leaves and shoots are affected, whereas with *Viburnum* the stem bases are affected. *Vaccinium vitis-idaea* (cowberry) has also been reported as a host in Poland - interceptions only.

Fig.2 Infected foliage of holm oak

[1] Virtually unknown in Europe.

Symptoms on trees

Lethal infection of trees by *P. ramorum* is rare, but the symptoms can be very similar to those caused by other tree diseases.

Trunk

Infection by *P. ramorum* is usually characterised by the presence of dark red to black sap oozing from the trunk: 'bleeding cankers' or 'tarry spots' (Fig.3). This is often on the lower portion of the trunk but may also occur several metres up the stem. When the outer bark is removed from the bleeding canker, mottled areas of necrotic, dead and discoloured inner-bark tissue can be seen (Fig. 4). Black 'zone lines' are often present within and around the edges of the necrotic region.

Fig.3 Bark bleeding or tarry spots

Fig.4 Mottled necrotic inner-bark

Foliage

The necrosis caused by bleeding cankers may girdle the tree and result in rapid death. As a result, foliage may change colour rapidly and uniformly throughout the crown, with the withered leaves remaining on branches after death.

Where *P. ramorum* infects the foliage of sweet chestnut and holm oak, the symptoms are scattered throughout the crown but mostly at the lower levels. Young foliage or epicormic shoots are the most commonly affected. In sweet chestnut dark necrotic lesions begin along the leaf margins or at the leaf tip (Fig.5) and in holm oak the necrosis extends down the petiole and kills the current year's shoot.

Fig.5 Infected leaf of sweet chestnut

Spread and distribution

Spread is aerial, probably in rainsplash, mist-laden winds or via watercourses. In the UK, infected trees have been found in close proximity to heavily infected rhododendrons, which probably act as the main source of spores of *P. ramorum*.

Similar symptoms

British oaks are already subject to a widespread but local mortality and dieback of complex cause known as 'oak decline'. In some cases this is associated with infection by other root infecting Phytophthoras. It also involves recurrent drought, root disease fungi such as *Collybia*, episodes of insect defoliation (e.g. by *Tortrix* species) and scale insect attacks. Oak decline symptoms have some similarities with those caused by *P. ramorum*. However, tests have shown that our native white oak species, *Q. robur* and *Q. petraea,* are not very susceptible to *P. ramorum*, and when these species suffer from oak decline they do not exhibit bleeding cankers on the main stem. Occasionally, declining trees have dark, watery fluxes from bark cracks which tend to run freely down the tree. On mature oaks with decline, foliar symptoms develop over many years and affected trees become 'stagheaded'.

Horse chestnut can also suffer from a disease known as 'bleeding canker'. The symptoms are very similar to those caused by *P. ramorum*, although the causal agent is another well-known species of *Phytophthora*; details at www.forestresearch.gov.uk/pdf/bleedingcanker.pdf

Contacts

P. ramorum is a quarantine pathogen and infected plants are subject to eradication. If the disease is suspected on trees please contact:

FC Pathology Disease Diagnosis Service
Tel: 01420 23000 Fax: 01420 23653
FC Plant Health Service
Tel: 0131 3146414 Fax: 0131 3146148
Or visit these websites for more information:
www.forestry.gov.uk/pramorum
www.defra.gov.uk/planth/pramorum.htm