

Sudden Oak Death: Recent Developments on Trees in Europe¹

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Abstract

In November 2000 a new *Phytophthora* originally found on rhododendron stock in Germany and the Netherlands in 1993 and the new *Phytophthora* believed to be the cause of sudden oak death in California were shown to be the same organism. This development led to a summary Pest Risk Analysis (PRA) for Europe being prepared by Forest Research (FR), United Kingdom. Subsequently, in 2002, the new fungus was formally named *P. ramorum*. The fact that *P. ramorum* was known to be present in Germany and the Netherlands led to surveys for the pathogen in nursery material, initially in the United Kingdom and the Netherlands in 2002 and later in many European countries. By 2003 it was clear that *P. ramorum* was still spreading on ornamental nursery stock in Europe, in particular on rhododendrons and viburnums. It is now known to be present on nursery stock in at least 12 European countries.

Currently there are two countries in Europe where, outside nurseries, the spread of *P. ramorum* from infected rhododendrons onto trees is known to have occurred. These are the U.K. and the Netherlands. In the Netherlands, extensive areas of 'public green' or public recreational parks occur, many of which are wooded and have large old understorey rhododendrons. In a survey in 2003, about 30 of these sites were found to have *P. ramorum* – infected rhododendrons. At one of these sites, a single infected *Quercus rubra* (northern red oak) with bleeding stem lesions was found. In 2004, another site was found to have nine *Q. rubra* with bleeding stem lesions. Containment measures for *P. ramorum* are in progress (see M. Steeghs, this volume).

In the U.K. between 2002-4, rhododendrons and other ornamental shrubs at approximately 900 parks and wooded gardens were surveyed for *P. ramorum* by the Plant Health and Seeds Inspectorate (PHSI) and the Central Science Laboratory. Sixty such sites were found to have outbreaks of *P. ramorum*, mainly on rhododendrons. About 25 percent of these outbreaks have since been eradicated (see D. Slawson, this volume). Investigations by Forest Research, U.K. showed that *P. ramorum* was also spreading onto tree stems at two main locations. In October 2003, a single *Q. falcata* (southern red oak) with girdling bleeding stem lesions from ground level to 2m was found at a site in Sussex. This

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observation was consistent with evidence from laboratory tests by FR that bark of *Q. rubra* and, by analogy, *Q. falcata* is potentially very susceptible to *P. ramorum* (Brasier and others 2004a).

From November 2003 onwards more infected trees, notably European beech, *Fagus sylvatica*, were found in woodlands and wooded gardens in Cornwall, south-west England. Some of these sites have extensive, and locally sometimes heavily diseased, understorey *Rhododendron ponticum*. Cornwall falls within a ‘higher-risk’ category when a climate match is made to the southern Oregon *P. ramorum* outbreak area (R. Baker, personal communication).

At these Cornish sites new tree hosts for *P. ramorum* continue to be found. So far bleeding stem lesions caused by *P. ramorum* have been found mainly on European beech. However, stems of mature *Q. cerris* (Turkey oak), *Q. petraea* (sessile oak), *Nothofagus obliqua* (Southern beech), *Aesculus hippocastanum* (Horse chestnut) and *Acer pseudoplatanus* (European sycamore) are also affected. Diseased *R. ponticum* is thought to fuel most of these stem infections. In addition to *R. ponticum*, *P. ramorum* has been found to cause foliage and shoot infections of *Q. ilex* (Mediterranean holm oak), *Castanea sativa* (sweet chestnut), *Fraxinus excelsior* (ash), *Pieris* spp. and other ornamental rhododendron varieties.

During surveys for *P. ramorum* in Cornwall another previously unknown *Phytophthora* was isolated concurrently from a large (> 1 m²) aerial bleeding lesion on a mature *F. sylvatica* and from *R. ponticum* in the same area. Like *P. ramorum* this new *Phytophthora* had caducous (deciduous) sporangia and was also probably aerially or splash dispersed. It was subsequently found to occur at several adjacent sites, and was apparently causing a locally more aggressive defoliation and dieback of *R. ponticum* than *P. ramorum*, leading to mortality, and locally serious damage to stems of beech. This new *Phytophthora* was informally designated *P. taxon C* and is now formally named *P. kernoviae* sp. nov. (after Kernow, the noun for Cornwall in the Cornish language, Brasier and others 2005).

Like *P. ramorum*, *P. kernoviae* is considered to be a new and invasive pathogen on trees in the U.K., most probably introduced by the plant trade, perhaps in the past 10–15 years. Possible origins for both species include the Himalayas, Yunnan and Taiwan (Brasier and others, 2004b). To date, *P. kernoviae* has been found mainly in woodlands in one area of Cornwall. Judging by its distribution, it may have arrived there before *P. ramorum*. In surveys by FR, it has been found causing bleeding stem lesions mainly on *F. sylvatica* (about 50 affected trees), but has also been isolated from bleeding stem lesions on *Q. robur* (English oak) and *Liriodendron tulipifera*. Diseased *R. ponticum* is again believed to fuel most of these stem infections. *P. kernoviae* is also causing foliar and shoot necrosis of *Gevuina*, *Magnolia*, *Michelia* and *Pieris* (in addition to *R. ponticum* and other rhododendron varieties). Interestingly, *Q. robur*, *Liriodendron* and *Michelia* are not presently known as natural hosts of *P. ramorum* in the U.K. Since *Liriodendron*, *Michelia* and *Magnolia* all belong to the Magnoliaceae, *P. kernoviae* might be a magnolia ‘specialist’ in its natural habitat.

Unlike *P. ramorum*, *P. kernoviae* is not widely present in the U.K. nursery trade, although it has been found at outlier locations in a garden/nursery in Swansea, south Wales, and in Cheshire, England (D. Slawson, this volume). These locations may reflect the further spread of *P. kernoviae* from the Cornish sites via the plant trade. A disease management zone has recently been set up in Cornwall by the U.K.

Forestry Commission and PHSI. Attempted eradication of infected rhododendrons is a major objective (D. Slawson, this volume).

P. kernoviae has a slightly different potential host range (see C. M. Brasier and colleagues, this volume) and a lower optimum temperature for growth than *P. ramorum*. Also, unlike *P. ramorum*, it is self-fertile i.e. probably inbreeding. Its reproductive strategy and its ecological strategy therefore may also be somewhat different. The threat that *P. kernoviae* poses to forests and natural ecosystems in other parts of the world is unknown (Brasier and others 2004b, 2005). In addition to *P. ramorum* and *P. kernoviae*, another recent ‘aerial *Phytophthora*’ invasive in the U.K., *P. ilicis*, plus the established species *P. cambivora*, *P. citricola* and *P. gonapodyides*, are also present on trees at the Cornish sites. Sometimes they occur together on the same tree (see A. Brown and colleagues, this volume). Consequently, another possible forest health risk is that, in the longer term, *P. kernoviae* or *P. ramorum* might adapt further to their new environment, either intrinsically or via horizontal transfer of genes with other *Phytophthora* species.

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