

Phytophthora ramorum

NOTE: *Phytophthora ramorum* has now been added to the EPPO A2 List. A full datasheet is being prepared, in the meantime you can view here the data which was previously available from the EPPO Alert List.

Why: Sudden oak death came first to our attention as significant tree mortality has been observed on several oak species in California (US). A new species *Phytophthora ramorum* was found associated with the disease and considered as the primary causal agent. *P. ramorum* was also found in Europe on nursery plants (mainly *Rhododendron*, *Viburnum*) causing twig dieback but has never been found causing extensive damage in forests. Genetic studies have shown that USA and European populations belong to the same species *P. ramorum*. At first, different mating types were found in Europe (A1) and North America (A2), but in 2003 the occurrence of a few isolates belonging to A1 and A2 mating types was respectively reported in North America and Europe. It is hypothesized that the pathogen was separately introduced into these two regions from a third area which remains unknown.



Rhododendron shoot tip wilt
caused by *Phytophthora ramorum*

Note: An [EPPO diagnostic protocol](#) is now available ([with figures](#)).

Where:

North America: Sudden oak death has only been reported in USA, in central coastal areas of California and one county in Oregon: California (counties of Alameda, Contra Costa, Humboldt, Lake, Los Angeles, Marin, Mendocino, Monterey, Napa, San Francisco, San Mateo, Santa Clara, Santa Cruz, Solano, Sonoma), Oregon (county of Curry). In ornamental nurseries, infections have reported in several states: California, Georgia, Louisiana, Oregon, South Carolina, Tennessee, Washington. In Canada, it was detected in 2003 on 1 *Rhododendron* plant in a nursery (British Columbia), under eradication.

EPPO region: *P. ramorum* has been found mainly on *Rhododendron* and *Viburnum* in nurseries in Belgium, Croatia, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Lithuania, Netherlands, Norway, Poland, Serbia, Slovenia, Spain (Asturias, Galicia, Islas Baleares: Mallorca), Switzerland, Sweden, United Kingdom. Since November 2002, emergency measures have been taken by EU Member States to avoid introduction and spread of *P. ramorum*.

On which plants: Sudden oak death has been observed on: *Lithocarpus densiflorus* (tanoaks), *Quercus agrifolia* (coast live oak) and *Q. kelloggii* (black oaks), *Q. parvula* var. *shrevei*. These oak species are native to California. The pathogen was found on *Vaccinium ovatum* causing twig dieback. In California, *P. ramorum* has been found in rhododendron plants adjacent to infested oaks. The fungus was also isolated from *Sequoia sempervirens* and *Pseudotsuga*

menziesii. Symptoms were limited to young and small branches and no mortality of mature trees was observed. *P. ramorum* was found on: *Acer macrophyllum*, *Aesculus californica*, *Arbutus menziesii*, *Arctostaphylos manzanita*, *Heteromeles arbutifolia*, *Lonicera hispidula*, *Rhamnus californica*, *Rosa gymnocarpa*, and *Umbellularia californica*, although its pathogenicity has not been yet demonstrated on these species. More recently, the following species were reported as hosts in USA: *Quercus chrysolepis*, *Toxicodendron diversilobatum*, *Rubus spectabilis*, *Rhamnus purshiana*, *Corylus cornuta*, *Pittosporum undulatum*, *Trientalis latifolia*. In Europe, *P. ramorum* is mainly found on *Rhododendron* and *Viburnum*, but it was also isolated from *Arbutus*, *Camellia*, *Hamamelis*, *Kalmia*, *Leucothoe*, *Magnolia*, *Pieris*, *Syringa* and *Vaccinium myrtillus*. An isolated finding on one *Quercus falcata* tree was reported by UK in November 2003, and shortly after on a few trees of *Fagus sylvatica*, *Quercus ilex*, *Q. cerris*, *Castanea sativa* and *Aesculus hippocastanum*. In the Netherlands, one infected tree of *Q. rubra*, and two *Fagus sylvatica* have also been identified (all trees were located near infected *Rhododendron*). In Ireland, *P. ramorum* has been isolated from one *Q. phillyraeoides* tree. In summer 2009, *P. ramorum* was detected for the first time on conifer trees (*Larix kaempferi*) in the United Kingdom. Since this initial discovery, large numbers of infected *L. kaempferi* have been observed in South West England. Other coniferous species have also been reported to be infected by *P. ramorum* (e.g. *Chamaecyparis lawsoniana*). Ireland has detected the pathogen on a single *Picea sitchensis* (Sitka spruce). In California (US), there are isolated records of *P. ramorum* on *Abies magnifica* and *A. grandis* growing near infected *Umbellularia californica*.

Damage: In North America, symptoms vary slightly between tree species. In *L. densiflorus*, wilted shoots are usually observed as the first symptoms. Older leaves become pale green and 2 to 3 weeks later the foliage turns brown, announcing the death of the tree. On the lower portion of the trunk, a burgundy-red to black sap oozing (bleeding) appears on the bark surface. In *Q. agrifolia* and *Q. kelloggii*, the earliest symptom is usually the sap oozing. Sunken or flattened cankers are observed beneath the bleeding with a distinctive dark red canker margin in the bark and outer sapwood. In Europe, *P. ramorum* mainly causes leaf and twig blight.

Transmission: Infection would occur through zoospores, sporangia and chlamydozoospores. As for other *Phytophthora*, it is likely that the disease can be transmitted by infected plants and soil. However, it has also been observed that sporangia of the pathogen are deciduous which opened the possibility that they could be transported by air currents but this has not been demonstrated. Bark beetles and ambrosia beetles are commonly found on diseased trees but their potential role of vectors has not been studied yet.

Pathway: Plants for planting, wood, bark of *L. densiflorus* (tanoaks), *Q. agrifolia* (coast live oak) and *Q. kelloggii*, soil from areas where the disease occurs. Plants for planting of ornamental hosts (e.g. *Rhododendron*, *Viburnum*) and of *Vaccinium* from areas where the disease occurs.

Possible risks: Oaks are important forest and amenity trees in the EPPO region. In USA significant oak tree mortality is observed, but not in Europe. Studies have been initiated on the susceptibility of European oak species to the disease, but no conclusion can be given yet. Nursery plants such as *Rhododendron*, *Viburnum*, are widely grown in the EPPO region and *P. ramorum* affects their quality. From experience with other *Phytophthora* diseases, control is difficult in practice. As a consequence of tree mortality, it was felt in USA that the disease could also have a negative impact on the biological diversity of forests and lead to

environmental problems (enhanced fire risk and damage to water catchments). More data is needed on the identity, biology, host range, geographical distribution and epidemiology of the pathogen. In particular, further comparison studies between USA and European populations are needed to understand why observed situations are so different between the two regions.

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