Forest Phytophthoras



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# *Phytophthora kernovi*

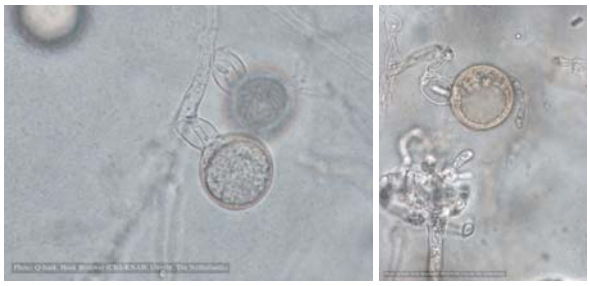
## Overview

*Phytophthora kernoviae* Brasier, Beales & S.A. Kirk (2005) was first observed in Co southwest England in 2003. The new species was described in 2005. It causes leaf rhododendron and stem lesions on European beech in gardens and woodlands in th trees and shrubs are also affected. The pathogen appears to match isolates recove Zealand from a diseased cherimoya orchard in 2006 and from soil isolates recovere from a native kauri forest and a radiata pine plantation. Etymology: 'Kernow', the c Cornwall.

## Morphology

Papillate and caducous sporangia, photos from Q-bank, used with permission.

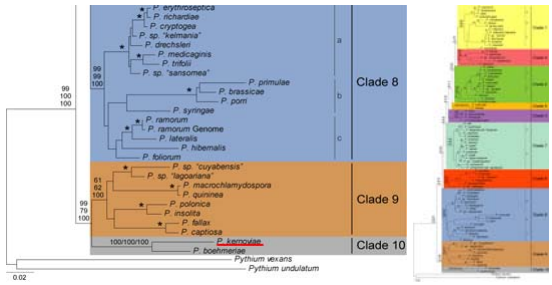
Sporangia (34-52 x 19-31 µm, mean range ca 38.5-45.5 x 22.3 x 27 µm) papillate formed occasionally on carrot agar (CA) in the light, produced abundantly on CA pl nonsterile pond water or soil leachate, ovoid, limoniform to asymmetric or 'mouse- with a conspicuous vacuole, pedicel length 5-19 µm , borne on sympodially branch sporangiophores. Hyphae sometimes denticulate or tuberculate. Chlamydospores n Colonies in dark on CA largely submerged with small central area of aerial myceliur alternating rings of mycelium in diurnal light. Homothallic, gametangia abundant o Oogonia diameter 21-28 µm (mean 23.5-25.5 µm), often with tapered stalks. Oosp (mean 21.1-22.5 µm), plerotic, wall thickness 3.5-5 µm (mean ca. 3.5 µm). Anther amphigynous, 10-14 x 9 x 12 µm, commonly 10-14 x 9-12 µm. Compared to UK is described above (Brasier et al., 2005), New Zealand isolates are reported to grow s slower at 20° C and have a few small differences in the size of oogonia, sporangia, length (Ramsfield et al. 2009).



Oogonia with amphigynous antheridia, photos from Q-bank, used with permission.

## Genetics

*P. kernoviae* is placed in Clade 9, with *P. boehmeriae* as its closest relative (Blair et sequences of New Zealand isolates matched 812/813 base pairs with the UK refere AY040661. The UK isolate AY040661 has adenine in position 679, whereas New Ze have either guanine in that position or are polymorphic for adenine and guanine. Th polymorphism in the ITS sequence is interpreted as evidence for some genetic dive Zealand population (Ramsfield et al. 2009). A possible origin in the southern hemis hypothesized for P. kernoviae, and although present in New Zealand since at least known if it is an endemic species (Ramsfield et al. 2009).




Phylogenetic tree from http://www.phytophthoradb.org/kernoviae (Blair et al 2008).

## Growth

Temperature optimum ca. 18° C, max. ca. 26° C. Growth rate in dark at 20° C on 3.8-4.6 mm/d (mean 4.2 mm/day).

Colony morphology at 7 days at 18°C on V8 (left). Growth on cornmeal agar with pimaricin, ampicillin, rifampicin, hymexazol, and Terrachlor (right). Plant Dis. 70:1038-1043 (with permission)

## Distinguishing characteristics for identification

*P. kernoviae* may be distinguished from other homothallic species with caducous, p sporangia with medium-length pedicels by its lower optimal temperature (cfr. *P. bo hevea*); higher optimum temperature (cfr. *P. nemerosa*), often tapered oogonial st *meadii*, *P. botryosa*, *P. nemerosa*), often asymmetric sporangia (cfr. *P. meadii*, *P. n nemerosa*), and longer pedicels (cfr. *P. boehmeriae*). Compared to *P. ramorum*, wh occurs in similar habitats in the UK, *P. kernoviae* is homothallic instead of heteroth instead of semi-papillate, does not produce chlamydospores, and has a longer pedi

The searchable web-based database phytophthora-id.org is useful for rapid identifi *Phytophthora* species based on sequencing of the ITS or Cox spacer regions, follow searching the database. The database includes only sequences that are associated *Phytophthora* species descriptions or classic *Phytophthora* phylogenetics references

## Disease History

A new *Phytophthora* species was isolated from diseased rhododendrons and Europe Cornwall, UK in 2003. Initially called '*Phytophthora* taxon C' or '*P. kernovii*', it was *kernoviae* (etymology: 'Kernow', the old name for Cornwall). It causes stem lesions of Fagaceae, and leaf lesions and dieback on plants in several families. Hosts includ *Rhododendron ponticum*, an understory species on which it sporulates. It is believe introduced pathogen in the UK. In 2006, *P. kernoviae* was reported from an abando the Northland region of New Zealand on rotting fruit of custard apple *Annona cheri* (Braithwaite et al, 2007). It appears to match earlier soil isolates recovered in New native kauri forest and a radiata pine plantation

## Impacts in the Forest

In the UK, *P. kernoviae* has been found mainly on rhododendron in woodlands of so England with a few sites in northern England, Wales and Scotland. Between 2002 a outbreaks occurred in managed and unmanaged land, and 5 outbreaks occurred in garden centers in England and Wales (Walters et al. 2010). The pathogen produces sporangia on leaves of *Rhododendron ponticum* that serve as primary inoculum for so management efforts have focused on removal of this invasive species. Recent fi that *P. kernoviae* can persist as oospores in rhododendron roots, complicating this strategy (Fichtner et al. 2011). In 2009, *P. kernoviae* was reported on *Vaccinium m* three heathland locations in Cornwall (Beales et al. 2009) and later on the Isle of A (Scotland). The pathogen sporulates profusely on leaves. It is postulated that long disease spread may occur when coastal winds carry infected, abscised leaves. Loca occur via infected roots and rhizomes (Fichtner et al. 2010). Other heathland speci *Vaccinium vitis-idaea* and *Arctostaphylos uva-ursi* appear to be highly susceptible i inoculation tests, suggesting that this valuable botanical resource could be endange al. 2009).


External lesion caused by *P. kernoviae* on a beech tree (top), necrosis of *Rhododendron* leaves (bottom).

## Forest and Wildland Hosts and Symptoms

In the UK, *P. kernoviae* causes a serious disease on European beech (*Fagus sylvati* infestations are associated with the invasive understory plant, *Rhododendron ponti* distributed in woodlands and gardens. The pathogen's host range includes Chilean tree, *Gevuina avellana*, winters bark, *Magnolia* spp., *Pieris* spp., *Michelia dolsopa*, H English oak, cherry laurel, ivy, and variegated holly. Bilberry (*Vaccinium myrtillus*) heathland species has become infected under natural conditions (Beales et al. 200 infestations have occurred rarely and were eradicated. Like *P. ramorum*, *P. kernovi* bleeding stem cankers on members of the Fagaceae and foliar blight and shoot diel hosts.

In New Zealand, the pathogen was associated with diseased leaves, shoots, and fru cherimoya trees that were near native shrublands and forest in Northland (Braithw 2007). Previous isolates from soil in kauri forests 50 km away were not associated nor were isolates from near Tokoroa, 400 km to the south, from *Pinus radiata* plant (Ramsfield et al. 2009). *P. kernoviae* seems to have been first observed by Newhoc Zealand in 1953 (Ramsfield et al. 2009).

| Host Latin Name | Host Common Name | Symptoms | Habitat | |
|---|---|---|---|---|
| *Annona cherimola* | Custard apple | Fruit rot, Dieback | Agricultural setting | New Z Northl |
| *Drimys winteri* | Winter's bark | Dieback, Leaf necrosis | Gardens | Englar |
| *Fagus sylvatica* | European Beech | Canker | Forest, Gardens, Parklands | Englar Cornw |
| *Gevuina avellana* | Chilean hazel | Dieback, Leaf necrosis | Gardens | Englar |
| *Hedera helix* | Common ivy | Dieback, Leaf necrosis | Gardens | Englar |
| *Host unknown* | None, found in streams or soil | None, found in streams or soil | Forest, Plantations | New Z Northl Zealar |
| *Ilex aquilfolium* | English holly | Decline, Leaf necrosis | Gardens | Englar |
| *Liriodendron tulipifera* | Tulip tree | Dieback, Leaf necrosis | Gardens | Englar |
| *Magnolia spp.* | Magnolia | Dieback, Leaf necrosis | Gardens | Englar |
| *Michelia doltsopa* | Sweet michelia | Dieback, Leaf necrosis | Gardens | Englar |
| *Pieris formosa* | Chinese pieris | | Gardens | Englar |

| Host Latin Name | Host Common Name | Symptoms | Habitat | |
|---|---|---|---|---|
| | | Dieback, Leaf necrosis | | |
| *Prunus laurocerasus* | Cherry laurel | Dieback, Leaf necrosis | Gardens | Englar |
| *Quercus ilex* | Holm oak, Oak | Dieback, Leaf necrosis | Gardens | Englar |
| *Quercus robur* | English oak, Oak | Dieback, Leaf necrosis | Gardens | Englar |
| *Rhododendron ponticum* | Pontic rhododendron | Blight, Decline, Wilting | Forest, Gardens, Parklands | Englar Cornw Wales |
| *Vaccinium myrtillus* | Bilberry | Dieback, Leaf necrosis | Wildland | Englar Scotla Arran |

## Educational and Management Materials

- *P. kernoviae* disease fact sheet (English) - FERA, UK
- *P. kernoviae* disease fact sheet (Welsh) - FERA, UK
- *P. kernoviae* slide show – Biosecurity New Zealand
- Recovery plan for *P. kernoviae* - USDA–ARS
- *P. kernoviae*: Growing threat to native heathlands – UK Forest Research
- Future management of risk from *P. kernoviae* and *P. ramorum* – DEFRA, UK

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