Preliminary Results of Foliage Susceptibility to *Phytophthora kernoviae* sp.nov. : A new pathogen of forest trees in the UK

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Phytophthora kernoviae sp. nov. is a newly discovered pathogen occurring in the UK, that attacks foliage, particularly of exotic shrub species, and bark of certain indigenous and exotic trees. Foliage infections cause leaf blight and necrosis of leaves and shoots, whereas infected trees develop blackened trunk cankers with associated bleeding, bark necrosis and ultimately severely infected trees die. Similarities in disease symptoms between *P. ramorum* and *P. kernoviae* exist. *Phytophthora kernoviae* was first discovered on a beech tree with a canker covering a large part of the stem, and later on a rhododendron bush adjacent to the tree, in Cornwall, south-west England.

Phytophthora kernoviae is homothallic, and produces caducous sporangia, which are adapted for aerial dissemination. To date sporangia have not been found on bark of infected hosts and this suggests that foliage may be a source of sporangial inoculum as has been demonstrated for *Phytophthora ramorum* with bay laurel (*Umbellularia californica*) (Davidson *et al*. 2002), tanoaks (*Lithocarpus densiflora*) and redwood needles (*Sequoia sempervirens*) (Garbelotto 2004). Consequently it is important to establish the foliage host range of *P. kernoviae* to determine the epidemiology of the disease and develop a disease management strategy. We report here on preliminary results of foliage susceptibility tested using a detached leaf dip assay, and list current foliar hosts discovered during field surveys in the UK.

Materials and Methods

Detached Leaf Dip Assay

- Leaves were dipped into a 10^6 zoospores/ml suspension for 30 seconds (Fig.1a).
- Leaves were placed on racks in plastic boxes (Fig 1b), which were then covered with cling film and incubated at 20ºC for 8 days with a 12h light/dark cycle.
- Visual assessment of the percentage necrotic leaf area and re-isolation from the dead-live junction of the lesion were carried out.

Field Survey

- Field surveys were carried out in natural woodlands and gardens in Cornwall, south-west England.
- Symptomatic foliage was collected and isolations made on synthetic mucor agar (Brasier and Kirk 2002).
- Isolates were transferred to carrot agar and incubated at 20°C for 6 d in the dark.
- Cultures were examined using a microscope. The ITS1 and ITS2 regions of representative isolates were sequenced.

Biological Name	Common Name
Acer pseudoplatanus	sycamore
Aesculus hippocastanum	horse chestnut
Betula pendula	birch
Carpinus betulus	hornbeam
Castanea sativa	sweet chestnut
Corylus avellana	hazel
Fagus sylvatica	beech
Fraxinus excelsior	ash
Gevuina avellana	Chilean hazelnut
Ilex aquifolium	holly
Liriodendron tulipifera	tulip tree
Magnolia sp.	magnolia
Populus tremula	aspen
Prunus avium	wild cherry
Prunus laurifolia	laurel
Quercus cerris	Turkey oak
Quercus ilex	holm oak
Quercus petraea	sessile oak
Quercus robur	common oak
Quercus rubra	red oak
Rhododendron catawbiense	rhododendron
Syringa vulgaris	lilac
Tilia cordata	small leaved lime
Ulmus procera	English elm
Umbellularia californica	bay laurel

Table 1. List of plant species inoculated in the detached leaf assay

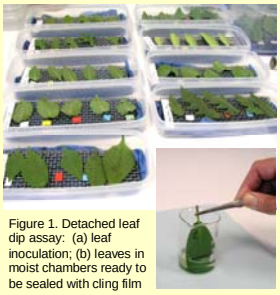

Figure 1. Detached leaf dip assay: (a) leaf inoculation; (b) leaves in moist chambers ready to be sealed with cling film

Figure(s) 4. *Gevuina avellana* with leaf blight caused by *Phytophthora kernoviae* in Cornwall

Figure(s) 5. Rhododendron infected with *Phytophthora kernoviae* in Cornwall

Results

Detached leaf dip assay

- Magnolia was most susceptible with 40% leaf area covered by a continuous lesion (Figs. 2 and 3).
- Rhododendron, tulip tree, wild cherry and lilac were also highly susceptible but necrosis was often patchy.
- Smaller speckled lesions formed on bay laurel, laurel and birch.
- No lesions occurred on ash, beech, elm, hazel, holly, lime or sweet chestnut.

Figure 2. Necrotic leaf area of inoculated plants after 8 days. Black line shows the limit of dipped region

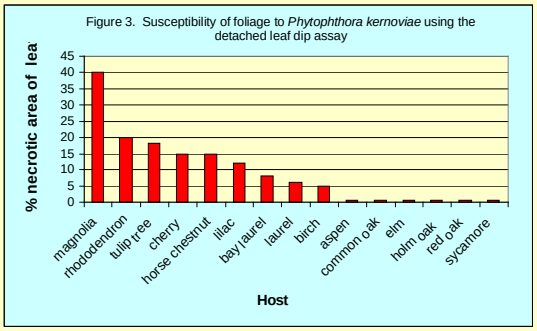

Figure 3. Susceptibility of foliage to *Phytophthora kernoviae* using the detached leaf dip assay

Field survey

Phytophthora kernoviae was isolated from these hosts sampled in the survey:
Gevuina avellana (Chilean hazelnut) (*Proteaceae*) (Fig. 4).
Liriodendron tulipifera (Tulip tree) (*Magnoliaceae*).
Michelia doltsopa (Michelia) (*Magnoliaceae*).
Rhododendron (*Ericaceae*) (Fig. 5).
It has also been reported from magnolias (*Magnoliaceae*) growing in the same area (PHSI and CSL, pers. comm.).

Discussion

This is the first report of naturally infected hosts susceptible to *Phytophthora kernoviae*. Most foliage hosts discovered so far belong to the plant family *Magnoliaceae*. Preliminary results of the leaf dip tests demonstrate that *Phytophthora kernoviae* may have a more limited host range than *Phytophthora ramorum* and that *Magnoliaceae* in particular are highly susceptible. This could suggest an origin of the pathogen in China where many *Magnoliaceae* are native.

Successful infection and disease development using zoospore inoculum on non-wounded foliage indicates that this is the probable mode of foliage infection in nature. During this study abundant sporangia developed on both surfaces of magnolia leaves, and to a lesser extent on the lower surface of rhododendron leaves. The ease and abundance with which they developed strengthens the idea that they play an important role in disease initiation. Further studies on infection of intact foliage on host plants need to be carried out. Although the bark of beech trees was highly susceptible, foliage was not.

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References
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