

## JKI Data Sheets

# Plant Diseases and Diagnosis

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## *Phytophthora* on *Quercus ilex* L. (holm oak)



## Imprint

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## Importance of *Quercus ilex*

*Quercus ilex* L. (holm oak) is a dominant tree within the Mediterranean basin and is used as a bio-indicator of Mediterranean-type ecosystems (Plieninger *et al.*, 2004; distribution map for *Q. ilex* see <http://www.discoverlife.org>). *Q. ilex* is an evergreen tree which grows in four bioclimates (semiarid, subhumid, humid and perhumid) and is present in different soil types. It grows up to 25 m and has sclerophyllous, tomentose leaves with a shape ranging from round to longer leaves, with or without spines. It comprises two different subspecies: *Q. ilex* subsp. *ilex* and *Q. ilex* subsp. *ballota* (syn. *Q. rotundifolia*). In the Iberian Peninsula, its importance derives from its presence in the most widespread agroforestry system in Europe known as dehesa. Dehesas play a main role as an ecological, economical and social system. They are characterized by the rearing of livestock, the production of acorns for livestock feeding, firewood production and cereal cropping.

## *Phytophthora* species

From *Q. ilex* trees, irrespective of the presence of decline symptoms, the following *Phytophthora* species have been isolated directly from the tissues or from the soil:

<i>Phytophthora</i> species	Disease symptoms	Reference
<i>cinnamomi</i> (most frequently isolated)	Defoliation, leaf discoloration and wilting, dead branches, exudations from bark, root rot	Brasier <i>et al.</i> , 1993 ; Sánchez <i>et al.</i> , 2002
<i>cryptogea</i>	Decline	Scanu <i>et al.</i> , 2012
<i>gonapodyides</i>	Defoliation, leaf discoloration and wilting, dead branches, root rot	Corcobado <i>et al.</i> , 2010
<i>psychrophila</i>	Defoliation, leaf discoloration and wilting, dead branches, root rot	Pérez-Sierra <i>et al.</i> , 2012, Scanu <i>et al.</i> , 2012
<i>quercina</i>	Defoliation, leaf discoloration and wilting, dead branches, root rot	Pérez-Sierra <i>et al.</i> , 2012, Scanu <i>et al.</i> , 2012
<i>ramorum</i> <sup>1</sup>	Defoliation, leaf discoloration and wilting, dead branches	Denman <i>et al.</i> , 2005
<i>syringae</i>	Defoliation, leaf discoloration and wilting, dead branches, root rot	Pérez-Sierra <i>et al.</i> , 2012

1 - in the European Union *P. ramorum* is a regulated organism (see chapter 'Quarantine recommendation')

In nurseries, *Q. ilex* seedlings have been found to be infected with *P. cinnamomi*, *P. cryptogea*, *P. drechsleri*, *P. cambivora* and *P. gonapodyides* (Sánchez *et al.*, 2004; Jung, 2011).

## Disease symptoms (see figures)

*Phytophthora* species can attack different plant tissues and cause different disease symptoms on *Q. ilex*. The most common symptoms are:

**Crown:** defoliation, leaf discoloration and wilting, branch dieback (Gallego *et al.*, 1999)

**Stem:** bleeding canker (Gallego *et al.*, 1999)

**Roots:** root necrosis (Corcobado *et al.*, 2011)

## Possibility of Symptom Confusion

The disease symptoms presented in the previous chapter are not specific only for *Phytophthora* infection. Oak decline mediated by drought can resemble those symptoms of *Phytophthora* infection such as defoliation and leaf discoloration and wilting. The fungus *Botryosphaeria* spp. can cause similar symptoms as *Phytophthora* infection, like cankers on branches and leaf yellowing and wilting (Sánchez *et al.*, 2003). The fungus *Biscogniauxia mediterranea* only affects non vigorous *Q. ilex* trees, causing yellowing of the leaves, defoliation, epicormic shoots and exudations (Jiménez *et al.*, 2005). To specify the cause of the disease, samples must be examined in the laboratory.

## Disease development

The disease can develop in two different ways: i) with a sudden death of the tree where dried leaves keep attached to the branches or ii) with a slow decline characterized by a gradual crown defoliation where the foliage of the highest part of the tree is the first to wilt and eventually affecting to the whole crown (Gallego *et al.*, 1999). The severity of the disease and its development depends on soil properties such as texture and pH, climatic conditions which influence water availability, tolerance of the tree and topographic position as valleys and slopes are associated with a higher incidence and severity of the decline.

## Diagnosis

It is not possible to identify a *Phytophthora* infection only by disease symptoms. Different diagnostic techniques like direct isolation, molecular and serological methods help to identify *Phytophthora* as the cause of the tree disease and to specify the *Phytophthora* species. Information on *Phytophthora* diagnosis on trees or in general are given for example in <http://forestphytophthoras.org/key-to-species>, <http://www.phytophthoradb.org>, <http://phytophthora-id.org/> and in Martin *et al.* (2012).

Please contact your national authorities (see next chapter) for help with diagnosis.

## What to do in case trees are suspected to be infected?

Contact your responsible national authorities, for example:

### Austria:

- Bundesforschungs- und Ausbildungszentrum für Wald, Naturgefahren und Landschaft (BFW)  
Federal Research and Training Centre for Forests, Natural Hazards and Landscape (BFW)  
Seckendorff-Gudent-Weg 8, 1131 Vienna, Austria; <http://www.bfw.ac.at/>
- Österreichische Agentur für Gesundheit und Ernährungssicherheit  
Austrian Agency for Health and Food Safety, Institute for Sustainable Plant Production  
Spargelfeldstraße 191, 1220 Vienna; <http://www.ages.at>

### Belgium:

- Département Sciences du Vivant, Centre Wallon de Recherches Agronomiques  
Life Sciences Department, Walloon Agricultural Research Centre  
Rue de Liroux 4, B-5030 Gembloux;  
Anne CHANDELIER | [a.chandelier@cra.wallonie.be](mailto:a.chandelier@cra.wallonie.be)
- Instituut voor Landbouw- en Visserijonderzoek (ILVO), Eenheid Plant -Gewasbescherming  
Institute for Agricultural and Fisheries Research, Plant Sciences Unit – Crop Protection - Gewas-  
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### Bulgaria:

- Българска Агенция по безопасност на храните: Централна лаборатория по карантина на растенията  
plant protection regional services: <http://www.babh.government.bg/en/labs.html>
- Агробиоинститут, Селскостопанска Академия бул 8, Драган Цанков № 8, София 1164  
Biotic Stress Group, AgroBioInstitute, Agricultural Academy  
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Славчо Славов, [sbslavov@abi.bg](mailto:sbslavov@abi.bg)  
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### Czech Republik:

Výzkumný ústav Silva Taroucy pro krajinu a okrasné zahradnictví, v.v.i  
The Silva Tarouca Research Institute for Landscape and Ornamental Gardening, Publ. Res. Institute  
Květnové náměstí 391, Průhonice, 252 67, Praha západ  
Matěj PANEK | [panek@vukoz.cz](mailto:panek@vukoz.cz)

### Denmark:

- NaturErhvervstyrelsen, Ministeriet for Fødevarer, Landbrug og Fiskeri  
The Danish AgriFish Agency, <http://www.naturerhverv.fvm.dk>
- Institut for Geovidenskab og Naturforvaltning, Det Natur- og Biovidenskabelige Fakultet,  
Københavns Universitet  
Department of Geosciences and Natural Resource Management, Faculty of Science, University of  
Copenhagen | [www.ign.ku.dk](http://www.ign.ku.dk)

**Finland:**

- Elintarviketurvallisuusvirasto Evira, Kasvinterveysyksikkö  
Finnish Food Safety Authority Evira, Plant Health Mustialankatu 3, FI-00790 Helsinki  
[http://www.evira.fi/portal/fi/kasvit/viljely\\_ja\\_tuotanto/metsanviljely/valvonta/](http://www.evira.fi/portal/fi/kasvit/viljely_ja_tuotanto/metsanviljely/valvonta/)
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- Services Régionaux de l'Alimentation (SRAL) des Directions Régionales de l'Alimentation, de l'Agriculture et de la Forêt (DRAAF)  
Regional Plant Protection services  
<http://agriculture.gouv.fr/suivi-de-la-sante-des-forets>  
<http://agriculture.gouv.fr/services-deconcentres>
- Laboratoire de Santé végétaux, unite de Mycologie, ANSES  
French Agency for Food, Environmental and Occupational Health & Safety (ANSES)- Plant Health Laboratory, unit of mycology  
Domaine de Pixérécourt Bat E., 54220 Malzéville, France; <http://www.anses.fr/PNTC01.htm>;  
Nathalie SCHENCK | [Nathalie.schenck@anses.fr](mailto:Nathalie.schenck@anses.fr)  
Renaud IOOS | [renaud.ioos@anses.fr](mailto:renaud.ioos@anses.fr)
- Pôle interrégionaux du Département de la santé des forêts:  
Regional forest health survey organisation:  
<http://agriculture.gouv.fr/departement-de-la-sante-des-forets>

**Germany:**

- Pflanzenschutzdienststellen der Bundesländer, Adressenliste siehe:  
regional plant protection services, address list see: <http://www.jki.bund.de/de/startseite/unsere-service/linksammlung.html>
- Julius Kühn Institut – Bundesforschungsanstalt für Kulturpflanzen (JKI), Institut für Pflanzenschutz in Gartenbau und Forst (JKI-GF)  
Julius Kühn Institut - Federal Research Center for Cultivated Plants (JKI),  
Institute for Plant Protection in Horticulture and Forestry (JKI-GF)  
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Forest Research Institute, 570 06 Vassilika, Thessaloniki, Greece  
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- Ινστιτούτο Μεσογειακών Δασικών Οικοσυστημάτων & Τεχνολογίας Δασικών Προϊόντων, Τέρμα Αλκμάνος, 115 28 Ιλίσια, Αθήνα, Ελλάδα  
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- Megyei Kormányhivatalok Növény- és Talajvédelmi Igazgatóságai  
Regional offices of NFCSO, Directorate of Plant Protection and Soil Conservation  
<http://www.nebih.gov.hu/elerhetosegek>
- MTA ATK Növényvédelmi Intézet  
Plant Protection Institute, Centre for Agricultural Research, Hungarian Academy of Sciences  
Herman Ottó u. 15, H-1022 Budapest, Hungary;  
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[cosvir11@pec.politicheagricole.gov.it](mailto:cosvir11@pec.politicheagricole.gov.it), <http://www.politicheagricole.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/2341>
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Valsts augu aizsardzības dienests

State Plant Protection Service <http://www.vaad.gov.lv/english/contacts/departments.aspx>

**Netherlands:**

Nationaal Referentie Centrum,

Nederlandse Voedsel- en Warenautoriteit (NVWA)

National Reference Centre, NPPO

Netherlands Food and Consumer Product Safety Authority

Ministry of Economic Affairs, Agriculture and Innovation Postbus 9102, 6700 Hc Wageningen, Nederland

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[http://www.wsl.ch/dienstleistungen/waldschutz/index\\_EN](http://www.wsl.ch/dienstleistungen/waldschutz/index_EN)

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## Management and control

In order to limit the spread of *Phytophthora* and the severity of the disease, management and control practices are recommended. Among them, it can be highlighted the following ones:

- ❖ Activities to reduce *Phytophthora* inoculum and/or decrease *Phytophthora* disease severity on trees:
  - Soil biofumigation with brassicas (under-researched control practice; Morales-Rodríguez *et al.*, 2012).
  - Calcium amendments (Serrano *et al.*, 2012).
  - Application of phosphite by aerial, foliar or basal bark sprays and injections has been proven to prevent infection or reduce the severity of symptoms (Hardy *et al.*, 2001). Before you use any kind of chemicals please contact your national authorities (e.g. plant protection services).
- ❖ Activities to reduce *Phytophthora* dispersal (McCabe, 2008):
  - Avoidance of people, livestock, vehicles and machinery movement from *Phytophthora* infested areas to non-infested areas, especially during the wet season.
  - Clean footwear, equipment and wheels of vehicles.
  - Installation of hygiene infrastructures.
  - Restrict travel to only roads and tracks.
  - Use of physical barriers to protect non-infested areas.
  - Restrict soil tilling.
  - Ensure good soil drainage to limit run-off.
  - Avoidance of high densities of livestock which increases soil compaction and run-off.
  - Replace herbaceous crops which host *Phytophthora spp.* with non-susceptible plants.
- ❖ *Phytophthora* disease awareness:
  - Design disease awareness programs.
  - Signposting of *Phytophthora* infested areas.

## Quarantine recommendation

The European and Mediterranean Plant Protection Organization (EPPO) considers *P. ramorum* to be a dangerous organism. It is listed on the EPPO Alert List. For details see [http://www.eppo.int/QUARANTINE/Alert\\_List/alert\\_list.htm](http://www.eppo.int/QUARANTINE/Alert_List/alert_list.htm).

In the European Union *P. ramorum* is a regulated organism according to the Commission Decision 2002/757/EU.

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## Links to further information

*Phytophthora* in the Forests: <http://forestphytophthoras.org/>

*Phytophthora* spp.: <http://www.forestry.gov.uk/fr/INFD-737ESG>,  
<http://oregonstate.edu/instruct/dce/phytophthora/>,  
<http://www.europe-aliens.org/speciesFactsheet.do?speciesId=50625>, [www.eppo.org](http://www.eppo.org)

*Phytophthora* determination keys: <http://apsjournals.apsnet.org/doi/abs/10.1094/PDIS-08-11-0636>

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## Disease symptoms of *Phytophthora* on *Quercus ilex* (holm oak)



### Crown symptoms on *Quercus ilex*

Left: slow decline with a gradual defoliation caused by *P. cinnamomi*

Right: sudden death, showing wilted leaves attached to the branches, caused by *P. cinnamomi*



### Trunk symptoms on *Quercus ilex*

bleeding canker



**Above-ground symptoms on seedlings of *Quercus ilex***

defoliation and leaf discoloration caused by *P. cinnamomi* (left), *P. gonapodyides* (center) and *P. quercina* (right)



**Root symptoms on seedlings of *Quercus ilex***

**Left:** Root rot characterized by the loss of lateral and fine roots, caused by *P. cinnamomi*

**Center:** Root rot caused by *P. gonapodyides*

**Right:** Root rot caused by *P. quercina*