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Sabine WERRES / Seçil AKILLI / Salih MADEN

Phytophthora on *Aesculus hippocastanum* L. (horse chestnut)

Julius Kühn-Institut, Federal Research Centre for Cultivated Plants

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Dr. Georg F. Backhaus, Präsident und Professor
Julius Kühn-Institut, Bundesforschungsanstalt für Kulturpflanzen
Erwin-Baur-Str. 27
D-06484 Quedlinburg
Deutschland

Managing Editor:
Dr. Olaf Hering, Informationszentrum und Bibliothek
Julius Kühn-Institut
Königin-Luise-Str. 19
D-14195 Berlin
Deutschland
E-Mail: redaktion.datasheets@jki.bund.de

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Importance of *Aesculus hippocastanum*

In Europe *Aesculus hippocastanum* L. (horse chestnut) is an important tree species in the roadside, in parks, alleys and in gardens. This tree species grows predominately in the temperate climatic zones (distribution map for *A. hippocastanum* see http://www.discoverlife.org). Horse chestnut is non-native in Central Europe. It originated from mountain forests in Greece, Albany and Bulgaria from where it was introduced to the western parts via Vienna by humans in the 16th century. Horse chestnuts can reach a maximum age of around 200 years.

There are different cultivars of *Aesculus hippocastanum* like 'Baumannii', 'Globosum' and 'Pyramidalis'. *Aesculus hippocastanum* is also a parent of the red flowering hybrid *A.* x *carnea* (Red Horse Chestnut). A famous cultivar of this hybrid is 'Briottii'.

Phytophthora species

From horse chestnut trees with characteristic disease symptoms the following *Phytophthora* species have been isolated directly from the tissue or from the soil:

***Phytophthora* species**	**Disease symptoms**	**Reference**
cactorum	bleeding canker	Caroselli 1953, Werres *et al.* 1995, Intini *et al.* 2002
cambivora	root rot	Brasier & Strouts 1976
citricola	bark canker bleeding canker	Brasier & Strouts 1976, Werres *et al.* 1995
citrophthora	bark necrosis bleeding	Akıllı *et al.* 2011
kernoviae		http://www.fera.defra.gov.uk/plants/plantHealth/pestsDiseases/phytophthora/documents/pKernoviaeHost.pdf
megasperma	root rot	Brasier & Strouts 1976
obscura[1]	bleeding canker	Grunwald *et al.* 2011
ramorum[2]	stem canker	Sansford & Woodhall 2007 http://rapra.csl.gov.uk/objectives/wp1/natural-hostresults.cfm
spec.	dead roots	Anonymus 1970

1 - formerly described as *P. syringae* (Werres et al., 1995)
2 - in the European Union *P. ramorum* is a regulated organism (see chapter 'Quarantine recommendation')

In infection trials with detached leaves *Aesculus hippocastanum* could also be infected by *P. kernoviae*. In Europe *P. ramorum* and *P. kernoviae* are regulated organisms (see chapter 'EPPO quarantine recommendation').

Most of these *Phytophthora* species isolated from diseased horse chestnuts have a wide host range. That means it cannot be excluded that they attack other tree species in the surroundings.

Disease symptoms (see figures)

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

Crown: small leaves, yellow discoloration of the leaves, wilting; usually the whole crown shows the disease symptoms
Stem: bleeding canker, cambium necrosis; the bleeding can be visible at single spots on the bark ("tarry spots") but can also be large dark areas surrounding the stem
Roots: root rot

Usually the crown shows the first visible symptoms, followed by bleeding, mainly at the stem base. Disease symptoms can develop over years and can remain undetected at the beginning of the disease.

Possibility of Symptom Confusion

The disease symptoms presented in the previous chapter are not specific only for *Phytophthora* infection. Other pathogens like *Pseudomonas syringae* pv. *aesculi* can cause very similar symptoms. Bacteria, insects and mechanical damage can also cause bleeding; fungi like *Verticillium* can cause wilting (mainly single branches), *Armillaria* species occasionally also cause bleeding cankers. To specify the cause of the disease samples must be examined in the laboratory.

Disease development

Disease development can be very slow and can continue over years. *Phytophthora* species can kill the horse chestnuts but don't do that in every case. Depending on the genetic tolerance of the tree, the tree physiology, the climate and the general condition of the tree, it can sometimes survive and recover from the *Phytophthora* attack. Very often the infected horse chestnuts die because secondary pathogens attack the weakened trees. If these pathogens are wood killing fungi the road safety of the trees is no longer guaranteed.

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 (BWF)
  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
- Instituut voor Landbouw- en Visserijonderzoek (ILVO), Eenheid Plant -Gewasbescherming
  Institute for Agricultural and Fisheries Research, Plant Sciences Unit – Crop Protection - Gewasbescherming
  Burg. van Gansberghelaan 96 bus 2, 9820 Merelbeke
  Kurt HEUNGENS | kurt.heungens@ilvo.vlaanderen.be

Bulgaria:

- Българска Агенция по безопастност 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
  8 Dragan Tsankov blvd., 1164 Sofia
  Славчо Славов, sbslavov@abi.bg
  Slavtcho SLAVOV | sbslavov@abi.bg

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

Denmark:

- NaturErhvervstryrelsen, 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

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/
- Metsäntutkimuslaitos
  Finnish Forest Research Institute
  P.O. Box 18, FI-01301 Vantaa
  Anna RYTKÖNEN | anna.rytkonen@metla.fi
- Maa- ja elintarviketalouden tutkimuskeskus MTT
  Agrifood Research, MTT
  FI-31600 Jokioinen
  Päivi PARIKKA | paivi.parikka@mtt.fi.

France:

- 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
  Renaud IOOS | 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:

- Pflanzenschutzdienstellen der Bundesländer, Adressenliste siehe:
  regional plant protection services, address list see: http://www.jki.bund.de/de/startseite/unser-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)
  Messeweg 11/12, 38104 Braunschweig, Germany
  http://www.jki.bund.de
  Sabine WERRES | sabine.werres@jki.bund.de

Greece:

- Ινστιτούτο Δασικών Ερευνών, 570 06 Βασιλικά, Θεσσαλονίκη, Ελλάς
  Forest Research Institute, 570 06 Vassilika, Thessaloniki, Greece
  http://www.fri.gr, Στέφανος ΔΙΑΜΑΝΤΗΣ | info@fri.gr
- Ινστιτούτο Μεσογειακών Δασικών Οικοσυστημάτων & Τεχνολογίας Δασικών Προϊόντων, Τέρμα Αλκμάνος, 115 28 Ιλίσια, Αθήνα, Ελλάς
  Institute of Mediterranean Forest Ecosystems & Forest Products Technology, Terma Alkmanos, 115 28 Ilissia, Athens, Greece
  http://www.fria.gr, Παναγιώτης ΤΣΟΠΕΛΑΣ | tsop@fria.gr
- Γεωπονικό Πανεπιστήμιο Αθηνών, Εργαστήριο Φυτοπαθολογίας, Ιερά Οδός 75, 11855 Αθήνα
  Agricultural University of Athens, Laboratory of Plant Pathology, Iera Odos 75, 11855 Athens, Greece
  http://www.aua.gr/index.php, Επαμεινώνδας ΠΑΠΛΩΜΑΤΑΣ | epaplom@aua.gr
- Μπενάκειο Φυτοπαθολογικό Ινστιτούτο, Στεφάνου Δέλτα 8, Κηφισιά, Αθήνα, 14561
  Benaki Phytopathological Institute, 8 Stefanou Delta Street, Kifissia, Athens, 14561
  http://www.bpi.gr, Ειρήνη ΒΛΟΥΤΟΓΛΟΥ | I.Vloutoglou@bpi.gr

Hungary:

- 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;
  József BAKONYI | bakonyi.jozsef@agrar.mta.hu

Ireland:

- Department of Agriculture, Food and the Marine, Horticulture and Plant Health Division
  Backweston Agri-Campus, Celbridge, Co. Kildare, Ireland
  oliver.mcevoy@agriculture.gov.ie

Italy:

- COSVIR XI - Servizio fitosanitario centrale
  Italian Phytosanitary Service
  cosvir11@pec.politicheagricole.gov.it, http://www.politicheagricole.it/flex/cm/pages/Ser veBLOB.php/L/IT/IDPagina/2341
- Dipartimento per la Innovazione nei sistemi Biologici, Agroalimentari e Forestali, Università degli Studi della Tuscia
  DIBAF-Department for Innovation in Biological, Agro-food and Forest systems, University of Tuscia
  Via S. Camillo de Lellis snc
  01100 Viterbo- Italy
  Anna Maria VETTRAINO| vettrain@unitus.it
- Dipartimento di Gestione dei Sistemi Agroalimentari e Ambientali
  Sezione Patologia vegetale, Università di Catania
  Department of Agri-food and Environmental Systems Management, University of Catania
  Via Santa Sofia, 100 95123 Catania Italy
  Santa Olga CACCIOLA | olgacacciola@unict.it

Latvia:
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
Johan MEFFERT | j.p.meffert@minlnv.nl

Norway:
Bioforsk Plantehelse
Norwegian Institute for Agricultural and Environmental Research,
Plant Health and Plant Pro tection Division
Høgskoleveien 7, 1432 Ås, Norway;
Venche TALGØ | venche.talgo@bioforsk.no

Poland:
Instytut Ogrodnictwa
Research Institute of Horticulture, Dept. of Ornamental Plant Protection
Konstytucji 3 Maja 1/3, 96-100 Skierniewice
Leszek B. ORLIKOWSKI | leszek.orlikowski@inhort.pl

Portugal:
- Instituto Nacional de Investigação Agrária e Veterinária-UEIS-SAFSV
National Institute for Agrarian and Veterinarian Research
Quinta do Marquês, Av. da República, Nova Oeiras, 2780-505 Oeiras
Ana Cristina MOREIRA & Amélia LOPES | cristina.moreira@iniav.pt ; amelia.lopes@iniav.pt
-Direção Geral de Alimentação e Veterinária
Directorate General of Food and Veterinary
Tapada da Ajuda, Ed. 1, 1349-018 Lisboa
Paula CARVALHO | pcarvalho@dgav.pt

Romania:
Institutul de Cercetari si Amenajari Silvice - ICAS,
Forest Research and Management Institute
Statiunea Brasov; Closca 13, 500040, Brasov, Romania,
Danut & Florentina CHIRA | florichr@yahoo.com, chira@rdsbv.ro

Serbia:

- Институт за шумарство, Одељење за заштиту шума
  Institute of Forestry, Department of Forest Protection Kneza Višeslava 1
  11030 Belgrade, Serbia www.forest.org.rs
- Institut za nizijsko šumarstvo i životnu sredinu, Zaštita šuma
  Institute of Lowland Forestry and Environment, Forest Protection Antona Čehova 13,
  21000 Novi Sad, Serbia
  www.ilfe.org

Slovenia:

Kmetijski inštitut Slovenije Agricultural Institute of Slovenia Hacquetova 17, 1001 Ljubljana, Slovenia Alenka MUNDA | alenka.munda@kis.si

Spain:

Grupo de Investigación en Hongos Fitopatógenos, Instituto Agroforestal Mediterráneo, Universitat Politècnica de València
Polytechnic University of Valencia (UPV), Mediterranean Agroforestal Institute (IAM), Research group on Plant Pathogenic fungi
Camino de Vera s/n, 46022 Valencia, Spain
Ana Mª PÉREZ-SIERRA | aperesi@eaf.upv.es

Sweden:

SLU, Institutionen för Skoglig Mykologi och Växtpatologi
Dept. of Forest Mycology and Plant Pathology
Box 7026, 750 07 Uppsala
Jan STENLID | Jan.Stenlid@slu.se

Switzerland:

Eidg. Forschungsanstalt für Wald, Schnee und Landschaft (WSL)
Competence Center of Forest Protection (WSL)
http://www.wsl.ch/dienstleistungen/waldschutz/index_EN

Turkey:

- Çankırı Karatekin Üniversitesi, Fen Fakültesi, Biyoloji Bölümü, Çankırı, Türkiye
  Çankırı Karatekin University, Faculty of Science, Department of Biology, Çankırı, Turkey
  Seçil AKILLI | secilakilli@gmail.com
- Ankara Üniversitesi, Ziraat Fakültesi, Bitki Koruma Bölümü, 06100, Kalaba, Ankara, Türkiye
  Agricultural Faculty of Ankara University, Department of Plant Protection 06100, Kalaba, Ankara, Turkey
  Salih MADEN | salihmaden@hotmail.com

United Kingdom:

- Tree Health Diagnostic & Advisory Service, Forest Research, Northern Research Station, Roslin, Midlothian EH25 9SY; ddas.nrs@forestry.gsi.gov.uk
- Tree Health Diagnostic & Advisory Service, Forest Research, Alice Holt Lodge, Wrecclesham, Farnham, Surrey GU10 4LH; ddas.ah@forestry.gsi.gov.uk

Management and control

For direct control with chemicals contact your national authorities (see chapter above). If feasible, the following measures might help to prevent infection and to keep the trees healthy: no stagnant moisture, optimum nutrition and soil aeration. Twig and branch cutting should not be done in wet periods to enable a quick drying of the wound and a quick periderm development. Injury of the stem, for example, by mechanical weed control should be avoided. Although *Phytophthora* species can invade plant tissue actively any kind of wounds increases invasion potential. Planting flowers around the tree stems can result in damp soil favorable for infection and can increase inoculum level if the flowers are hosts of *Phytophthora* species known to attack horse chestnuts.

Quarantine recommendation

The European and Mediterranean Plant Protection Organization (EPPO) consider *P. ramorum* and *P. kernoviae* to be dangerous organisms. Both are listed on the EPPO Alert List. For details see 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.

Literature used

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Links to further information

Aesculus hippocastanum: http://en.wikipedia.org/wiki/Aesculus_hippocastanum, http://www.baumkunde.de/

Phytophthora in the Forests: http://forestphytophthoras.org/

P. ramorum: www.suddenoakdeath.org, http://rapra.csl.gov.uk/, http://www.eppo.int/QUARANTINE/Alert_List/alert_list.htm

P. kernoviae: http://www.fera.defra.gov.uk/plants/plantHealth/pestsDiseases/phytophthora/pKernoviae/, http://www.eppo.int/QUARANTINE/Alert_List/alert_list.htm

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

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Authors

Sabine WERRES[1], Seçil AKILLI[2], Salih MADEN[3]

[1] Julius Kühn-Institut – Federal Research Centre for Cultivated Plants (JKI), Institute for Plant Protection in Horticulture and Forestry (JKI-GF), Messeweg 11/12, 38104 Braunschweig, Germany; sabine.werres@jki.bund.de

[2] Çankırı Karatekin University, Faculty of Science, Department of Biology, Turkey; secilakilli@gmail.com

[3] Agricultural Faculty of Ankara University, Department of Plant Protection 06100, Kalaba, Ankara,Turkey; salihmaden@hotmail.com

Disease symptoms of *Phytophthora* on *Aesculus hippocastanum* (horse chestnut)

Left: Tree (right) infected with *P.* spec. showing pale green leaves (2)
Center: Twig decline caused by *P. spec.* (2)
Right: Declining tree infected with *P. citrophthora* (1)

Examples for bleeding canker and cambium necrosis caused by *Phytophthora* at the stem base

From left to right:
- Bleeding canker caused by *P.* spec. (2)
- Bleeding canker caused by *P. citrophthora* (1)
- Cambium necrosis caused by *P.* spec. (2)
- Cambium necrosis caused by *P. citrophthora* (1)

Photos: (1) – S. AKILLI, S. MADEN; (2) – S. WERRES