Forestry Commission

Contingency plan for Sweet Chestnut Blight – (*Cryphonectria parasitica*)

INTRODUCTION

1. Outbreaks of serious or significant pests require strategic-level plans developed at a national level, describing the overall aim and high-level objectives to be achieved, and setting out the response strategy to either eradicate or contain the outbreaks.

2. Following identification by the UK Plant Health Risk Register, the Plant Health Risk Group (PHRG) has commissioned pest-specific contingency plans for those pests that pose the greatest risk and require stakeholder consultation. This includes *Cryphonectria parasitica* (sweet chestnut blight). The Forestry Commission is also prioritising other plans that require updating.

3. The purpose of these pest-specific contingency plans is to ensure a rapid and effective response to an outbreak of the pest or disease described.

4. Contingency planning starts with the anticipation and assessment of potential threats, includes preparation and response, and finishes with recovery.

Anticipate

5. Sources of information and intelligence about the pest, including horizon scanning.

Assess

6. Identifying concerns and the preparation of plans.
7. Setting outbreak objectives.

Prepare

8. Ensuring staff and stakeholders are familiar with the pest.

Response

9. The requirements to either contain or eradicate, including work to determine success.

Recovery

10. When the response strategy has been effective or when the response is not considered feasible, cost effective or beneficial.

11. The Defra Contingency Plan for Plant Health in England (in draft) gives details of the teams and organisations involved in pest response in England and their responsibilities and governance. It also describes how these teams and organisations work together in the event of an outbreak of a plant health pest.

The purpose of Pest-Specific Contingency Plans is to ensure a rapid and effective response to an outbreak of the pest or disease described.

Scope

This contingency plan was prepared by the Forestry Commission Plant Health Cross-Border team to be used at both country and national levels. It should be used in England in conjunction with the Defra Plant Health Contingency Plan, which is being developed by Defra/APHA and which provides details as to the level of response required and by whom, depending on the scenario. Forestry Commission England (Forest Service) will use OGB17b 'Managing Incidents in the Forestry Commission' for relevant incidents. The Scottish Government has a generic plan in place which is under review, and the Welsh Government will develop similar documents detailing its management of outbreaks. When an outbreak becomes of UK-wide concern, the UK Chief Plant Health Officer will form an outbreak management team to co-ordinate the activities in the different countries. Sweet chestnut blight infections that occur in non-woodland situations are managed by the Plant Health & Seeds Inspectorate (PHSI) of Apha.

This contingency plan falls into three main parts:

- official action following a presumptive diagnosis;
- official action following the confirmation of an outbreak; and
- background information about the pest.

This plan will be updated following new information, lessons identified from outbreaks of other pests, or changes in policy or contact details. (It was last updated in December 2015).

Objectives of this plan

- In the event of a **new** outbreak, to raise awareness of the potential threat posed by *Cryphonectria parasitica,* and therefore ensure that stakeholders are aware of the symptoms caused by this pathogen.
- To provide guidance on steps to be taken whenever symptoms of infection by *Cryphonectria parasitica* are observed.
- To ensure that infections of *Cryphonectria parasitica* are managed effectively.
- To ensure that all relevant Forestry Commission staff, other government agencies and local authorities are conversant with the contents of this Contingency Plan so that effective and immediate action is implemented when the pathogen is first suspected.
- To ensure that good communications are put in place so that all stakeholders (including the media) are kept fully informed of the scale and management of the outbreak, both at regional and national levels.

Anticipation & Assessment

1.1. Chestnut blight is a fungal disease caused by the ascomycete fungus *Cryphonectria parasitica*. The biology, risks and threats posed by the fungus to the UK, including spread and potential damage, have been evaluated in a recent pest risk analysis (PRA) available on the UK Risk Register. This PRA, together with information in Appendix 1, should be referred to in order to provide background information which will guide decision making. The pathogen has also been evaluated in the UK Risk Register.

1.2. It is native to Far East Asia, but has been introduced into North America and Europe, being first reported in Europe in Italy in 1938.

1.3. Infection usually occurs via bark cracks or wounds in woody tissue, such as those from grafting.

1.4. It has caused massive losses to American sweet chestnut (*Castanea dentata*) in the USA, and has been found infecting European sweet chestnut (*C. sativa*) in Europe.

1.5. It can also infect oak, although there is no evidence that it causes mortality, so the movement of all untreated oak wood oak from suspected or confirmed areas of infection should be restricted.

1.6. It is officially absent from the UK, although there have been ten findings of the pathogen, all associated with new planting stock. (See UK Risk Register entry).

Preparation

2.1. *Cryphonectria parasitica* is listed in Annex II/AII of the EC Plant Health Directive (Council Directive 2000/29/EC). It is also an A2 quarantine organism for EPPO (OEPP/EPPO, 1982), and of quarantine significance for NAPPO and IAPSC.

2.2. Under the Plant health (England) (Amendment) (No.3) order, 2013, the UK (except the Isle of Man) has protected zone status.

2.3. *C. parasitica* has been placed on the UK Plant Health Risk Register, with an unmitigated risk rating of 60/125.

Response

Legislation

3.1. A list of the relevant legislation which may influence a response is listed in appendix 3.

OFFICIAL ACTION FOLLOWING A PRESUMPTIVE DIAGNOSIS

Trigger

3.2. A new outbreak is determined as the presence of an infected tree, either as an import intercepted at port or in the wider environment. This can reported by port inspectors, nursery growers, woodland owners or members of the public.

Determining the response

3.3. In England, a duty officer (from FC England or APHA) will act as a point of contact for incidents, and it is their job to assign a response officer to incidents when they occur. Similar arrangements are expected to be in place in Scotland and Wales. The response officer investigates and reports back to the Defra Contingency Core Group. For outbreaks in Scotland and Wales, respective country teams will fully manage the outbreak as per their own generic contingency plans, but will provide updates to the Defra Contingency Core Group for information purposes and for Defra to report to ministers and the European Commission (EC).

3.4. The response officer will gather information including the location, likely origin, host or commodity, level of damage, extent of outbreak and chance of spread. The contingency core group will comprise plant health officials and specialists from the risk group. Based on the information fed back to the contingency core group, in England they will decide upon the alert status given (black, amber or red), which will determine the level of response. (See Appendix 2 for alert status table). In Scotland and Wales, the core contingency group can advise on alert status and the appropriate response. If required, the contingency core group will request the relevant organisation/s to set up an incident management team to resolve the incident.

Holding consignments and movement / planting restrictions

3.5. Until further investigation, no material shall leave the site and local operations will be halted until such time as the suspected case is confirmed as a false alarm, until the outbreak has been eradicated, or until such time as it is determined that such a restriction no longer serves a useful purpose.

Preliminary trace forward / trace backward

3.6. The most likely source of entry is the importation of live trees from continental Europe. Depending upon the pathway of entry, tracing forwards and backwards to identify suspect material will be conducted to identify other potentially contaminated stock or sites. This will include suppliers, propagators and wholesalers, including any clonally related or potentially contaminated stocks, where appropriate. Such work would be carried out by the PHSI.

3.7. Other pathways to consider are timber imports and seeds, although live plants are the most likely source of the pathogen.

How to survey to determine whether there is an outbreak

3.8. An outbreak of *C. parasitica* is most likely to be detected through general surveillance, nursery inspections, or a report from a forestry or arboricultural practitioner, or possibly a member of the public, describing sweet chestnut trees with symptoms. Confirmation that *C. parasitica* is present will require examination of samples, laboratory diagnosis and follow-up inspections.

3.9. Follow-up inspections, either by APHA for non-woodland situations or a Forestry Commission England Plant Health Officer for woodlands, should gather information on:

- the likely origin of the disease and, if a consignment of plant and plant product is suspected to be at the origin of the outbreak, details such as other points of destination;
- the geographical location and ownership of the affected site, including any abiotic factors that might influence the outbreak, e.g. public access, presence of watercourses, etc. Include maps if possible;
- the hosts infested at the site (species, variety, development stage, etc.);
- when and how the disease was detected and identified (including photographs of symptoms);
- the level of disease incidence;
- the extent and impact of damage (including part of host affected);

- any recent importation or movements of host plants or host plant products into and out of the affected site;
- any movement of people, products, equipment and vehicles into or out of the affected site where appropriate;
- any relevant treatments applied to host plants that might affect development of symptoms or detection and diagnosis of the disease;
- the history of the disease on the site, at the place of production or in the area; and
- the likely biodiversity impacts of any control, including any duty of care obligations under the Natural Environment and Rural Communities (2006) Act.

3.10. Suspect material from infected trees in the wider environment should be either:

(a) triple wrapped in robust plastic bags; or

(b) double wrapped in robust plastic bags and the bags placed inside a secure box or vial and sent immediately to the Tree Health Diagnostic & Advisory Service at Forest Research for diagnosis. Suspect vectors should be preserved in alcohol and sent in a similar manner. The samples should be accompanied by information about the date when the samples were collected, the location (address, postcode, GPS) and contact details of the person collecting the samples. The address is: Tree Health Diagnostic & Advisory Service, Forest Research, Alice Holt Lodge, Gravel Hill Road, Wrecclesham, Farnham, Surrey, GU10 4LH.

Samples collected from nurseries by APHA's PHSI staff should be sent to Fera Science for analysis.

Confirmation of a new outbreak

3.11. Positive identification of *C. parasitica* can only be made in the laboratory, but on-site inspection by a Forest Research pathologist or experienced plant health officer (FC, NRW, APHA) is part of the confirmation process. Samples should not be removed from the site unless done so by an individual trained and with the relevant safety equipment to do so.

3.12. An outbreak of *C. parasitica* should be declared when a positive identification is associated with: (1) the discovery of symptomatic material (living trees, plants for planting, bark, wood) of *Castanea*; (2) DNA-based molecular confirmation of the presence of *C. parasitica* in such material, using an internationally accepted protocol; and (3) a living culture of *C. parasitica* is obtained from the suspect material and confirmed using the same DNA-based method. All three must be met in order to confirm an outbreak.

OFFICIAL ACTION FOLLOWING THE CONFIRMATION OF AN OUTBREAK

Strategic Actions on confirmation

3.13. On positive confirmation, the following should be initiated:

- notify ministers and senior officials;
- set up regular (determined by scale of outbreak) Lead Government Department (LGD) meetings to keep partners aware of current status, actions and possible future requirements and to agree communications strategy;
- notify EU and others; and
- discuss with stakeholders.

3.14. In most instances the Forestry Commission (England and Scotland) is likely to appoint an Incident Controller and an Incident Management Team. In Wales the Welsh Government would take the lead. Forestry Commission England Forest Services will follow the Defra Generic Contingency Plan for Plant Health Pest and Disease Outbreaks which will be enacted in response to a confirmed *C. parasitica* outbreak. Forestry Commission Scotland and the Welsh Government will have similar documents detailing their management of outbreaks.

3.15. Initial efforts will be towards eradication of new outbreaks following the procedures set out below. Failing eradication, efforts will concentrate upon containment.

Communication

3.16. The Incident controller will set up a management structure to deliver functions of incident management. The management structure will be determined by the size and nature of the outbreak. Identification of and liaison with key stakeholders is a crucial part of this process.

Surveillance

3.17. A delimiting survey will be set up as soon as possible after the first finding of *C. parasitica* to determine the geographic limits of the infested area, and to demarcate a regulated area. There are two elements to the delimiting survey:

- an intensive survey of all sweet chestnut (*Castanea sativa*) trees within at least a 1km radius of the first tree(s) found to be infected; and
- if symptomatic trees are found within that area, the other significant host species, oak (*Quercus*) in the survey area should be surveyed.

3.18. Depending on the location and distribution of sweet chestnut in the area, the IMT will decide on who should conduct the surveillance work. Surveys should focus first on sweet chestnut trees, because these are most likely to show typical symptoms, including fruiting bodies. Surveys should include inspection of any logs previously cut from trunks and branches of sweet chestnut, because these might also be colonised by the fungus and show evidence of fruit bodies (visible as yellow-orange to reddish-brown pustules). Sweet chestnut trees showing canopy thinning and dieback should be examined carefully for any other typical symptoms, including fruit bodies or mycelial fans under the bark.

3.19. If more trees are found to be infected, the surveys should be extended so that the intensive survey covers all *Castanea* trees out to at least 1km from the new infected trees. This process should be continued to provide a preliminary assessment of the infested area, and should be repeated up to three years after removal of infected material to monitor the possibility of reoccurrence or spread of *C. parasitica,* and to update the boundaries of the infestation and regulated area.

Demarcated zones

3.20. A statutory regulated area should be established as soon as possible after the discovery of an outbreak of *C. parasitica*, to help minimise spread of the pest within the infected area, and to prevent human-assisted transport to areas outside the infested area. An initial regulated area of 5km radius around the infected trees will need to be established, within which measures to prevent the movement of potentially infected chestnut material should be implemented. These measures should include a prohibition on the movement of untreated chestnut wood (including firewood, roundwood, sawn wood, wood chips, waste wood and arboricultural arisings). It should also include chestnut plants for planting from the infected area to the rest of the regulated area, and from the regulated area to regions outside the regulated area. Subsequently, the size of the regulated area might need to be increased, depending on the spread of *C. parasitica*. As oak is a carrier for *C. parasitica*, there should also be a prohibition on the movement of untreated oak wood (including firewood, roundwood, sawn wood, wood chips, waste wood and arboricultural arisings), and plants for planting of oak from the infected area.

3.21. Nurseries within the demarcated zone will be inspected for the presence of *C. parasitica,* and any plant passporting for sweet chestnut plants (*Castanea sativa*) will be suspended until the presence or absence of the pathogen both within the nursery and within the zone can be determined.

Tracing forwards / backwards

3.22. If the infected trees have been recently planted (i.e. within the previous five years)the source of the plants must be traced back, if possible, to the supplying nursery, and the nursery visited and inspected for the presence of *C. parasitica*. In addition, any supplies of sweet chestnut planting material from the nursery over the previous five years should be traced to the final planting site, and inspected for the presence of *C. parasitica*.

Pest management procedures

3.23. Depending on the location of the new outbreak, statutory plant health notices (SPHNs) will be issued, either by the Forestry Commission in woodland situations or by APHA in non-woodland situations. Timely issue of, and response to, SPHNS, and subsequent action, are vital if new outbreaks are to be contained and eradicated. It should be made clear at the outset that the costs of any remedial actions required will be borne by the landowner. The Forestry Commission or APHA will need to consider whether direct intervention by government is required to ensure a rapid response to reduce the risk of spread.

3.24. The management programme should focus on monitoring and removing infected sweet chestnut trees to eradicate the disease. As soon as possible after the outbreak is discovered, and at least annually thereafter for a minimum of three years, all sweet chestnut trees within the known affected area should be assessed during mid to late summer for bark cankers, signs of dieback, and fruit bodies of the fungus. Assessing trees for symptoms can be based on visual, ground-based surveys. Trees confirmed as affected should be removed as soon as possible fruit bodies have been observed during both summer and winter months in England. (Observations on recent plantings; disease now eradicated).

3.25. Control methods used against *C. parasitica* include exclusion and eradication, chemical control, host genetic resistance, and biological control (hypovirulence). Hypovirulence in *C. parasitica* is a reduction in virulence that results from infections by fungal viruses in the family *Hypoviridae.* It can also weaken and slow down chestnut blight by reducing the pathogenicity (virulence or aggressiveness) of the fungus. The most successful control methods of *C. parasitica* in the EU are exclusion, eradication and use of viruses that cause hypovirulence. In general, fungicide treatments against chestnut blight, although sometimes effective, do not appear to be used in countries where the disease occurs, and they are not recommended, because they are likely to have undesirable side effects on the environment, especially if applied on a large scale. There are no approved fungicides for treatment of *C. parasitica* registered in the UK.

Disposal

3.26. Chestnut and oak trees, including the branches, roundwood, wood chips and associated debris, which are to be felled to eradicate *C .parasitica* infection should be destroyed, preferably on site, by either:

- burning in a nearby location within the demarcated area designated for this purpose. (Burning must comply with appropriate Waste Management regulations provided by the Environment Agency in England, Scottish Environment Protection Agency or Natural Resources Wales. No more than 10 tonnes can be burnt per 24 hours without approval from the Environment Agency or SEPA); or

- deep burial (minimum 2m depth) within the demarcated site.

3.27. If material has to be moved from the site, it should be transported, with a protective covering ensuring that all material is contained, to a licensed incinerator or to an approved landfill site for deep burial.

Public outreach

3.28. It is crucial to have public support for the management programme and to help with general surveillance. Engaging the public will require the provision of timely, balanced and accurate information regarding monitoring and control. It can also provide opportunities for the public to participate in monitoring and reporting suspect trees using the reporting tool Tree Alert. Information, subject to available budget, can be made available through newspapers, radio, TV, the internet and social media, and should be targeted locally, especially within the infested and regulated areas, and at a national level.

3.29. It is important to provide information on the location and size of the infected and regulated areas, statutory and voluntary responsibilities, rates of spread, management options, pathways and how the disease might have arrived and could be spread, and the wider effects on British forestry. Managing this level of public engagement will require a central communications office capable of handling large numbers of enquiries and able to provide general and specific information. Liaison with

communications and press teams from other countries might be required for cross-border outbreaks.

Review measures in the case of prolonged official action

3.30. Efforts should shift to containment if eradication proves unachievable, and the focus should move to a plan for containing the outbreak as much as possible. A review of the management programme should be undertaken regularly (e.g. annually) to determine the success and cost-effectiveness of the measures in the longer term. This review will involve consultation with stakeholders and should include:

- evaluation of the effectiveness of current measures;
- evaluation of the economic impact and cost-effectiveness of continuing existing measures;
- consideration of further measures to strengthen containment and eradication actions;
- consideration of statutory obligations and impact on import and export procedures;
- consideration of alternative approaches or the cessation of statutory action; and
- consideration of the impacts of control methods on biodiversity.

3.31. In circumstances where official action is no longer considered appropriate, stakeholders should be consulted and a timetable and mechanism agreed for the removal of official measures and for the dissemination of pest management information as appropriate.

Criteria for declaring / change of policy

3.32. Policy changes should be considered in light of the following:

- changes in the geographic distribution of *C. parasitica*;
- new or updated research information on the disease species range and lifecycle; and
- identification of any new pathways.

Evaluation and review of the contingency plan

3.33. Plan to be reviewed annually to take account of:

- any new legislative measures, or amendments to measures, implemented to reduce the risk of introduction;
- changes in the geographic distribution of *C. parasitica*;
- new or updated research information on the range and life cycle of *C. parasitica*;
- any new pathways; and
- lessons identified from other outbreaks which will improve this plan and any Standard Operating Procedures (SOPs) or Operational Guidance.

The plan should only be re-consulted upon if significant new information is presented which affects the approach to the management of an outbreak.

Recovery

4.1. A site can be deemed as recovered from an outbreak if, after three years of monitoring, there are no indications of disease presence.

Appendix 1: PEST BACKGROUND INFORMATION

Identity of organism and quarantine status

Species name: *Cryphonectria parasitica* (Murrill) Barr
(Ascomytes: Diaporthales)

Synonyms: *Diaporthe parasitica* Murrill
Endothia parasitica (Murrill) P.J. & H.W. Anderson

Common name: Sweet Chestnut Blight

UK risk rating: Unmitigated 60/125 Mitigated 30/125

EU status: *Cryphonectria parasitica* is listed in Annex II/AII of the EC Plant Health Directive (Council Directive 2000/29/EC). It is also on the EPPO A2 List of pests recommended for regulation.

The status of *Cryphonectria parasitica* has also recently been reviewed by EFSA (European Food Safety Authority) as part of the European Commission revision of the regulatory status of organisms listed in the Annexes of Directive 2000/29/EC, see

http://www.efsa.europa.eu/en/efsajournal/doc/3859.pdf

UK status: Has UK protected zone status, officially absent

Hosts

Species of *Castanea* are considered the most important taxa affected by *C. parasitica* and the most susceptible species are *C. dentata* (American chestnut), and *C. sativa* (European chestnut). Asian chestnut species such as *C. mollissima* and *C. crenata* are largely blight resistant, but can become infected, as can other Asian species of *Castanea*. Oaks can also be affected, although the symptoms tend to be mild. Most known hosts are within the Fagaceae group.

Hosts in Europe:

***Castanea sativa* (sweet chestnut)**
***Quercus robur* (pedunculate oak)**
***Quercus petraea* (sessile oak)**

***Quercus ilex* (holm oak)**
***Quercus pubescens* (downy oak)**
***Alnus cordata* (Italian alder)**
***Ostrya carpinifolia* (hop hornbeam)**

Hosts in North America:

***Castanea dentata* (American chestnut)**
***Castanea pumila* (American chinquapin)**
***Castanea alnifolia* (bush chinquapin)**
Castanea paupispina
***Carya ovata* (shagbark hickory)**
***Quercus coccinea* (scarlet oak)**
***Quercus rubra* (northern red oak)**
***Quercus stellata* (post oak)**
***Quercus virginiana* (southern live oak)**
***Rhus typhina* (staghorn sumac)**

Hosts in the native region in East Asia:

***Castanea mollissima* (Chinese chestnut)**
***Castanea crenata* (Japanese chestnut)**
***Castanea davidii* (Père David's chestnut)**
***Castanea henryi* (Henry's chestnut)**
***Castanea seguinii* (Seguin's chestnut)**
***Castanopsis chrysophylla* (giant chinquapin)**

Life history

C. parasitica attacks healthy trees, but can only infect via wounds or bark fissures, so cankers are often associated with a cut branch stub, a branch point on the stem, or a graft point. Cankers and fruiting bodies can form under the ties or labels on trees grown on in nurseries, if they are staked. Once it has entered a susceptible host, the fungus can spread rapidly, killing bark and causing cankers that might eventually girdle the stem or branch. As the infected bark is killed, masses of yellow-orange-brown pustules (stromata) develop on infected bark. These contain the fruit bodies of the fungus. Two types of spore-forming fruit bodies can be formed – conidiomata, which produce spores called conidia, and ascomata, which produce ascospores. The conidiomata erupt through lenticels,

and extrude long orange-yellow tendrils of conidia, usually under conditions of high humidity. The ascospores are disseminated in air currents and water-splash, and released from infected bark mainly in the spring and early summer usually after rain. Conidia are primarily spread through rain-splash and by casual insect vectors (Coleoptera and Diptera). The life cycle is repeated once the spores have been transferred to a suitable wound so that germination and colonisation can occur. Cankers which form on main stems can kill the entire above-ground part of a tree, often within one or 2two years for susceptible *Castanea* spp, although sprouts commonly develop from the root collar after stem death. Apart from dispersal by natural means, the fungus can also be transferred from tree to tree by grafting during propagation.

Identification

All symptoms on infected trees occur above the ground. *C. parasitica* attacks the bark of European sweet chestnut, and enters through fissures or wounds. On grafted trees, infections are most frequently found in the region of the graft, where callusing occurs.

Figures 1 and 2 - varying degrees of severity of cankering associated with grafting. Dr. D. Rigling, Eidg. Forschungsanstalt für Wald, Schnee und Landschaft (WSL), Switzerland.

In coppices or orchards, infections are often located at the base of the stem (collars or insertion points), although they do not spread into the root system.

The fungus can spread with such rapidity in infected bark that stems or branches are soon girdled and the dead bark becomes visible as a sunken canker. Above the girdling canker, leaves wilt and turn brown, but remain hanging on the tree.

Figure 3 – Stem girdling causing branch wilting. Dr. D. Rigling, Eidg. Forschungsanstalt für Wald, Schnee und Landschaft (WSL), Switzerland.

Below the canker, branches have healthy foliage and, after a short time, new shoots are produced below the area of dead bark. It is common to find many cankers on a single tree.

Figure 4 – growth of epicormic shoots below the canker are a clear sign that the canker has girdled the tree. Dr. D. Rigling, Eidg. Forschungsanstalt für Wald, Schnee und Landschaft (WSL), Switzerland.

On young, smooth-barked branches the cankered bark can be a bright brown, in contrast to the greenish colour of normal bark. On older stem infections, the discoloration or sunken nature of the infected bark is much less obvious. When

the bark is killed rapidly the stem is girdled without any callus formation. However, sometimes the disease's progress is slower, and new layers of bark form under the affected areas, so that swelling and subsequent cracking of the outer bark occurs.


Figures 4 and 5 – canker symptoms on young stems. Dr. D. Rigling, Eidg. Forschungsanstalt für Wald, Schnee und Landschaft (WSL), Switzerland.

Masses of yellow-orange to reddish-brown pustules, the size of a pin-head, develop on infected bark. These fruit bodies erupt through lenticels and exude long, orange-yellow tendrils of spores in moist weather.


Figures 6 and 7 – orange sporulation in bark cracks. Dr. D. Rigling, Eidg. Forschungsanstalt für Wald, Schnee und Landschaft (WSL), Switzerland.

Another characteristic symptom is the formation of pale-brown mycelial fans in the inner bark, although these can only be revealed by cutting away the outer bark.

Figures 8 – characteristic development of mycelial fans under the canker. Dr. D. Rigling, Eidg. Forschungsanstalt für Wald, Schnee und Landschaft (WSL), Switzerland.

Some of the disease symptoms caused by *C. parasitica, such* as crown dieback*,* can be confused with other diseases caused by other pathogens, including *Phytophthora* species*, e.g. Phytophthora cinnamomi* or *P. cambivora* (commonly associated with 'ink disease', named after a blue-black stain found around damaged roots). These pathogens are already present on a range of host plants in the UK, and have been known for many decades to cause disease on sweet chestnut. Other, less common diseases that cause diebacks and cankers on sweet chestnut are forms of *Amphiporthe castanea* (formerly *Cryptodiaporthe castanea)* and *Diplodina castaneae.*

Distribution of the organism

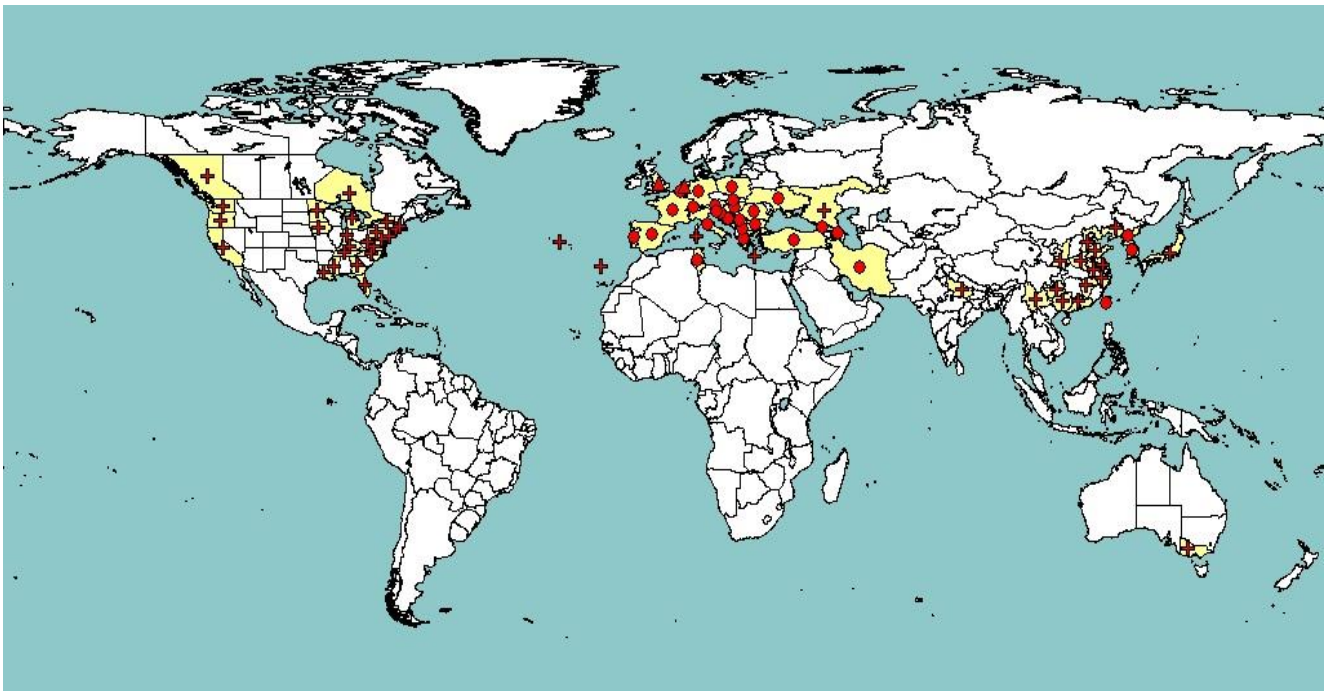

Figure 9 - Distribution of Sweet Chestnut Blight (*Cryphonectria parasitica*) as at December 2015; circles represent national records, crosses represent sub-national records. (EPPO PQR database)

Cryphonectria parasitica is widespread throughout much of its native range in east Asia, including China, Japan, Korea and Taiwan. Since its introduction into the eastern USA, probably in the late part of the 19th century, it has spread to 27 states and extended into Canada. Since *C. parasitica* was first reported in Italy in 1938, it has also spread throughout much of Europe, especially in countries with significant *Castanea* populations. It is now reported present in Albania, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, France, Germany, Greece, Hungary, Italy, Macedonia, the Netherlands, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Switzerland and Ukraine.

Damage impact and controls

In China and other countries in East Asia, the native *Castanea* species are resistant to the chestnut blight pathogen, and although they might become infected, they are seldom killed by the disease. In contrast, in its introduced range in North America and Europe, *C. parasitica* is highly damaging to the native *Castanea* species. In the USA it has caused widespread mortality to the highly susceptible *C. dentata,* with an estimated 4 billion trees lost to the disease 40-50 years after the discovery of the causal agent. Nowadays American chestnut survives mostly as small, understorey trees on which *C. parasitica* is endemic. The native European sweet chestnut, *C. sativa*, is also susceptible, although slightly less so than the American chestnut. Despite this, *C. parasitica* still causes significant disease, including mortality, in chestnut orchards, plantations and woodlands throughout many regions of Europe. Oak can also be infected, and in the USA, *C. parasitica* is an important pathogen of *Q. virginiana* (live oak), *Q. coccinea* (scarlet oak) and *Q. stellata* (post oak). *Cryphonectria parasitica* has also been found infecting native European oak species in some parts of Europe (e.g. Hungary and Switzerland), although the infrequent reports of diseased oaks suggests that European oak species are mainly incidental hosts.

In North America, control has focussed on breeding for resistance using the high levels of blight resistance found in Asian chestnut species and, to a much lesser extent, biocontrol through the use of hypovirulent strains of *C. parasitica* infected with dsRNA hypoviruses to bring about a loss of virulence in the pathogen. In Europe, spread of the dsRNA hypoviruses in *C. parasitica* populations occurs more readily than it does in North America, and operates much more effectively at reducing the impacts of the disease. Disease control in Europe is also helped by the slightly higher level of blight resistance in the European chestnut compared with the American chestnut.

Main pathways

Cryphonectria parasitica has been shown to move along a number of different pathways. In North America infected plants of *Castanea* are considered to have been responsible for the initial introduction, and plants for planting are assessed as a major pathway in the PRA.

Information on pathways is summarised in the Rapid PRA for *C. parasitica* (see https://secure.fera.defra.gov.uk/phiw/riskRegister/plant-

health/documents/rapidAssessmentCryphonectriaParasitica.pdf) and the datasheet produced by CABI (http://www.cabi.org/isc/datasheet/21108)

The pathways covered include the importation and movement of:

- **plants for planting** (excluding seeds) of *Castanea* and *Quercus*;
- **wood with and without bark** of *Castanea and Quercus,* including round wood, sawn wood, firewood and isolated bark;
- **chestnut seeds** (nuts) can carry the fungus, but mainly as an external contaminant; and
- **natural dispersal by spores**, either as wind-borne ascospores or conidia carried in water droplets, or on the bodies of insects, or even birds and mammals.

If introduced and established, *C. parasitica* would be capable of spreading through natural dispersal, albeit probably slowly. Spread could occur much more quickly via movement of infected plants or wood. To prevent the introduction of the pest, the UK is designated a Protected Zone (PZ). This means that only wood which is bark-free can be imported, and the import of bark is prohibited, and plants for planting must originate from an area demonstrated to be free from the pest. In Great Britain, fixed plots have been set up and monitored regularly for the presence of both *C. parasitica* and the non-native Oriental chestnut gall wasp *Dryocosmos kuriphilus.*

Import controls

The movement of round timber and isolated bark into countries with protected-zone status is not permitted unless the timber or bark has been passported and is accompanied by an official statement to show that it has been kiln dried or that the bark has been fumigated.

New requirements for statutory notification of imports of *Castanea* (Sweet Chestnut) - as well as *Platanus* (Plane), *Quercus* (Oak), and *Fraxinus* (Ash) - came into effect on 17 January 2013.

Appendix 2 – Alert status categories – (based on alert status levels for draft Defra generic contingency plan).

ALERT	STATUS	COMMAND LEVEL
White	Plant pest or disease with potential for limited geographical spread	Instigation of incident management plan involving operational command at appropriate level, and implementation of Standard Operating Procedures or scientific advice where applicable
Black	Significant plant pest or disease with potential for limited geographical spread	Instigation of incident management plan, usually involving joint tactical and operational command at appropriate level. Implementation of plant pest/disease-specific response plans where applicable
Amber	Serious plant pest or disease with potential for relatively slow, but extensive, spread leading to host death and/or major economic, food security or environmental impacts	Instigation of incident management plan usually involving joint strategic and tactical command, and plant pest/disease-specific response plans where applicable
Red	Serious or catastrophic plant pest or disease with potential for rapid and extensive geographical spread leading to host death and/or major economic, food security or environmental impacts	Instigation of incident management plan involving strategic, tactical and operational command, and implementation of plant pest/disease-specific response plans where applicable

Appendix 3: Relevant legislation

Domestic:

The Waste Management Licensing (Scotland) Regulations 2011
The Environmental Permitting (England and Wales) Regulations 2010

Natural Environment and Rural Communities Act 2006
Plant Health (Forestry) Order 2005
Plant Health Act 1967
Forestry Act 1967

European:
EC Council Directive 2000/29/EC

References:

Anagnostakis S.L. (1982). Biological control of chestnut blight. Science, 215, 466–471.

Anderson, P.J., & Rankin, W.H. (1914) *Endothia* canker of chestnut. *Cornell University Agricultural Experiment Station Bulletin* No. 347.

Boyce, J.S. (1961) *Forest pathology*, 572 pp. McGraw-Hill Book Company, London, UK.

CABI/EPPO (1982) Data sheets on quarantine organisms No. 69, *Endothia parasitica*. *Bulletin OEPP/EPPO Bulletin* **12** (1).

CABI (Commonwealth Agricultural Bureaux International). (2013). CABI Crop protection compendium: *Cryphonectria parasitica* (blight of chestnut). CABI, Wallingford, UK. Available online: http://www.cabi.org/cpc

Collins J.F. (1915). The chestnut bark disease on freshly fallen nuts. Phytopathology, 5, 233–235.

Cunnington J.H., & Pascoe I.G., (2003). Post entry quarantine interception of chestnut blight in Victoria. Australasian Plant Pathology, 32, 569–570.

Darpoux, H.; Ride, M., & Bondoux, P. (1975) Apparition de foyers d'*Endothia parasitica* sur châtaigniers en France. *Comptes Rendus de l'Académie d'Agriculture de France* **43**, 670-674.

EFSA (European Food Safety Authority). (2014) Scientific Opinion on the pest categorisation of *Cryphonectria parasitica*. EFSA Journal 2014, 12(10), 3859-101. http://www.efsa.europa.eu/en/efsajournal/doc/3859.pdf

EPPO (European and Mediterranean Plant Protection Organization), 2005. *Cryphonectria parasitica*. EPPO Bulletin, 35, 295–298.

EPPO (European and Mediterranean Plant Protection Organization) PQR (Plant Quarantine Data Retrieval system). (2014). EPPO database on quarantine pests. Available online: http://www.eppo.int/DATABASES/pqr/pqr.html

Grente, M.J. (1981) *Les variants hypovirulents de l'*Endothia parasitica *et la lutte biologique contre le chancre châtaignier*, 194 pp. Institut National de Recherche Agronomique, Rennes Cedex, France.

Guérin L & Robin C. (2003). Seasonal effect on infection and development of lesions caused by *Cryphonectria parasitica* in *Castanea sativa*. Forest Pathology, 33, 223–235.

Guérin L., Bastien S. & Chauvin B (1998). The production and dispersal of ascospores of Cryphonectria parasitica (Murrill) Barr in an orchard in south-western France. Acta Horticulturae, 494, 473–480.

Heald F.D. & Studhalter R.A. (1914). Birds as carriers of the chestnut blight fungus. Journal of Agricultural Research, 2, 405–422.

Heald F.D., Gardner M.W., & Studhalter R.A. (1915). Air and wind dissemination of ascospores of the chestnut blight fungus. Journal of Agricultural Research, 3, 493–526.

Heiniger U. & Rigling D. (1994). Biological control of chestnut blight in Europe. Annual Review of Phytopathology, 32, 581–599.

Hepting, G.H. (1974) Death of the American chestnut. *Journal of Forest History* **18**, 60-67.

IMI (1994) *Distribution Maps of Plant Diseases* No. 66 (edition 6). CAB International, Wallingford, UK.

Jaynes, R. A. & DePalma, N.K. (1984) Natural infection of nuts of *Castanea dentata* by *Endothia parasitica*. *Phytopathology* **74**, 296-299.

Marra R.E., Cortesi P., Bissegger M. & Milgroom M.G. (2004). Mixed mating in natural populations of the chestnut blight fungus, Cryphonectria parasitica. Heredity, 93, 189–195.

Milgroom M.G. & Cortesi P. (2004). Biological control of chestnut blight with hypovirulence: a critical analysis. Annual Review of Phytopathology, 42, 311–338.

Myburg, H., M. Gryzenhout, B.D. Wingfield, M.G. Milgroom, S.Kaneko & M.J. Wingfield. (2004). DNA sequence data and morphology define Cryphonectria species in Europe, China, and Japan. Canadian Journal of Botany, 82, 1730-1743.

Nannelli R. and Turchetti T. (1998). Preliminary observations on the association of some species of corticolous Acari with *Cryphonectria parasitica* (Murr.) Barr. Redia, 72, 581–593.

NDP (2011). National Diagnostic Protocol for Chestnut Blight caused by *Cryphonectria parasitica.*

http://plantbiosecuritydiagnostics.net.au/wordpress/wp-content/uploads/2014/09/NDP-11-Chestnut-blight-Cryphonectria-V1.1.pdf

Robin C. & Heiniger U., (2001). Chestnut blight in Europe: diversity of *Cryphonectria parasitica*, hypovirulence and biocontrol. Forest Snow and Landscape Research, 76, 361–367.

Scharf C.S. & DePalma N.K. (1981). Birds and mammals as vectors of the chestnut blight fungus (Endothia parasitica). Canadian Journal of Zoology, 59, 1647–1650.

Smith A.H. (2012). Introduction to chestnut blight. Journal of the American Chestnut Foundation. Special Issue: Chestnut Blight and Blight Resistance, 2, 9–10.

Tarcali G. & Radócz L. (2006). Occurrence of fungus *Cryphonectria parasitica* (Murr.) Barr on oak trees in the Carpathian-basin. Folia Oecologica, 2, 129–132.