The Food & Environment Research Agency

Rapid Pest Risk Analysis for *Ceratocystis platani*

This document provides a rapid assessment of the risks posed by the pest to the UK in order to assist Risk Managers decide on a response to a new or revised pest threat. It does not constitute a detailed Pest Risk Analysis (PRA) but includes advice on whether it would be helpful to develop such a PRA and, if so, whether the PRA area should be the UK or the EU and whether to use the UK or the EPPO PRA scheme.

STAGE 1: INITIATION

1. What is the name of the pest?

Ceratocystis platani Engelbrecht and Harrington

Synonyms
Ceratocystis fimbriata f. sp. *platani* Walter
Endoconidiophora fimbriata f. sp. *platani* Walter

Common names
Canker stain of plane (UK English)
Canker of sycamore (US English)
Plane wilt

Taxonomic position
Kingdom - Fungi; Phylum - Ascomycota; Class - Sordariomycetes; Order - Microascales; Family – Ceratocystidaceae, Helotiaceae; Genus – *Ceratocystis*

Special notes on nomenclature or taxonomy:
The pathogen was previously considered to be part of the *Ceratocystis fimbriata* species complex as *Ceratocystis fimbriata* f. sp. *platani*. Substantial genetic variation exists within the *Ceratocystis fimbriata* complex (Marin *et al*., 2003, Steimel *et al*., 2004) along with wide host and geographic ranges (Engelbrecht and Harrington, 2005). *Ceratocystis platani* was raised to a distinct species on the basis of rDNA ITS sequence (Baker *et al*., 2003), microsatellite markers (Barnes *et al*., 2001, Steimel *et al*., 2004) and certain morphological characteristics (Engelbrecht and Harrington, 2005).

2. What is the pest's status in the EC Plant Health Directive (Council Directive 2000/29/EC[1]) and in the lists of EPPO[2]?

EU Annex designation: II/A2 (as *Ceratocystis fimbriata* f. sp. *platani*) on 'Plants of *Platanus* L., intended for planting, other than seeds, and wood of *Platanus* L., including wood which has not kept its natural round surface'.

The organism is also on the EPPO A2 list.

[1] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2000L0029:20100113:EN:PDF
[2] http://archives.eppo.int/EPPOStandards/PM1_GENERAL/pm1-02(21)_A1A2_2012.pdf

3. What is the reason for the rapid assessment?

This pathogen has been identified in the Tree Health and Plant Bio-security Action Plan as being of concern to the UK.

STAGE 2: RISK ASSESSMENT

4. What is the pest's present geographical distribution?

The disease was first reported in the USA in 1935 affecting *Platanus x acerifolia*, although there is evidence the disease was observed perhaps as early as 1926 (Panconesi, 1999). In subsequent years the disease was reported in almost all Atlantic seaboard states (Panconesi *et al*., 2003). It was then reported in plantations and in natural forests of *P. occidentalis* (McCracken and Burkhardt, 1977). The disease has also been reported in California (Perry and McCain, 1988). It is speculated that the fungal pathogen is native to North American forests (Panconesi, 1999).

The disease was first found in Europe in Marseille, France in 1945 (Anselmi *et al*., 1994). The disease was reported in Italy in 1972 but dead plane trees had already been reported in southern Italy in the 1960s (Panconesi *et al*., 2003). The pathogen is now present in almost all of Italy with the exception of Sardinia and some southern regions, where plane trees are uncommon (Panconesi, 1999). It is speculated that the disease was introduced during World War II on colonized crating material or dunnage from the USA (Panconesi, 1981; 1999; Santini and Capretti, 2000; Baker *et al*. 2003). The pathogen spread throughout Italy and was reported in Spain in 1977 (La Porta *et al*., 2008) and Switzerland in 1986 (Matasci and Gessler, 1997). These reports were associated with urban plantings but in 1986 the disease was discovered in natural forests of *P. orientalis* in Sicily, Italy (La Porta *et al*., 2008) and more recently in Greece (Tsopelas and Angelopoulos, 2004). The introduction to Greece is speculated to be via infected London Plane rooted-cuttings from Italy (Ocasio-Morales *et al*., 2007)

In Spain the presence of *C. platani* was confirmed in 2010 in a small plantation of *Platanus acerifolia* in Catalonia and the current status of the disease in Spain is considered to be transient and under eradication (EPPO PQR, 2013). In France[3] the pathogen has been reported in the most southern regions – Languedoc-Roussillon, Midi-Pyrénées, Provence-Alpes-Côte d'Azur, Rhône-Alpes, Aquitaine (EPPO PQR, 2013). The disease has also been reported in Armenia (Simonyan and Mamikonyan, 1982).

DNA profiling studies suggest this pathogen was introduced in Europe and in California from the eastern United States (Engelbrecht *et al*., 2004).

In addition to records from the established literature, Soulioti *et al*. (2008) reported that the pathogen was also in Belgium, Serbia and Iran. Anselmi *et al.* (1994) also reported that there was an unconfirmed report of the strain in Belgium and some unconfirmed reports of the pathogen in Algeria, northern France and Turkey (Anselmi *et al.,* 1994). However, these reports are not in the current EPPO PQR database or CABI Crop Protection Compendium and should be considered with caution.

The confirmed distribution of the pathogen is given in Table 1.

[3] See also: http://www.draaf.midi-pyrenees.agriculture.gouv.fr/IMG/pdf/note_info_mars2011_cle8858c1.pdf
http://www.fredonra.com/collectivites/le-chancre-colore-du-platane/
http://www.fredonra.com/files/2012/11/CC_communes_conta_novembre121.pdf

Table 1. Known distribution of *Ceratocystis platani* (from EPPO PQR, 2013)

North America	USA (Jackson and Sleeth, 1935; Panconesi *et al*., 2003)
Central America	No record
South America	No record
Caribbean	No record
Europe	France (Ferrari and Pichenot, 1976; Anselmi *et al*., 1994), Greece (Tsopelas and Angelopoulos, 2004; Ocasio-Morales *et al*., 2007), Italy (Panconesi *et al*., 2003), Switzerland (Matasci and Gessler 1997), Spain (under eradication) (EPPO PQR, 2013)
Africa	No record
Asia	Armenia (Simonyan and Mamikonyan, 1982)
Oceania	No record

5. Is the pest established or transient, or suspected to be established/transient in the UK? *(Include summary information on interceptions and outbreaks here).*

The pest is not considered to be present in the UK. However, an entry on the Fungal Records Database of Britain and Ireland (FRDBI, http://www.fieldmycology.net/FRDBI/FRDBI.asp) lists one record of *Ceratocystis fimbriata* (as *Endoconidiophora fimbriata*), on/with a *Platanus* tree in 1966 in Canterbury, Kent (FRDBI Record No.: 1378905). No further information is available.

6. What are the pest's natural and experimental host plants; of these, which are of economic and/or environmental importance in the UK?

Platanus species are the only known hosts of *Ceratocystis platani.* Details of hosts are given in Table 2. While *P. orientalis* and *P. x acerifolia* are considered to be extremely susceptible to the disease, *P. occidentalis* has shown some degree of resistance to the pathogen (Panconesi, 1999).

Table 2. Natural hosts of *Ceratocystis platani*

Scientific name	**Synonym**	**Common name**	**Global distribution of host (CABI, 2013)**	**Location**
Platanus x acerifolia	*Platanus x hispanica, Platanus x hybrida*	London Plane	Planted worldwide	USA (Panconesi, 1999) Italy (Panconesi *et al*., 2003)
Platanus occidentalis		American Sycamore, American plane tree	Native to North America. Plantings in Italy	USA (McCracken and Burkhardt, 1977)
Platanus orientalis	*Platanus digitata, Platanus digitifolia*	Oriental plane	Natural and planted to European and Asia. Planted in Oceania, North and South America.	Italy (Panconesi *et al*., 2003) Greece (Tsopelas and Angelopoulos, 2004)

Platanus x acerifolia and *Platanus orientalis* both have a considerable presence in the UK (Figure 1 and Figure 2). Some plantings of *Platanus orientalis* occur in England and Wales.

Twenty-nine nurseries offer *Platanus* trees for sale in the UK (RHS, 2013).

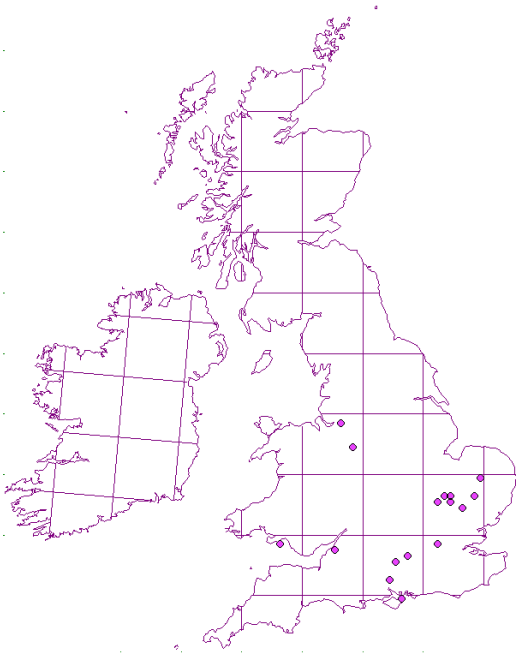

Figure 1. Distribution of *Platanus orientalis* in the UK (shaded areas indicate presence in 10km squares over the UK (Figure taken from the Botanical society of the British Isles Maps Scheme – [www.bsbimaps.org.uk])

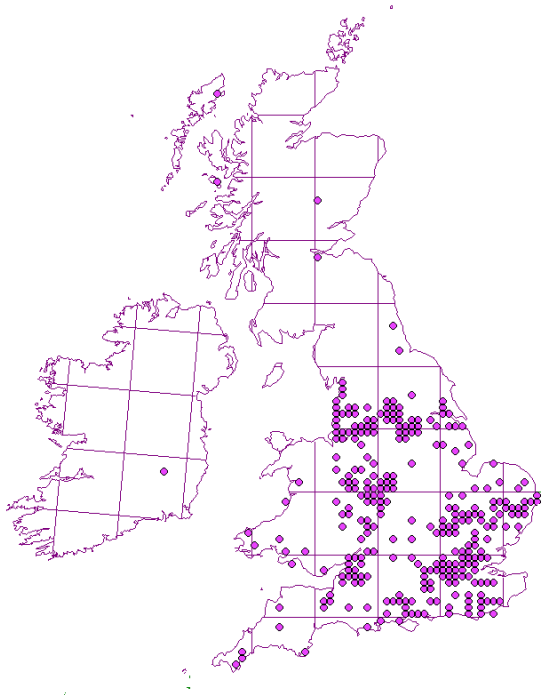

Figure 2. Distribution of *Platanus x acerifolia* in the UK (shaded areas indicate presence in 10km squares over the UK (Figure taken from the Botanical society of the British Isles Maps Scheme – [www.bsbimaps.org.uk])

7. If the pest needs a vector, is it present in the UK?

No vector is directly associated with the *C. platani*, although it is possible that insects and mammals could transfer infectious propagules of the pathogen between host plants. Other members of the *C. fimbriata* complex have been associated with dispersal by insects. The fruiting bodies and smell of the pathogen are believed to be adaptations for insect dispersal (CABI, 2013). There is evidence that nitidulid beetles acquire the pathogen and visit fresh wounds on susceptible *Populus* (Hinds, 1972) and *Prunus* (Moller and DeVay, 1968) trees. Spores of *C. fimbriata* may be carried externally by ambrosia beetles (Iton, 1966) and can also survive passage through an insect gut (Iton, 1966). Ambrosia beetles are also attracted to diseased plants and produce relatively large amounts of frass in the process of creating breeding galleries within the trunk and branches (Goitia and Rosales, 2001). Frass, containing spores and hyphal fragments, is pushed outside the tree as the galleries are excavated. This fine material has the potential for wind dispersal.

8. What are the pathways on which the pest is likely to move and how likely is the pest to enter the UK? (*By pathway*):

Movement with infected *Platanus* plants and/or contaminated soil/growing media

Pathway title:	Very unlikely		Unlikely		Moderately likely	✓	Likely		Very likely	

The most likely means of international spread is by trade in unknown infected plants (CABI, 2013). Imports of plane trees from third countries are already subject to statutory pre-arrival notification (through normal phytosanitary certification procedures) and there are specific requirements set out in Annex IVAI of Directive 2000/29/EC for plants for planting of *Platanus* originating for the USA and Armenia requiring an official statement that *C. fimbriata f. spp. platani* has not been observed at the place of production or the immediate vicinity in the last complete cycle of vegetation. Recently UK national measures have been introduced requiring prior notification of plants for planting of *Platanus* being moved into the UK from other EU member states through an amendment of the Plant Health (England) Order 2005 (http://www.fera.defra.gov.uk/plants/plantHealth/). Plane trees are already included in the EU Plant Passporting Scheme. *C. fimbriata f. spp. platani* is listed in Annex IIAII of Directive 2000/29/EC and requirements set out in Annex IVAII of Directive 2000/29/EC state that plane trees need either to originate in an area free of the pathogen or consignments must state that no symptoms of the disease have been observed in the place of production or in its immediate vicinity since the beginning of the last complete cycle of vegetation.

The inspection of imported plane tree material will help prevent infected trees with symptoms from entering the UK, however notification of imports does not mean that all plane trees will be inspected and inspection of large plant material can pose logistical difficulties. Additionally, the pathogen could still be present in asymptomatic plants and/or soil/growing media. Consideration should be given to using molecular diagnostic protocols in order to detect the pathogen in such infested material (Panconesi *et al*., 2003).

Movement in infested soil/growing media transported with non-host plant material

Pathway title:	Very unlikely		Unlikely	✓	Moderately likely		Likely		Very likely	

The pathogen is capable of surviving at least several months in soil (Accordi, 1989). It is therefore feasible, although unlikely, that infested soil or growing media can enter with non-host plants that are not subject to regulation.

Movement with contaminated wood, sawdust and wood packaging material

Pathway title:	Very unlikely		Unlikely		Moderately likely	✓	Likely		Very likely	

The initial introduction of the pathogen to Europe is widely accepted to be with wood used as packaging material. However all wood packing entering the EU from third countries would be subject to the requirements of ISPM 15, which regulates wood packaging material used in international trade. Wood packaging material is required to be debarked and subject to a suitable form of treatment such as heat treatment or methyl bromide treatment.

Requirements for wood originating in the USA or Armenia are set out in Annex IVAI of Directive 2000/29/EC and for wood (except in the form of chips, particles, sawdust, shaving, wood waste and scrap) an official statement that the wood has undergone kiln drying to below 20% moisture content is required. For wood in the form of chips, particles, sawdust, shaving, wood waste and scrap from the USA or Armenia an official statement that it has been produced from wood that has been debarked or has undergone kiln drying or appropriate fumigation or has been heat treated is required.

Requirements for the movement of *Platanus* within the EU are set out in Annex IVAII of Directive 2000/29/EC these requirements are that either the wood has originated in an area know to be free from *C. fimbriata* f. spp. *platani* or has undergone kiln drying to below 20% moisture content. This should reduce the risk of the pathogen being introduced by this pathway.

Movement with footwear/machinery/equipment contaminated with the pathogen

Pathway title:	Very unlikely		Unlikely	✓	Moderately likely		Likely		Very likely	

The pathogen could enter by hitchhiking on footwear, vehicles or equipment. The pathogen is known to survive for several months in soil (Accordi, 1989) so it could be introduced in infested soil attached, for example, to shoes or bicycle tyres. As the pathogen is present in areas likely to be visited by UK tourists this pathway cannot be discounted, but is considered to be unlikely.

9. How likely is the pest to establish outdoors or under protection in the UK?

	Very unlikely		Unlikely		Moderately likely		Likely		Very likely	
Outdoors:				✓		✓		✓		
Under protection:		✓								

Based only on the presence of susceptible host material and the current knowledge of the biology of this fungal pathogen it could be considered to be likely to establish in the UK. Abundant susceptible hosts exist in both urban and woodland areas in the UK. The biology of the pathogen means that it is likely to survive in soil and decaying parts of plane trees for several years. Survival of the pathogen is facilitated by the production of numerous chlamydospores. It may survive in wood fragments in river water (Grosclaude *et al*., 1991; Ocasio-Morales *et al*., 2007).

Its climatic responses also do not appear to be an impediment to survival in the UK. The optimum growth temperature of *C. platani* is 25°C and, although the pathogen does not grow below 10°C or above 45°C, it can survive *in vitro* at -17°C for several years. Maximum

germination of conidia and ascospores occurs at 25°C but viability is lost after 48 hours incubation in soil at 35 to 40°C (Accordi, 1989; Mancini and Scapin, 1981). Weather conditions can influence the ability of the pathogen to colonise a tree wound and hence infect a tree, favourable conditions for rapid colonisation are considered to be high humidity and temperatures between 20 and 25°C (Panconesi *et al*., 2003).

However, despite the fungus being present in Europe since 1945, the confirmed distribution of the pathogen shows that it has not progressed further north than the southern departments of France and Geneva in Switzerland. This could be due to various factors. These could include slow or limited spread, a requirement for higher temperatures for disease symptoms to occur or the presence of an unknown vector. More detailed research on the relationship between climate and this pathogen is required to clarify the climatic suitability of the UK, particularly on the role of temperature and humidity in influencing colonisation of tree wounds and symptom development. Further research is also required to determine the likelihood that infected trees and/or infested soil with trees for the nursery trade are an important pathway. Until further data is available, the likelihood of introduction is highly uncertain. Therefore the unlikely, moderately likely and likely boxes have all been ticked.

It is feasible that the pathogen can cause disease under protection based upon its biology and optimum growth temperature but this species is unlikely to be grown in protected cultivation.

10. How quickly could the pest spread in the UK?

	Very slowly	Slowly	Moderate pace	Quickly	Very quickly
Natural spread:			✓		
In trade:				✓	

The pathogen is principally spread through human mediated transport; either through movement of infected host material, infested soil/growing media or contaminated machinery, equipment, host contact with footwear/clothing. Urban trees are particularly prone to the disease as these are frequently subject to pruning and pollarding – this effectively causes an open wound permitting the pathogen to enter the tree (Panconesi *et al*., 2003). *C. platani* is considered a wound pathogen as it cannot invade the tree through a sound epidermis (Panconesi *et al*., 2003).

Also in urban areas, the species grown is typically the London plane that has limited genetic variability in the population and is highly susceptible to the pathogen (Panconesi, 1999). The pathogen can also move relatively quickly via water. Water-borne dispersal of the pathogen is of importance in France, Switzerland, and Italy (Grosclaude *et al*., 1991). *Platanus orientalis* is a riparian species, the pathogen will be able to spread along water courses, this, combined with aerial dispersal of the pathogen in infested beetle frass, may lead to rapid spread of the pathogen within a particular area (Ocasio-Morales *et al*., 2007).

However, although the pathogen may spread rapidly once introduced through specific clusters of plane trees, based on the rate of spread elsewhere in Europe, wider dispersal could be more protracted. The fungus was first introduced into Europe in the 1940s and took 30 years to spread throughout Italy before its discovery in 1972. The rate of spread in France and Spain after the pathogen's presence was known was considerably less; the pathogen has a restricted distribution in each of those countries despite being introduced over thirty years ago. Therefore, if the pathogen was introduced into the UK, and if a UK climate is suitable for symptoms to develop, it could spread relatively quickly if undetected.

However, if the pathogen was detected and movement of material from contaminated areas was reduced or prohibited, it is likely that natural spread of the pathogen would be at a moderate pace.

11. What is the area endangered by the pest?

Should the UK's climate be suitable for the disease to occur, anywhere plane trees are grown would be affected. Plane trees are grown throughout the UK but the Midlands and Southern parts of England would be most affected.

12. What is the pest's economic, environmental or social impact within its existing distribution?

Very small		Small		Medium		Large		Very large	✓

Ceratocystis platani is a serious disease of plane trees both in the USA and Europe. It causes staining of the xylem, disruption of water movement, formation of cankers and eventually tree death (Ocasio-Morales *et al*., 2007). The parasite colonises the wound-exposed tissue immediately on contact and a single infection can kill a tree of 30-40 cm diameter in 2-3 years (Panconesi, 1999). Infected trees typically die within 3-6 years. The disease has killed tens of thousands of plantation trees and street trees in the eastern United States, California, and southern Europe (La Porta *et al*., 2008).

Impact in the USA

In Gloucester, New Jersey, which is one of the earliest centres of infection (thought to have been introduced in 1926), by 1949, 87.1% of the original London plane trees had already died and an additional 4.3% were infected (Walter *et al.,* 1952). In Philadelphia, where the disease was thought to have been present in London plane trees for at least a decade before its initial discovery in 1935, the disease had killed 10,000 out of a total 150,000 trees by 1945. By the 1970s the disease was present in *P. occidentalis* in some natural forests in Arkansas (McCracken and Burkhardt*,* 1977). However, the rate of spread in *P. occidentalis* forests appeared to be slower as *P. occidentalis* seemed to display some resistance to the pathogen (Panconesi *et al*., 2003).

Impact in Europe

In Italy and the south-east of France the disease has caused serious losses to urban trees and natural plantings. In Marseille, where the first phase of infection started in 1945, 1850 *Platanus* trees with an average age of 110 years were killed between 1960 and 1972 (about 13% of the initial population) (Ferrari & Pichenot, 1976). At Forte dei Marmi, one of the oldest infection centres in Italy, 90% of all plane trees died of the disease in the twenty-year period from 1972-1991 (Panconesi *et al*., 2003). In 1986, there was a first report of *C. platani* invading a natural forest of *P. orientalis* in Sicily (Panconesi *et al*., 2003).

In 2006, the pathogen was identified as the cause of plane tree death along the Canal du Midi, a UNESCO world heritage site in France. The canal is lined with around 42,000 plane trees and up to 2011, around 2,500 trees have been felled, destroyed and replaced with disease-resistant planes. It is speculated that the remaining 40,000 will need to be destroyed over the next 20 years – at an estimated cost of around €210m (£180m) (Willsher, 2011).

Since the pathogen was first detected in Greece in 2003, it has had dramatic impact on natural populations of *P. orientalis* in the southwest of the country. Ornamental plane trees in residential areas and recreational sites apparently have died, with some of the dead trees centuries old. However, the impact has been greater in natural stands. Hundreds of dead

and dying oriental planes were found along streams and rivers. Patches of 15 to 20 dead and dying trees were often observed (Ocasio-Morales *et al*., 2007).

The removal of diseased mature trees in urban areas and along waterways and replacement with disease resistant trees or alternative species is costly. Also, the removal of mature trees could negatively affect tourism to some of the affected areas. In urban areas, the removal of mature trees will drastically affect the character and aesthetic value of a neighbourhood.

13. What is the pest's potential to cause economic, environmental or social impacts in the UK?

Very small	Small	Medium	Large	Very large
☐	☐	☐	☑	☐

The pathogen has been proven to cause serious disease in Italy and southern France. Should the pathogen establish in the UK, where London plane is relatively widely grown in urban, recreational and woodland areas, it is likely to result in the widespread infection and ultimately death of plane trees. Parts or all of the diseased trees would need to be removed for safety reasons. As a large number of London plane trees in the UK are mature (100-300 years old) (Hull, 2009) the cost of removing these trees and replacing them with resistant alternatives could be considerable (compare with costs of removing trees from the Canal du Midi above).

London plane trees in urban environments are particularly at risk. This tree is often specified in urban schemes for its aesthetic characteristics (foliage, crown shape, bark colour), longevity, ability to withstand environmental extremes, pollution, drought, pruning and soil compaction (Anselmi *et al*., 1994; Dineva, 2004). The tree is also considered to have a role in mitigating air pollution in highly polluted areas. Whilst London plane is not a native tree and was introduced to the UK over 300 years ago, they now form an integral part of London's landscape, in addition to being common in other UK cities. It has been reported that a tenth of all trees in Greater London are London planes[4] and the tree is such a significant feature of London that it gave the tree its common name. London plane accounts for some of the tallest and most planted trees in the city and within London is planted in a range of public and communal areas, including a number of parks and squares (such as the Royal Parks in central London) and also as roadside trees. Should these trees have to be removed it will considerably alter the aesthetic character of these urban environments, possibly having an adverse affect on tourism and access to green spaces for the residents.

In 2009, one London Plane tree was valued by the London Tree Officers Association at £750,000, and is therefore considered to be the UK's most valuable tree (Hull, 2009).

In addition to ornamental uses, the tree is used for timber and as fuel wood although it is difficult to determine its importance for these uses. The Plane tree's wood is moderately strong and is often used to construct outdoor furniture. The timber is also used for veneer. This use is also likely to be affected however little information available on how much wood is sourced from plane trees.

The 29 nurseries which sell *Platanus* saplings to wholesale or retail would also be affected.

14. What is the pest's potential as a vector of plant pathogens?

Ceratocystis platani is a plant pathogen with no capacity to act as a vector of other pathogens.

[4] http://www.aranya.co.uk/planes/text/intro.html

STAGE 3: PEST RISK MANAGEMENT

15. What are the risk management options for the UK? *(Consider exclusion, eradication, containment, and non-statutory controls; under protection and/or outdoors).*

The pathogen is listed in Annex IIAII of Directive 2000/29/EC with the specific requirement for plants for planting (other than seeds) and wood of *Platanus* L. in Annex IVA for plants originating from the USA and Armenia (section I) and for plants originating within the community (section II). This means that the movement of plane trees into the UK is already regulated. Recently UK national measures have been introduced requiring prior notification of plants for planting of *Platanus* being moved into the UK from other EU member states through an amendment of the Plant Health (England) Order 2005 (http://www.fera.defra.gov.uk/plants/plantHealth/).

However the specific requirements within Directive 2000/29/EC rely on the observation of visual symptoms. The pathogen has no known incubation period and wounds are immediately colonised. Unless through destructive sampling the wood is cut and staining observed, in trees that have been freshly cut and recently infected there may be no visual symptoms of the disease (the material is effectively asymptomatic). It could take more than one cycle of vegetation for wilting to occur which is often when the disease is first noticed. Since the pathogen can only infect through open wounds, trees could also be inspected for evidence of old wounds and these wounds could be tested for presence of the pathogen. It could also be stipulated that the trees cannot be moved for at least two years from any pruning/cutting activities. The notification requirement recently introduced by the UK would enable targeted inspection of the highest risk imported planting material.

Removal of infected material

Should the pathogen be introduced to the UK and eradication is attempted, the removal and destruction of infected material and restriction on planting susceptible host material would be required. If the pathogen is to be eradicated susceptible hosts would have to be removed from an outbreak site. Good practice would be to remove the entire tree including the stump as it can still become reinfected. However, if the mycelium of the pathogen is not in the roots, felling the tree at the base can separate a healthy stump from a diseased crown. Panconesi, (1999) recommends that if infection is present in the roots of the tree, the whole infected tree and all surrounding *Platanus* trees need to be removed since the pathogen can survive for long periods in the roots and the pathogen is readily spread through root anastomoses between neighbouring trees. However, complete removal of the tree is unlikely to be recommended in practice and herbicides are likely to be used to prevent re-growth from the roots/stump. Non-susceptible hosts could be planted instead of plane trees and as the pathogen is very host specific it would not be necessary to completly remove all traces of the pathogen from the soil.

If the pathogen is to be subjected to containment only, pruning of the infected parts of a tree could be attempted, although in reality this is only likely to delay the onset of tree death. Wounding of the trees would need to be kept to a minimum and any open wound should be treated with an appropriate preventative fungicide to stop subsequent colonisation. The removal and destruction of infested material is likely to produce enormous amounts of inoculum (such as sawdust which has the potential to allow airborne dispersal of the pathogen) (Panconesi *et al*., 2003) and several measures would need to be in place during eradication operations. These include the collection of sawdust and all residues during felling operations. Previous felling operations in outbreaks have required the suspension of vehicle traffic, the use of large plastic sheets to catch sawdust under the infected trees and the felling trees of in one piece or with as few cuts as possible (Panconesi, 1999). The resulting wood would need to be treated effectively (by heat treatment for example). Sawdust and smaller plant residues should be burnt and items which cannot be burnt (such as roots and stumps) should be disposed of by deep burial. Panconesi (1999) also recommends that once felling has been completed it is necessary to disinfect the plastic sheeting with 2%

sodium hypochlorite solution or 2% benomyl. Tools used in the operation are particularly liable to pass on the disease to new sites and should be cleaned thoroughly to remove any plant material and disinfected by immersion for several minutes in alcohol or sodium hypochlorite.

Chemical and Biological Control

Externally applied chemical treatments do not appear to be entirely effective (Panconesi, 1999). Pressure injection of effective fungicides such as cabendazim, thiabendazole and imazalil achieved a temporary halt to infection but could not eliminate the pathogen from the tree (Panconesi, 1999). However these chemicals currently do not have approval for this kind of use, if the use of chemical controls was considered to be appropriate in an outbreak situation approval would need to be sought. Biocontrol measures, whilst some show promise *in vitro*, also appear unable to provide complete control of the pathogen (Turchetti and Panconesi, 1982; Accordi, 1989; Panconesi, 1999).

Host Resistance

The high susceptibility and genetic uniformity of London plane favour rapid onset of the disease and spread of the pathogen., *P. occidentalis* clones with resistance to the pathogen exist (Panconesi, 1999). However, they cannot be cultivated in Europe because of a lack of acclimation and a high susceptibility to anthracnose caused by *Apiognomonia veneta* (Vigouroux and Olivier, 2004). The source of resistance was exploited by crossing resistant *P. occidentalis* with *P. orientalis* accessions from Greece which produced accessions with partial or complete resistance (Vigouroux and Olivier, 2004). Additional resistant *Platanus x acerifolia* genotypes suitable for European cultivation were produced by Pilotti *et al*. (2009).

16. Summary and conclusion of rapid assessment

Ceratocystis platani is an important pathogen of plane trees. The pathogen is already present in Europe and, despite current EU wide legislation designed to limit its further spread, the pathogen is still spreading in France and other southern member states. Although it is moderately likely that the pathogen could enter the UK, the likelihood of establishment is assessed as very uncertain because, although hosts are widespread and the known climatic responses suggest that the climate is suitable, since its arrival 70 years ago the pathogen has spread widely in southern Europe but has never been reliably confirmed north of a latitude approximating to Geneva.

If the pathogen establishes, large economic impacts may occur. Felling, removal and destruction of infested material would be very costly. Biosecurity measures during clean up operations to prevent further dispersal of the pathogen would need to be stringent and therefore add to the cost. Plane trees are a very common urban tree and if the disease becomes widespread, several major UK cities would lose a considerable proportion of their trees from parks, roadsides and squares. This could affect the character of certain cities and ultimately have adverse affects on tourism and access to green spaces for the residents. No fully effective chemical or biocontrol options currently exist and although resistant *Platanus* genotypes are available, it would take several years/decades for any affected habitats to recover.

The Plant Health (England) (Amendment) Order 2013, which came into force in January 2013 strengthened existing EU measures to limit the spread of this pathogen through the introduction of statutory notifications requirements for all imports of *Platanus* (Plane), along with several other genera of trees. A major uncertainty is the risk that the pathogen could be introduced via asymptomatic host planting material and associated soil / growing media. Although not all imported material can be checked, the notification requirements enable further evaluation of this risk through the development of a surveillance strategy, enabling targeted inspection of the highest risk imported planting material i.e. trees imported from

areas where the disease is known to occur. Trees showing damage or suspicious symptoms would be submitted for more detailed laboratory examination and testing for the presence of the pathogen.

17. Is there a need for a detailed PRA? If yes, select the PRA area (UK or EU) and the PRA scheme (UK or EPPO) to be used. *(for PH Risk Management Work stream to decide)* ✓ *(put tick in box)*

Although this rapid PRA is highly uncertain, it is based on the available literature. The uncertainties expressed are supported by experts contacted overseas. It is clear that further research is required on this pathogen to determine whether climate or some other factor is limiting its establishment to southern Europe.

No	✓

Yes		PRA area: UK or EU		PRA scheme: UK or EPPO	

18. Given the information assembled within the time scale required, is statutory action considered appropriate / justified?

Yes Statutory action	✓	No Statutory action	

Statutory action against *Ceratocystis platani* is a requirement of the EU Plant Health Directive 2000/29/EC. It is an important pathogen of plane trees and although the likelihood of establishment in the UK is very uncertain, the potential impacts could be large and control very expensive. A surveillance strategy is being developed to target inspections at the highest risk imported planting material, with any plants exhibiting suspect symptoms to be submitted for laboratory testing.

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