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Risk assessment and reduction options for *Ceratocystis platani* in the EU

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Abstract

Following a request from the European Commission, the EFSA Plant Health (PLH) Panel performed a risk assessment for *Ceratocystis platani* in the EU with the aim to assess the effectiveness of risk reduction options (RROs) on the basis of the mechanisms of spread identified in the pest categorisation (natural and human-assisted means, including waterways, root anastomosis, contaminated pruning tools, machinery, insects, contaminated insect frass and sawdust). *C. platani* is a destructive pathogen of *Platanus* trees, which is currently present in the EU (in France, Greece and Italy). Three scenarios were considered: the current situation (A_0 scenario); the situation without RROs (A_1); and the application of additional RROs (A_2). The risk of new introductions into the EU of *C. platani* by means of the main pathways of entry (i.e. plants for planting, wood and machinery, e.g. construction machinery and pruning/cutting tools) is relatively limited, but about 250 times higher for the A_1 scenario compared to the A_2 scenario (median numbers of established populations). The risk of spread from already affected EU regions is higher, but varies depending on the scenario. Machinery is the most important mechanism of long-distance spread. Focusing the additional RROs in A_2 scenario on this mechanism of spread – which is not currently regulated – would be an effective way to reduce the likelihood of further spread and thus impacts of *C. platani* to not yet affected EU regions. The emergency measures applied by the *C. platani*-affected EU Member States (France, Greece and Italy) could be harmonised and improved. An enhanced programme could be developed which includes surveillance, early detection of the disease foci, effective eradication measures and planting resistant *Platanus* clones in new plantations in affected areas. Surveillance could also be intensified in the EU MSs not yet known to be affected by the disease.

Keywords: forest pathology, phytosanitary regulation, plants for planting, *Platanus*, wood trade, machinery

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Summary

Following a request from the European Commission, the EFSA Plant Health (PLH) Panel performed a quantitative risk assessment of the risk to plant health in the European Union (EU) posed by *Ceratocystis platani*, a destructive fungal pathogen of *Platanus* spp. The pathogen was introduced from North America into France and Italy during World War II. It was then introduced at the beginning of the 2000s to Greece, causing severe damage to plane trees both in urban and rural areas.

The Panel interpreted the Terms of Reference (ToR) as a request to conduct a full Pest Risk Assessment (PRA) with the aim of assessing the effectiveness of risk reduction options (RROs) on the basis of the mechanisms of spread identified in the pest categorisation (EFSA PLH panel, 2014) (natural and human-assisted means, including waterways, root anastomosis, contaminated pruning tools, machinery, insects, contaminated insect frass and sawdust). The risk assessment (RA) area is the EU territory.

A literature search was performed following the strategy described in the pest categorisation, so as to retrieve relevant papers that appeared since the time the pest categorisation was published (2014). The content of these publications was considered in the risk assessment wherever relevant. Information already provided in the pest categorisation on *C. platani* (EFSA PLH panel, 2014) was not repeated here.

Data on which to base many of the quantitative estimates presented here were either not available or incomplete. Expert judgement was thus used in most cases. The quantitative estimates provided by the experts should be taken with caution, as different experts might provide different figures in such a situation where evidence is lacking. One exception was the historical spread of the pathogen through Europe, for which data at the level of NUTS3 regions from France, Greece and Italy were available to the Panel. NUTS3 was the spatial unit chosen in this assessment to provide an evaluation of the potential further spread of the pathogen in the RA area.

The quantitative risk assessment template, currently developed by the EFSA PLH Panel, was followed. The assessment model is described in detail by means of flow charts and formulas in Appendix A.

The risk assessment was carried out for the following three scenarios:

- A_0 scenario describes the current situation in the RA area with respect to the EU legislation (Council Directive 2000/29/EC) on the pathogen and its host as well as the emergency measures applied by the *C. platani*-affected EU Member States (EU MSs).
- A_1 scenario describes the situation without RROs and is used to demonstrate the worst-case scenario.
- A_2 scenario describes the current situation but with the application of additional RROs. In this scenario, the application of a combination of the most effective RROs is considered.

All the scenarios also include the current agricultural practices (Good Agricultural Practices) commonly used in the RA area.

The host plants for planting, the wood and the machinery pathways were considered by the Panel as major pathways for the entry of the pathogen into the RA area.

The risk of new introductions of *C. platani* into the RA area by means of the main pathways for entry (i.e. plants for planting, wood and machinery, i.e. construction/terracing/logging machinery and pruning/cutting tools) is relatively limited, with less than 1 (median value; for all values, please see the main text for the 50% prediction intervals as a proxy for uncertainty) new established population predicted in a 10-year period under the A_0 scenario. In case additional RROs will be considered (A_2 scenario), the number of new introductions is expected to be about 40 times lower compared to the A_0 scenario. In contrast, new introductions are expected to be about six times higher compared to the A_0 scenario in case the current regulation is removed (A_1 scenario). Under the A_1 scenario, and considering the 99th percentile (i.e. the worst case), the number of new established populations becomes considerable (more than 200 in 10 years).

In scenario A_2, the additional RROs for reducing the risk of entry include, among others: (i) a certification scheme for the production of *Platanus* plants intended for planting; (ii) the extension of these measures to all affected Third Countries and to firewood in the case of the current regulations on wood; (iii) a new regulation framework on machinery, which is recommended either to be sourced from pathogen-free areas or be cleaned, disinfected and be free from soil and plant debris when brought into places where *Platanus* trees are grown (it would also be accompanied by a certificate verifying that it has been cleaned and disinfected). Additional RROs for reducing the risk of

establishment include surveillance and the use of enhanced eradication programmes, which should also be effective in decreasing the number of potential founder populations by reducing the transfer of the pathogen to a suitable host in the RA area.

The range of the estimated distributions for the number of established populations is relatively narrow for scenario A_0, implying relatively limited uncertainty, compared to scenarios A_1 and A_2. Many factors influence the assessment of entry and establishment, and their relative contribution to the overall uncertainty varies between scenarios. However, there are no dominant factors to which a major contribution to the overall uncertainty can be attributed. This makes it difficult to pinpoint particular areas of the risk assessment that would benefit from additional data collection or more formal expert knowledge elicitation. However, future risk assessment would benefit from data on trade volumes of *Platanus* plants for planting and wood, as well as on the number of machinery units moving from Third Countries into the EU.

The spread of *C. platani* via the main mechanisms of spread (i.e. in decreasing order of importance, machinery, wood, plants for planting and natural spread through wind, mainly as sawdust) at the NUTS3 spatial level (which corresponds to long-distance spread) is estimated to lead to a considerable increase from the currently affected 84 NUTS3 regions (France = 18, Greece = 12, Italy = 54) to 99 (+15 as median value) in a 10-year period in the A_0 scenario, or to 111 (+27) in the A_1, worst-case scenario. The spread is estimated to be lower with the application of appropriate, additional RROs (A_2 scenario), with a total of 88 NUTS3 affected (+4). Under the A_1 scenario (without measures), the worst case (99th percentile) would result in an additional 73 NUTS3 regions becoming infested.

The spread assessment does not include the contribution of newly introduced *C. platani* populations because the average probability to have a new established population due to new entries was assessed as 0.3 out of 1,240 NUTS3 regions (i.e. the total number of EU NUTS3 regions with *Platanus* plants), i.e. 0.0002, which may be considered as minor in terms of contribution to the spread.

Machinery was assessed to be the most important mechanism of long-distance spread. Focusing the additional RROs in the A_2 scenario on this mechanism of spread – which is not currently regulated – would thus be an effective way to reduce the risk of spread of *C. platani* to not yet affected EU NUTS3 regions. Additional RROs for spread through machinery include the requirements that machinery (i) originates from a pest free area, or (when moving from an affected region) that (ii) it has been cleaned and disinfected, and is free from soil and plant debris when moved into places where *Platanus* trees are grown and (iii) is accompanied by a certificate proving that it has been cleaned and disinfected.

Among the RROs, surveillance, use of optimised eradication programmes and planting resistant *Platanus* clones in new plantations in affected areas play a relevant role in reducing the spread. Eradication remains a very effective RRO in case surveillance makes early detection possible and if optimised eradication procedures are applied.

The range of the estimated distributions for the number of newly affected NUTS3 regions is relatively limited for scenario A_0 compared to scenarios A_1 and A_2. The overall uncertainty associated with the spread assessment is thus lower for scenario A_0 compared to scenarios A_1 and A_2.

The relative contribution of the factors to the overall uncertainty varies between mechanisms of spread and scenarios. The uncertainty breakdown for the current situation (scenario A_0) shows that the most important factor contributing to uncertainty for all mechanisms of long-distance spread is the estimated growth rate of the pathogen per year. For the scenarios without measures (A_1) and with additional RROs (A_2), for all mechanisms of spread (with the exception of wood and natural spread in the A_1 scenario), the effectiveness of the RROs applied to prevent spread is the most important factor contributing to uncertainty.

The assessment of impact considers several aspects: (i) the percentage of affected host plants of *C. platani* at the initial conditions, i.e. year 2016, in the currently affected spatial unit; (ii) the growth rate of the pathogen population expressed as the number of affected plants at the end of the time horizon of 10 years in the affected spatial regions (mainly due to short-distance spread), in the different scenarios; and (iii) the number of spatial regions occupied in the 10-year period because of long-distance spread, in the different scenarios. It is assumed that each affected host tree dies in a relatively short time period.

The estimated abundance at the initial conditions ranges from 0.01% to 20% of affected plants, with a median value of 1%. At the end of the time horizon, the median proportion of dead host plants ranges between 1.2% (scenario A_2) and 2.1% (scenario A_1). The median value for scenario A_0 (1.4%) is close to the value of scenario A_2 because it is estimated that the time horizon considered (10 years) is relatively short to make the additional RROs in the A_2 scenarios highly effective.

However, the overall impact in terms of dead host plants at the EU level (which also considers spread) in scenario A_2 is expected to be about (median values) four times smaller than in scenario A_0, and about 12 times smaller than in scenario A_1.

The impacts at the per-area unit level (i.e. service providing unit where the pathogen is present) in terms of reduction of (i) provisioning (wood), (ii) regulating and supporting (e.g. pollution reduction, water regulation, shade provision and avoidance of soil erosion) and (iii) cultural ecosystem services are expected to be about 1.5 times higher under the A_1 scenario compared to scenario A_0, and about two times lower under scenario A_2 compared to scenario A_0. The overall impact on the ecosystem services at the EU level is not considered in this assessment.

Uncertainty regarding impacts (in terms of dead plants) is considerable, mainly due to the uncertainty in the estimate of pathogen abundance in the currently affected relevant habitats. In all the scenarios, the interval of estimated abundance in the year 2016 ranges from a low value of less than one plant affected in ten thousand to a high value of about 20% of the plants affected (the difference between the low and the high percentile is of a factor 2000).

Based on the above, the Panel provides the following conclusions:

- The current measures for the prohibition of entry of *C. platani* into the EU (Council Directive 2000/29/EC) could be improved by introducing additional requirements for plants for planting, wood (including firewood, which seems currently not considered) and machinery (which is currently not regulated) pathways. It should also be considered that there are affected Third Countries not listed in the Council Directive, and new Third Countries may become affected in subsequent years. Removing the current regulation could lead to a relevant increase in the number of potential *C. platani* founder populations and, as a consequence, in the magnitude of impacts.
- Similar to entry, the current measures for avoiding spread of *C. platani* (Council Directive 2000/29/EC) within the EU could be maintained, but these measures are not expected to stop the spread of the disease to new areas. Introduction of additional requirements – as those considered in scenario A_2 – would reduce by about 1/4 the number of newly affected NUTS3 regions in the next 10 years. A certification scheme for plants for planting produced in affected areas, measures for all types of wood produced in affected areas, and cleaning and disinfection of the machinery moving from affected areas could also be considered.
- The emergency measures applied by the *C. platani*-affected EU MSs (France, Greece and Italy) differ in various respects and could be harmonised and improved. An enhanced programme could be developed, which includes surveillance, early detection of the disease foci, effective eradication measures and planting resistant *Platanus* clones in new plantations in affected areas. Surveillance could also be extended to the EU MSs not yet reported as affected by the pathogen.

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1. Introduction

1.1. Background and Terms of Reference as provided by the requestor

The European Food Safety Authority (EFSA) is requested, pursuant to Article 22(5.b) and Article 29(1) of Regulation (EC) No 178/2002[1], to provide a scientific opinion in the field of plant health. Specifically, as a follow-up to the request of 29 March 2014 (Ares(2014)970361) and the pest categorisations (step 1) delivered in the meantime for 38 regulated pests, EFSA is requested to complete the pest risk assessment (PRA), to identify risk reduction options and to provide an assessment of the effectiveness of current EU phytosanitary requirements (step 2) for (1) *Ceratocystis platani* (Walter) Engelbrecht et Harrington, (2) *Cryphonectria parasitica* (Murrill) Barr, (3) *Diaporthe vaccinii* Shaer, (4) *Ditylenchus destructor* Thorne, (5) *Eotetranychus lewisi* (McGregor), (6) grapevine flavescence dorée and (7) *Radopholus similis* (Cobb) Thorne.

During the preparation of these opinions, EFSA is requested to take into account the recommendations, which have been prepared on the basis of the EFSA pest categorisations and discussed with Member States in the relevant Standing Committee. In order to gain time and resources, the recommendations highlight, where possible, some elements which require further work during the completion of the PRA process.

Recommendation of the Working Group on the Annexes of the Council Directive 2000/29/EC – Section II – Listing of Harmful Organisms as regards the future listing of *Ceratocystis platani* (Walter) Engelbrecht et Harrington

Current regulatory status

Ceratocystis fimbriata f. sp. *platani* is listed in Annex IIAII of Directive 2000/29/EC. It has been recently reclassified as *Ceratocystis platani*. Specific requirements are laid out in Annex IV and Annex V of Directive 2000/29/EC as regards internal movement of plants of *Platanus* L., intended for planting, other than seeds, and as regards import. Specific requirements are also listed in Annex IV as regards commodities (wood and chips, etc.) regulated for *C. platani*.

Protected Zones for plants, other than seeds, and wood of *Platanus* L. are also established in some areas of the European Union (EU) (e.g. the UK).

Lastly, host plants of *C. platani* that are regulated in Annex IIAII of Council Directive 2000/29/EC are also covered by Council Directive 1999/105/EC on the marketing of forest reproductive material and Council Directive 98/56/EC on the marketing of propagating material of ornamental plants.

Identity of the pest

C. platani is a single taxonomic entity. Fast, sensitive and reliable methods are available for its detection and differentiation from other related fungal species.

Distribution of the pest

C. platani is currently present with restricted distribution or was present and has been eradicated in part of the risk assessment area, such as Italy (including Sicily), France, including Corsica, Greece and region of Catalonia, Spain (eradicated).

Potential for establishment and spread in the PRA area

Hosts, particularly the most susceptible ones are widely grown in most of the MSs and eco-climatic conditions are suitable for the establishment of the pathogen in non-infested areas. Following establishment, there is potential to spread by multiple natural and human-assisted means, including movement of infected host plants for planting and wood, waterways, root anastomosis, contaminated pruning tools, insects, contaminated insect frass and sawdust.

The pest is strongly associated with plants for planting, which can spread the pathogen into new areas or MS. The pest can be eradicated when the infection does not occur close to water.

Potential for consequences in the PRA area

C. platani causes wilt, cankers and eventually the death of its hosts. Since its first detection in 1972, the disease has killed tens of thousands of plane trees in southern MSs (France, Greece and

[1] Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety. OJ L 31, 1.2.2002, p. 1–24.

Italy), where the hosts are grown in natural stands, coppices, and public and private gardens in both rural and urban regions. The disease continues to spread into new areas in the EU and has serious consequences, including environmental ones.

Reduction of yield and quality is experienced, including visual impairment especially under favourable conditions for disease development. Importantly, it also introduces the pathogen into new areas where it can be rapidly spread under favourable conditions.

Recommendation

Considering the great potential impact, and the limited distribution of *Ceratocystis platani* in the three EU Member States, the Working Group suggests listing it as a Union Quarantine pest.

The PRA started by EFSA needs to continue with the aim to develop risk reduction options on the basis of the pathways of spread identified in the pest categorisation (natural and human-assisted means, including waterways, root anastomosis, contaminated pruning tools, insects, contaminated insect frass and sawdust).

1.2. Interpretation of the Terms of Reference

The Terms of Reference (ToR) asked the Panel to perform a pest risk assessment for the EU territory and an evaluation of risk reduction options (RROs). The European Commission Annexes WG recommended to continue the pest risk assessment with the aim to develop RROs on the basis of the pathways of spread identified in the pest categorisation.

The Panel interpreted the ToR as a request to conduct a full PRA for *C. platani* with the aim to assess the effectiveness of RROs on the basis of the mechanisms of spread identified in the pest categorisation (natural and human-assisted means, including waterways, root anastomosis, contaminated pruning tools, machinery, insects, contaminated insect frass and sawdust). The risk assessment (RA) area is the EU territory.

While the ToR does not explicitly mention entry and establishment, the RA was performed also for these steps so as to be able to assess the potential contribution of new entries of the pathogen in the spread process.

Information already provided in the pest categorisation on *C. platani* (EFSA PLH panel, 2014) is not repeated here.

The consolidated version of the Council Directive 2000/29/EC last updated in June 2014 was considered in this RA (http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:02000L0029-20140630&from=EN).

The protected zone status of the UK for plants of *Platanus*, intended for planting, other than seeds, and wood of *Platanus* spp., including wood which has not kept its natural round surface (2000/29/EC), was not considered in the scenarios of this RA, (a) to simplify an already complex RA, and (b) given the recent PRA performed in the UK (Woodhall, 2013).

1.3. Specification of the scenarios

The risk assessment was carried out for the following three scenarios:

- A_0 scenario describes the current situation in the RA area with respect to the EU legislation (Council Directive 2000/29/EC) on the pathogen and its host as well as the emergency measures applied by the *C. platani*-affected EU Member States (EU MSs).
- A_1 scenario describes the situation without RROs and is used to demonstrate the worst-case scenario.
- A_2 scenario describes the current situation but with the application of additional RROs. In this scenario, the application of a combination of the most effective RROs is considered.

All the scenarios also include the current agricultural practices (Good Agricultural Practices) commonly adopted in the RA area.

A summary of the RROs considered in scenarios A_0 and A_2 is reported in Appendix C.

1.3.1. Definitions specific for the assessment

C. platani forms three types of asexual spores: cylindrical endoconidia, doliform endoconidia and aleurioconidia (chlamydospores); it also produces ascospores (sexual spores), which are expelled in a sticky mass from the ostioles of the perithecia (Engelbrecht and Harrington, 2005). All types of spores can cause infections. The pathogen infects *Platanus* trees through wounds or other injuries made on the host by abiotic or biotic agents (Vigouroux and Stojadinovic, 1990). Once the pathogen's spores come into contact with a wound, they germinate and the developing mycelium colonises the exposed tissues and advances into the xylem tissues of the underlying sapwood, where it develops both longitudinally and tangentially. All types of spores are formed within 2–8 days following infection in the form of an ash-coloured, powdery layer, mainly on pruning cuts (Panconesi, 1999; Engelbrecht and Harrington, 2005). Spores may also be produced in abundance inside the xylem vessels of the host, especially aleurioconidia, within 10–20 days following infection (Panconesi, 1999).

The optimum temperature for the growth of *C. platani* is 25°C; the fungus does not grow at temperatures below 10°C or above 35°C, but it survives at temperatures of 35°C, losing its viability at higher temperatures, reported as above 37.5°C (Pilotti et al., 2016) or 35–40°C for 48 h (Mutto Accordi, 1989). However, inside wood, the fungus survived after exposure to temperatures of 40°C for 24 h and lost its viability after 48 h at this temperature (P. Tsopelas, unpublished data). *C. platani* can survive for several years at −17°C (Pilotti et al., 2016). Mutto Accordi (1989) showed that the pathogen can survive in soil for more than 3 months during winter, while its survival potential in soil decreases quickly in spring and summer. The same author also reported that the pathogen can survive for at least 6 months in wood dust fragments on woodpiles and for 75 days in wood dust left on soil.

1.3.1.1. Pathways of entry

The Panel identified the following pathways for the entry of *C. platani* into the RA area:

a) Host plants for planting
b) Wood (any type of wood, including wood packaging material)
c) Machinery (construction/terracing/logging), pruning and cutting tools
d) Soil and growing media
    1) associated with living plants
    2) as commodities
    3) as a contaminant attached to various means (i.e. footwear, vehicles, etc.)
e) Waterways
f) Biological agents

Of the above-mentioned pathways, the host plants for planting, the wood and the machinery pathways are considered by the Panel as major pathways for the entry of the pathogen into the RA area. The soil and growing media pathway is considered a minor pathway, as it is very unlikely for living propagules of the fungus present in the soil and growing media to come into contact with wounded roots of *Platanus* trees and cause infection.

Two additional pathways, namely waterways and biological agents able to mechanically transfer the fungus (e.g. insects, birds and other animals), are considered of minor importance for the entry of the pathogen into the RA area, as they are valid only in a few cases (e.g. in case of waterways from affected European Third Countries to neighbouring EU MSs with the presence of susceptible hosts).

a) Host plants for planting

Platanus species are the only known hosts of *C. platani* (Woodhall, 2013). *Platanus* spp. plants for planting originated in affected areas may become infected and carry the pathogen in the form of mycelium and/or spores (Tubby and Pérez-Sierra, 2015). It has been speculated that the pathogen spread from Italy or France to Greece on infected *Platanus* plants (Ocasio-Morales et al., 2007). This was further supported by genotyping studies, which showed that the genotype present in Greece was identical to the genotype reported earlier from Italy, France and Switzerland (Ocasio-Morales et al., 2007) and different from the genotype present in the USA. There is only one interception in Europhyt in February 2015, which concerned plants for planting of *P. orientalis* imported into Cyprus from Greece. The nursery in Greece was inspected twice and five out of a total of 152 plants were found to be infected by the pathogen.

b) Wood (any form of wood, including wood packaging material)

Since *C. platani* survives for long periods of time in deadwood, all wood products, including wood particles, sawdust, shavings, wood waste and chips obtained from infected host plants, may carry the pathogen (Grosclaude et al., 1988; Mutto Accordi, 1989; Panconesi, 1999; Engelbrecht et al., 2004). *C. platani* can enter into and spread within the RA area on various forms of infected host wood material (saw logs, timber, lumber, wood chips, dunnage, pallets, packaging material, firewood, etc.) originated in affected areas. It is widely accepted that the first introduction of the pathogen from the USA into Europe (Italy) was with wood used as packaging material during the World War II (Panconesi, 1972, 1973, 1999; Cristinzio et al., 1973).

No specific data on the trade of *Platanus* wood are available in Eurostat.

c) Machinery (construction, excavation, terracing, logging), including pruning and cutting tools

The pathogen may enter into the RA area with contaminated soil and sawdust as well as with other woody host plant debris attached to construction, excavation, terracing or logging machinery previously used in affected areas (Walter, 1946; Walter et al., 1952; Panconesi, 1999; Panconesi et al., 2003). Such machinery can also spread the pathogen over long distances within the RA area. The pathogen is assumed to have been transferred from Peloponnese (southern Greece) to Epiros (north-western Greece) on road construction machinery and vehicles that had previously been used in affected areas in Peloponnese (Tsopelas and Soulioti, 2010, 2013). It has also been suggested that the pathogen was spread from France to Spain on machinery that had visited affected areas in France. Following the first detection of the disease in south-eastern Albania, Tsopelas et al. (2015a) speculated that construction and terracing machinery used in the Greek-Albanian borders was probably one of the means by which the pathogen spread from one country to the other.

In addition to transferring the pathogen to new areas, construction, excavation, terracing and logging machinery is also responsible for the majority of new infections of plane trees in both urban and rural environments through the wounds they cause on the crown, trunk and roots of susceptible hosts (Panconesi, 1999; Panconesi et al., 2003; Ocasio-Morales et al., 2007). Plane trees in streets, parks and open-air parking places are particularly subjected to wounds made to their roots and trunks by machinery during construction or other work carried out around the trees (e.g. construction of pavements, power lines, gas lines, water mains, mechanical weed removal, lawn cutting, etc.) as well as by vehicles, especially in open-air parking places (Ferrari and Pichenot, 1976; Panconesi, 1999; Panconesi et al., 2003).

Pruning and cutting tools (pruning scissors, secateurs, axes, saws) are an important pathway of entry into and spread within the RA area of *C. platani*. The pathogen can be transferred on such tools in the form of spores and/or infected sawdust. *C. platani* spores attached to pruning tools maintain their viability for about 1 month (Crone, 1962) and infected sawdust may harbour viable spores of the pathogen for at least 5 years (Grosclaude et al., 1993, 1996). According to Walter (1946), pruning saws were found to be highly effective in inoculating plane trees on the 12th day after their contamination, the longest interval tested. Tests involving a period of 4 years have shown that infection develops in about 40% of the wounds made during the growing season with saws that have been used in diseased trees immediately beforehand (Walter, 1946).

d) Soil and growing media (associated with living plants, as a commodity or as a contaminant attached to various means)

The pathogen can survive for more than 3 months in soil during the winter, but its survival potential decreases quickly during spring and summer (Mutto Accordi, 1989). Contaminated soil and growing media can be a pathway of entry into and spread within the RA area of *C. platani*, even if there are no reports on this so far. However, it is very unlikely for living propagules of the fungus in the soil to come into contact with wounded roots of *Platanus* trees and start infections.

1.3.1.2. Mechanisms of spread

The Panel identified the following mechanisms of spread of *C. platani* within the RA area in addition to those mentioned above regarding entry (i.e. host plants for planting, wood and machinery, including pruning/cutting tools):

a) Root anastomosis
b) Natural spread through wind (mainly sawdust)
c) Water courses (carrying *C. platani* spores, infected sawdust, pieces of wood, insect frass, etc.)
d) Biological agents able to mechanically transfer the fungus (e.g. insects, birds and other animals)
e) Natural spread through rain and running surface water
f) Wound dressing

Of the above-mentioned means, host plants for planting, wood, machinery (including pruning/cutting tools), root anastomosis and natural spread through wind are considered by the Panel as major mechanisms for the spread of the pathogen into the RA area.

a) Root anastomosis

Because of their riparian nature, *Platanus* trees are usually grown together along the sides of streams and rivers with resulting root anastomosis (Tsopelas et al., 2006). A similar situation occurs in urban areas, where plane trees are planted in the pavements. In such cases, once the pathogen is established in a host tree, it may spread to neighbouring trees through root anastomosis (Mutto Accordi, 1989; Tsopelas et al., 2006; Gilbert, 2007), especially if the trees grow close to each other or if dead or dying infected trees are left standing for a long time before being removed. Therefore, root anastomosis is considered to be a pathway for the spread of the pathogen over short distances within the RA area. Spread of the pathogen between neighbouring trees through root anastomosis has been shown experimentally by Mutto Accordi (1986) and has also been reported by Panconesi (1999), Tsopelas et al. (2006), Tsopelas and Soulioti (2013) and Vigouroux (2013). Based on examination of root systems of infected dead and dying trees of *P. orientalis* in the region of Messinia Prefecture (south-western Peloponnese, Greece), Ocasio-Morales et al. (2007) suggested that, in some cases, the pathogen had spread between adjacent trees through root anastomosis. Panconesi et al. (2003) reported that the spread of the disease through root anastomosis is particularly dangerous in the case of street *Platanus* trees grown in rows or in natural stands along rivers and streams where the trees grow very close together. Similarly, Perry and McCain (1988) suggested that root anastomosis was involved in the spread of the disease in street *Platanus* plantings in the region of Modesto (California, USA).

b) Natural spread through wind (mainly sawdust)

Although it has not been extensively studied, *C. platani* inoculum (ascospores, conidia) and infected sawdust can spread by weather-related events, such as wind, wind-driven rain, etc. (CABI, 2014). Luchi et al. (2013) trapped airborne inoculum of *C. platani* up to a maximum distance of 200 m from the closest symptomatic infected plane tree. Panconesi (1999) also reported that infected sawdust can be spread over long distances by wind.

c) Water courses (carrying *C. platani* spores, infected sawdust, pieces of wood, insect frass, etc.)

The pathogen can spread within the RA area over short and long distances through the water of rivers, streams and channels (Panconesi, 1999; Panconesi et al., 2003). Because *P. orientalis* in its native range is a riparian species and *P.* × *acerifolia* is widely planted in France, Switzerland and Italy as a row species along rivers and channels (Grosclaude et al., 1991), water courses can be an important mechanism of spread.

Dead logs and pieces of branches from infected plane trees as well as spores of the pathogen may be carried by the water downstream, creating new infection foci (Grosclaude et al., 1991; Panconesi, 1999; Panconesi et al., 2003; Ocasio-Morales et al., 2007). *C. platani* spores, especially chlamydospores, can survive in river water and may cause infections into roots damaged by rolling pebbles and other material (logs, branches, etc.) carried by the water (Vigouroux and Stojadinovic, 1990; Grosclaude et al., 1991; Ocasio-Morales et al., 2007). Infected sawdust or insect frass may also be carried by stream water and can come into contact with wounded roots causing infections.

d) Biological agents able to mechanically transfer the fungus (e.g. insects, birds and other animals)

C. platani spores present between cracks in the bark or at the base of the trees, as well as in the debris produced by some insects (nitidulids, wood-dwelling scolitids, etc.) are the main sources of inoculum (Panconesi et al., 2003). This inoculum may spread, sometimes over considerable distances, by insects, small rodents, birds, etc., that may have either an active role by wounding the tree and transporting inoculum, or a passive one, by only wounding the tree and leaving infection to chance (Panconesi et al., 2003). Plane wood infected by *C. platani* has a fruity odour that attracts different kind of insects, and this has also been observed with other species of *Ceratocystis* and other ophiostomatoid fungi on different woody hosts (Panconesi et al., 2003). It is considered as an adaptation for fungal dispersal by insects. In addition, because of the morphology of the pathogen's perithecia (globose base with a long neck), the spore mass is located higher than the substrate, thus facilitating dispersal, especially by insects (Panconesi, 1999). Other types of *C. platani* spores (chlamydospores, endoconidia) can also be carried by insects. It is well known that bark beetles and ambrosia beetles are attracted to diseased plants and can carry spores of fungal pathogens to healthy plants initiating infections (Ploetz et al., 2013).

Crone (1962) in the USA showed that *C. platani* can be transmitted by certain insect species of the family Nitidulidae, such as *Colydium lineola, Laemophloeus biguttatus, Colopterus semitectus,* *Colopterus unicolor, Colopterus niger* and *Carpophilus lugubris*. In recent studies, Soulioti et al. (2015) demonstrated that the ambrosia beetle *Platypus cylindrus* can transmit *C. platani* to healthy trees. *P. cylindrus* is very common in Greece and Albania on *P. orientalis* trees that have been infected for long periods (1–2 years) and has also been reported on infected *P. acerifolia* trees in Italy. *P. cylindrus* usually does not infest healthy plane trees, however, it is attracted to trees that have been freshly wounded by humans (pruning or other type of wounds), animals or by natural means (wind, floods, etc.).

C. platani can be traced in the frass of insects that feed on infected plane trees and the fungal spores can survive passage through the gut of insects (Crone, 1962). Crone (1962) demonstrated infection of healthy *P. acerifolia* trees with frass from *Carpophilus lugubris* and Ocasio-Morales et al. (2007) isolated the fungus from frass of *P. cylindrus*. Frass of *P. cylindrus* containing live propagules of *C. platani* and dispersed by wind or through river water or rain may contribute to new infections (Ocasio-Morales et al., 2007; Soulioti et al., 2015). The insect *Corythucha ciliata* ('tiger of plane tree'), frequently found on leaves of plane trees grown in southern and central Europe, could be a potential carrier of *C. platani* spores, but its role in the dispersal of the pathogen has not been documented and no evidence has so far been reported that it may carry the pathogen (Panconesi, 1999; Tsopelas et al., 2006).

Some authors (Walter, 1946; Panconesi, 1999) have suggested that birds, squirrels and other rodents may transmit *C. platani*. Roots of *Platanus* trees growing along river sides can be wounded by rodents that can also carry propagules of the fungus and cause infections. However, there is no evidence for this type of transmission and these animals do not seem to play a major role in the spread of the pathogen (Panconesi, 1981).

e) Natural spread through rain and running surface water

Although it has not been extensively studied, *C. platani* inoculum (ascospores, conidia) can spread by rain and running surface water (CABI, 2014). Also, infected sawdust and pieces of wood as well as insect frass can be transferred by rain and running surface water to cause new infections (Panconesi, 1999). As *P. orientalis* is a riparian species, the ability of the pathogen to disperse along water courses implies that the disease can spread relatively rapidly downstream within watercourses (Woodhall, 2013).

f) Wound dressing

Contaminated wound dressing is considered to be a very effective mechanism of spread of *C. platani* (Walter, 1946). During handling by the arborist, the brush used for the application of the wound dressing collects sawdust and fragments of bark and wood from diseased trees and transfers them to the wounds made on the healthy trees during the pruning operations. Field and laboratory tests have demonstrated that the pathogen survives for quite long periods in wound dressings. However, this technique is no longer or rarely used in plane trees.

1.3.1.3. Unit definitions

Pathway units

For the plants for planting pathway, a single *Platanus* plant was chosen as a pathway unit.

For the wood pathway, 1 m^3 of wood was chosen as a pathway unit, as this is the unit used in the Eurostat database.

For the machinery/pruning/cutting tools pathway, one single construction, terracing, logging, etc. machinery or pruning/cutting tool was chosen as a pathway unit.

1.3.1.4. Definition of abundance of the pest

For the plants for planting pathway, pest abundance (prevalence) is defined as the percentage of infected plants for planting.

For the wood pathway, pest abundance (prevalence) is defined as the percentage of infected m^3 of wood.

For the machinery, pruning and cutting tools pathway, pest abundance (prevalence) is defined as the percentage of contaminated machinery or pruning/cutting tools.

1.3.1.5. Definitions relevant to the risk reduction options (RROs)

The RROs are defined according to the guidance provided by the EFSA PLH working group on the methodology for quantitative risk assessment. Details on RROs are provided in Appendix C.

1.3.1.6. Ecological factors and conditions

The assessment is done considering the current ecological conditions. No additional scenarios are defined in relation to ecological factors and conditions in the RA area.

1.3.2. Temporal and spatial scales

See Section 1.3.3.

1.3.3. Summary of the different scenarios

A summary of the key elements for the three scenarios considered is provided in Table 1.

Table 1: Summary of the main elements of the three scenarios considered in the RA

Pathways	**ENTRY** 1) Host plants for planting 2) Wood (any form of wood, including wood packaging material) 3) Machinery, pruning and cutting tools
Means	**SPREAD** 1) Host plants for planting 2) Wood (any form of wood, including wood packaging material) 3) Machinery, pruning and cutting tools 4) Root anastomosis 5) Natural spread through wind
Units a) Entry b) Establishment c) Spread	**a) Entry** 1) Plants for planting: one single *Platanus* plant 2) Wood: 1 m^3 (Eurostat unit of measure) 3) Machinery: one single construction/terracing/logging/military vehicle or one pruning/cutting tool **b) Establishment** For pathways of entry 1, 2 and 3 (see above): one living infected *Platanus* plant (founder population) **c) Spread** For pathways 1, 2 and 3 (see above): one single NUTS3 region
Subunits a) Entry b) Establishment c) Spread	Not considered
Abundance of the pest in the a) Production/growing area b) Pathway unit c) Pathway subunit d) Transfer unit	a) % infected host plants b) and d) for pathway 1: % infected host plants for pathway 2: % of infected m^3 of wood, for pathway 3: % of contaminated machinery or pruning/cutting tools
Production unit	Single plants
Service providing unit	Provisioning services, such as firewood and all those related to ornamental trees
Critical value economically important losses: quantity	No thresholds because of the severity of the disease, i.e. the disease is able to kill the plants, so the number of affected plants can be equated to the losses. This implies that the endangered area corresponds to the distribution of the host in the RA area
Critical value economically important losses: quality	As above for quantity
Critical value environmentally important losses	As above for quantity

Scenario A_0 assesses the current regulatory situation, which is assumed to be maintained for the next 10 years (Table 2). Nevertheless, in cases where (i) the disease will affect other European Third Countries from which it could spread to the RA area, (ii) the trade of host plants will change concerning both the place of origin and the trade volume and (iii) the current EU regulations will not be extended to these newly affected Third Countries, the assessment based on the A_0 scenario will not be valid.

Table 2: Summary of the main elements (steps, scenarios and scales) of the RA

ASSESSMENT		**STEPS**			
		Entry	**Establish-ment**	**Spread**	**Impact**
Scenarios	All pathways	No change is expected with regard to the pathways of entry in the time horizon (10 years).	No change is expected with regard to the establishment in the time horizon (10 years).	No change is expected with regard to the mechanisms of spread in the time horizon (10 years).	No change is expected with regard to the impact in the time horizon (10 years).
	RROs	See Appendix C			
	Ecological factors and conditions	Current situation	Current situation	Current situation	Current situation
Scales	Temporal horizon	10 years	10 years	10 years	10 years
	Temporal resolution	One year	One year	One year	One year
	Spatial extent	RA area	RA area	RA area	RA area
	Spatial resolution	RA area	RA area	NUTS3	RA area

RA: risk assessment.

2. Data and methodologies

2.1. Data

A literature search (up to August 2016) was made following the strategy described in the pest categorisation, so as to retrieve relevant papers that appeared since the time the pest categorisation was published (2014). The content of these publications is considered in the risk assessment wherever relevant.

Data on which to base many of the quantitative estimations presented here were either not available or incomplete. Expert judgment was thus used in most cases. The quantitative estimations provided by the experts should be taken with caution, as different experts might provide different figures in such a situation where evidence (either published or unpublished) is lacking. One exception was the historical spread of the pathogen through Europe, for which the dates of first reports were obtained from some National Plant Protection Organizations (i.e. France and Italy) and were kindly provided by Panagiotis Tsopelas (Greece) at the level of NUTS3 regions.

2.2. Methodologies

The Panel performed the pest risk assessment for *C. platani* following the guiding principles presented in the EFSA Guidance on a harmonised framework for risk assessment (EFSA PLH Panel, 2010) and as defined in the International Standard for Phytosanitary Measures (ISPM) No. 11 (FAO, 2013).

When conducting this pest risk assessment, the Panel took into consideration the following EFSA horizontal guidance documents:

- Guidance of the Scientific Committee on Transparency in the Scientific Aspects of risk assessments carried out by EFSA. Part 2: General Principles (EFSA, 2009),
- Guidance on Statistical Reporting (EFSA, 2014),
- Guidance on the structure and content of EFSA's scientific opinions and statements (EFSA Scientific Committee, 2014),
- Guidance on uncertainty (EFSA Scientific Committee, 2016).

The assessment follows a quantitative approach, in which the steps of entry, establishment, spread and impact are elaborated quantitatively for the three pathways identified under three RRO scenarios, identified as A_0, A_1 and A_2, according to the ToR. Within each step, substeps are distinguished to quantitatively assess the underlying component processes. An overall summary description of the steps is provided in Appendix B which describes the overall risk assessment model without mathematical equations.

Uncertainty involved in estimating entry, establishment, spread and impact, is represented using a probability distribution which expresses the best estimates of the uncertainty in the quantity assessed by the experts considering both available data and judgement. The distribution is characterised by a median value and four additional percentiles of the distribution. The median is the value for which the probability of over- or under-estimation of the actual true value is judged as equal. Calculations with the model are made by stochastic simulation, whereby values are drawn randomly from the distribution specified for each parameter. The stochastic simulations are repeated 20,000 times to generate a probability distribution of outcomes, i.e. the outcome of the entry, establishment, spread and impact process in a given time period in the future.

In the model calculation, the uncertainty of each component is passed through the model equation, in a way that its contribution to the uncertainty of the final result can be shown. The decomposition of uncertainty calculates the relative contribution (as a proportion) of each individual input to the overall uncertainty of the result (sum to 1).

Section 3 of the assessment reports the outcomes of scenario calculations. The distributions given in this section characterise the possible range of outcomes at the time horizon of the opinion under a certain scenario.

The distributions of the uncertain components are characterised by different values and ranges:

The median is a central value with equal probability of over- or under-estimating the actual value. In the opinion, the median is also referred as ‘best estimate’.

The interquartile range is an interval around the median, where it is as likely that the actual value is inside as it is likely that the actual value is outside that range. The interquartile range is bounded by the 1st and 3rd quartile (the 25th and 75th percentile) of the distribution. This range expresses the precision of the estimation of interest. The wider the interquartile range, the greater is the uncertainty on the estimate. In this opinion, we refer to the interquartile range by using the term ‘uncertainty interval’.

For experimental designs, it is common to report the mean (m) and the standard error ($\pm$ s) for the precision of the estimate of a measured parameter. The interval: m $\pm$ s ([m $-$ s, m $+$ s]) is used to express an interval of likely values. This estimation concept is based on replicated measurements. In the context of uncertainty, it is not reasonable to assume replicated judgements. Therefore, the median and interquartile ranges are used instead of the mean and the interval m$\pm$s, but the interpretation as the precision of judgements is similar.

In addition to the median and interquartile ranges, a second range is reported: the credibility range. The credibility range is formally defined as the range between the 1st and 99th percentile of the distribution allowing the interpretation that it is extremely unlikely that the actual value is above the range, and it is extremely unlikely that it is below the range, respectively.

Further intervals with different levels of coverage could be calculated from the probability distribution, but these are not reported as standard in this opinion.

Please note that the number of significant figures used to report the characteristics of the distribution does not imply the precision of the estimation. For example, the precision of a variable with a median of 13 could be reported using the associated interquartile range, perhaps 3–38, which means that the actual value is below a few tens. In the opinion, an effort was made to present all results both as a statement on the model outcome in numerical expressions, and as an interpretation in verbal terms.

Nevertheless, the distributions of one variable under different scenarios can be compared via the corresponding median values, e.g. consider a variable with a median value of 13 within scenario 1 and the same variable with a median value of 6 within scenario 2. This can be interpreted as the variable in scenario 2 being about half of scenario 1 in terms of its central value. The same principle is also valid for other characteristics of the distribution of a variable under different scenarios, such as comparisons of quartiles or percentiles.

2.3. Integration of risk reduction options in the risk assessment

A quantitative assessment was provided for the effectiveness of the combined RROs in the current situation (A_0 scenario) and in the scenario with additional RROs (A_2 scenario). Details are shown in Appendix C.

3. Summary of the assessment

3.1. Entry

The model of entry shown in Appendix A was used for the assessment of the various substeps of the entry process. The main characteristics of the three scenarios considered (A_0, A_1 and A_2) and of the three pathways of entry (host plants for planting, wood and machinery, including pruning/cutting tools) are described in Section 1.3. Detailed information on the entry assessment can be found in Appendix B.1.

3.1.1. Presentation of the results

The results of the entry assessment are shown in Table 3 (all pathways combined) and Figure 1 (by individual pathway and for all pathways combined). Table 3 reports five quantile values (1st, 25th, 50th, 75th and 99th) of the number of potential founder populations of *C. platani* expected per year due to new entries in the EU in the next 10 years for scenarios A_0, A_1, and A_2, whereas Figure 1 shows the estimated continuous probability distribution associated with the values of the number of potential founder populations.

Table 3: Quantile values of the distribution of the number of potential founder populations of *C. platani* expected per year due to new entries in the EU in the next 10 years for scenarios A_0, A_1 and A_2 (all pathways combined)

Overall assessment quantile	Low (1%)	1st Quartile (25%)	Median (50%)	3rd Quartile (75%)	High (99%)
Number of potential founder populations for scenario A_0	0.00	0.11	0.26	0.54	2.4
Number of potential founder populations for scenario A_1	0.01	0.28	0.85	2.4	21
Number of potential founder populations for scenario A_2	0.00	0.00	0.02	0.06	0.51

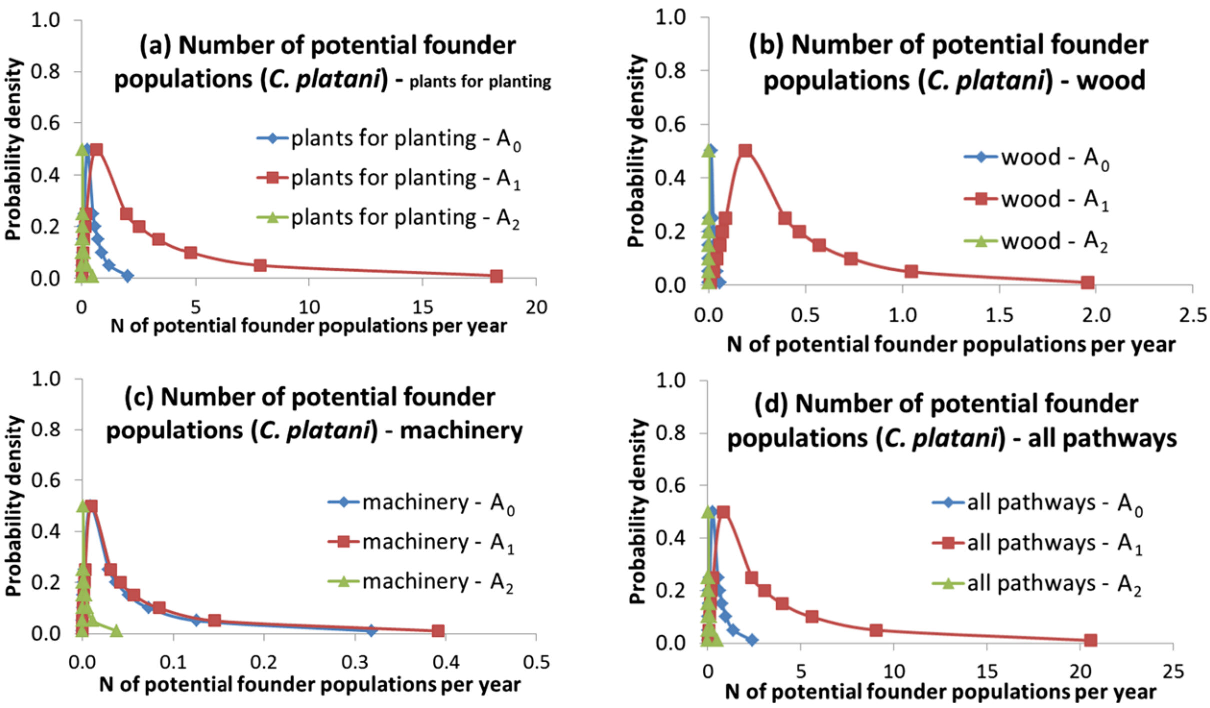

Figure 1: Graphs showing the outcome of the assessment for entry with regard to the number of potential founder populations of *C. platani* expected per year due to new entries in the EU for the three scenarios (A_0, A_1 and A_2), for (a, b, c) each of the three different pathways of entry (host plants for planting, wood and machinery), and (d) for all the pathways combined

Four main points can be highlighted in Figure 1:

1) The highest number of founder populations of *C. platani* results from scenario A_1 and the lowest from scenario A_2. This is the case both for individual pathways (with the exception of machinery, where the A_0 and A_1 scenarios overlap) (Figure 1a, b, c) and for all pathways combined (Figure 1d).
2) Most founder populations are due to the pathways plants for planting (Figure 1a) and wood (Figure 1b), while the number of expected entries due to the machinery pathway (Figure 1c) is much lower.
3) For the wood pathway (Figure 1b), the number of potential founder populations of *C. platani* under scenario A_0 and under scenario A_2 are very similar, which means that no significant improvement of the current situation with additional RROs can be obtained. Nevertheless, removing the current measures would worsen the situation considerably.
4) For the machinery pathway (Figure 1c), the number of potential founder populations of *C. platani* under scenario A_0 (current situation) and under scenario A_1 (without measures) are very similar, which reflects the absence of measures in place with respect to machinery. However, the measures considered by the Panel in scenario A_2 would be able to remove most of the risk of further entries of the pathogen due to the machinery pathway.

3.1.2. Uncertainty

The uncertainty associated with the different scenarios is represented by the range and the distribution in the predicted number of potential founder populations per year as shown in Table 3 and in Figure 1. The contribution to the overall uncertainty of the various factors considered in the entry assessment is shown in Figure 2.

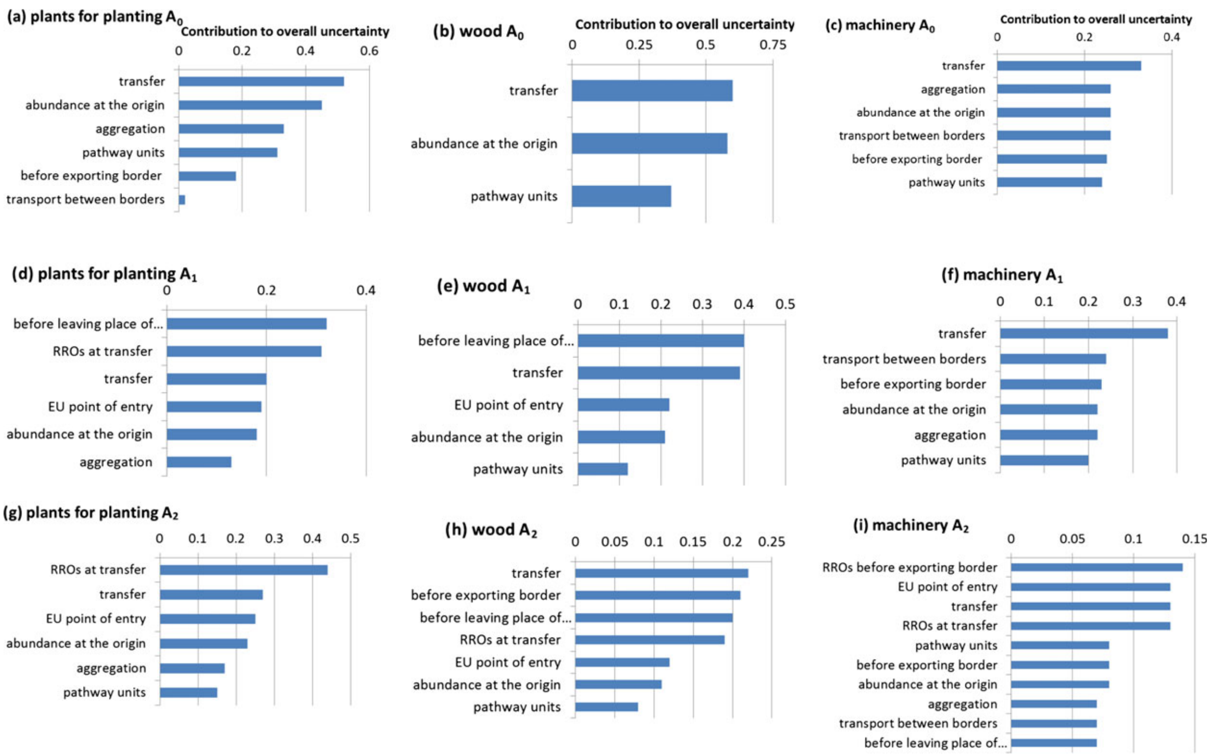

Figure 2: Bar chart showing an index for the uncertainty associated with parameter estimates for factors influencing the entry of *C. platani* into the risk assessment area for the three pathways (host plants for planting, wood and machinery) and the three scenarios considered (A_0, A_1 and A_2). The number of factors differs between scenarios as only in scenarios A_1 and A_2 factors related to RROs were considered

3.1.3 Discussion on the entry assessment

- Under the conditions of the scenarios of this risk assessment, the entry of 2.6 (median value) new potential founder populations of *C. platani* is expected in 10 years in the risk assessment area in the current situation (scenario A_0). In case all EU regulations are removed (scenario A_1), the number of new potential founder populations over 10 years increases to 8.5. In case the additional RROs of scenario A_2 are implemented, the number decreases to 0.2.
- Considering the median values, the expected number of potential founder populations is relatively limited, but under the A_1 scenario (without measures) in the 99th percentile (the worst case), this number becomes considerable (210 new potential founder populations of *C. platani* are expected in 10 years in the risk assessment area). This value considers that there might be additional affected Third Countries which may not currently be recognised as having the disease.
- The entry assessment highlighted important differences among the various entry pathways, with plants for planting as the most important pathway. The median value of the number of potential founder populations due to the plants for planting pathway is expected to be about 20 times higher than the number of potential founder populations due to the wood pathway. In turn, the number of potential founder populations due to the wood pathway is expected to be 40% higher than the number of potential founder populations due to the machinery pathway.
- The uncertainty associated with the estimated numbers of potential founder populations is evaluated in terms of the width of the distribution. The ratio of the 99th percentile by the 1st percentile value for the estimated number of potential founder populations is about 400, 1,600 and 5,000 times for the A_0, A_1 and A_2 scenarios, respectively, implying relatively limited uncertainty for scenario A_0 compared to the other two scenarios.
- The relative contribution of the considered factors to the overall uncertainty varies between pathways and scenarios (Figure 2). In general, there are no dominant factors to which a major contribution to the overall uncertainty regarding entry can be attributed.
- However, for scenario A_0 (current situation), transfer of the pathogen to susceptible hosts is a key factor contributing to the uncertainty for all pathways. Transfer is also a relatively important factor for the uncertainty in scenarios A_1 (without measures) and A_2 (with additional RROs). Further work would, thus be required for addressing the specific lack of knowledge about the transfer process.

3.2. Establishment

The assessment of the establishment process followed the model of establishment described in Appendix A. In the model, the contribution of various factors affecting establishment was estimated. The differences between scenarios are obtained from a multiplication factor specific to scenarios A_1 and A_2 taking into account the effectiveness of the RROs. Detailed information on the establishment assessment can be found in Appendix B.2.

3.2.1. Presentation of the results

The results of the establishment assessment are shown in Table 4 and Figure 3. Table 4 reports five quantile values (1st, 25th, 50th, 75th and 99th) of the numbers of established populations per year of *C. platani* due to new entries expected for scenarios A_0, A_1 and A_2 in the next 10 years, whereas Figure 3 shows the estimated continuous probability distribution associated with the number of established populations.

Table 4: Quantile values of the distribution of the number of established populations of *C. platani* due to new entries expected per year in the EU for scenarios A_0, A_1 and A_2 (time horizon = 10 years)

Overall assessment quantile	Low (1%)	1st Quartile (25%)	Median (50%)	3rd Quartile (75%)	High (99%)
Number of established pathogen populations in the risk assessment area in scenario A_0	0.00	0.03	0.08	0.20	1.2
Number of established pathogen populations in the risk assessment area in scenario A_1	0.00	0.14	0.52	1.74	23
Number of established pathogen populations in the risk assessment area in scenario A_2	0.000	0.000	0.002	0.01	0.10

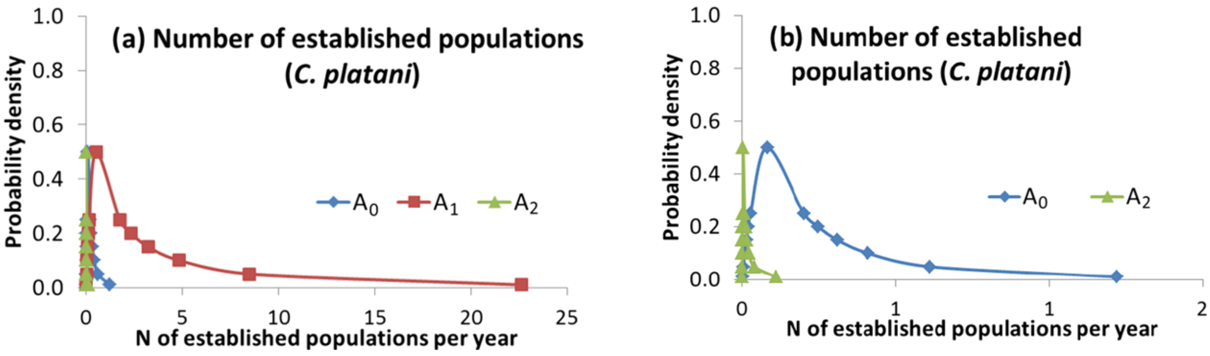

Figure 3: Graph showing the outcome of the assessment for establishment with regard to the number of established populations of *C. platani* expected per year due to new entries in the EU under the three scenarios considered (A_0, A_1 and A_2). As in graph (a) the much higher number of established populations resulting from scenario A_1 makes it difficult to notice the differences between scenario A_0 and A_2, an additional graph (b) with just the two latter scenarios is included

3.2.2. Uncertainty

The uncertainty associated with the different scenarios is given by the range in the predicted number of potential established populations per year as shown in Table 4 and Figure 3. Conversely, Figure 4 shows a visualisation of the contribution of the various factors to the uncertainty of the establishment assessment.

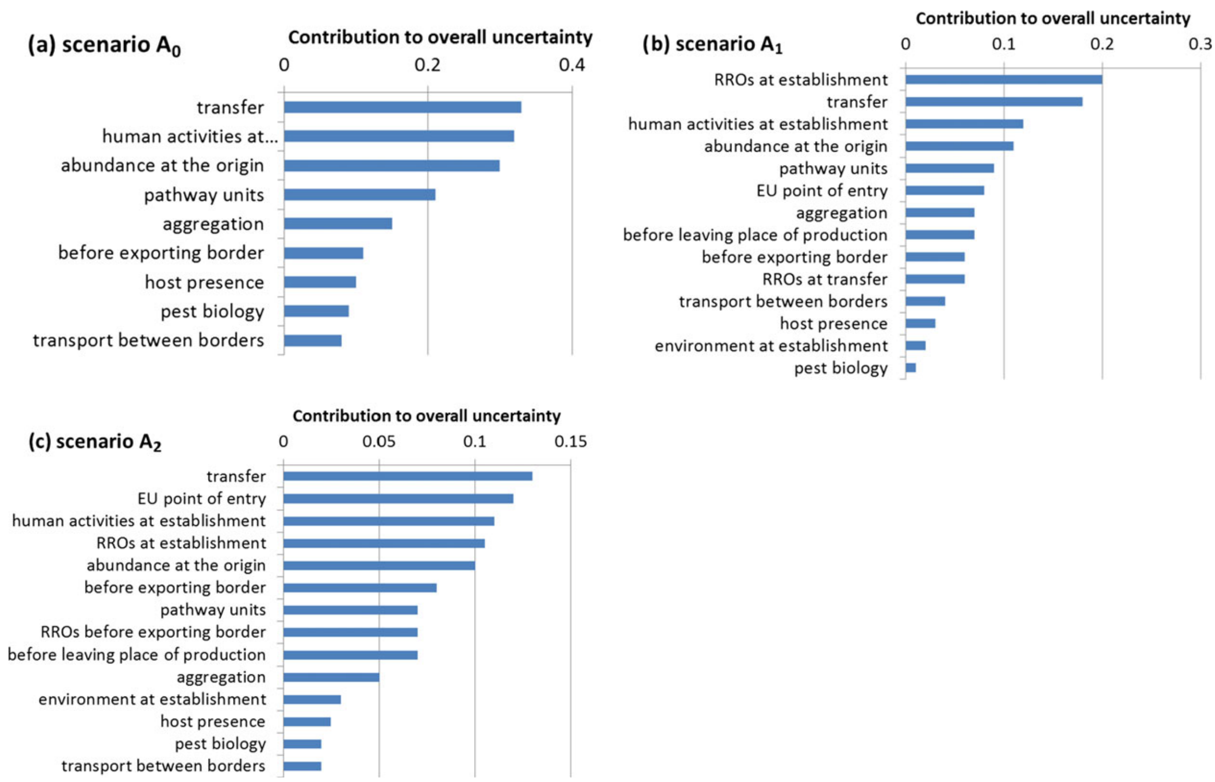

Figure 4: Bar chart showing an index expressing the contribution of the factors considered in the establishment to the overall uncertainty in the assessment of the number of established populations of *C. platani* in the RA area for the (a) A_0, (b) A_1 and (c) A_2 scenarios. The number of factors differs between scenarios as only in scenarios A_1 and A_2 factors related to RROs were considered

3.2.3. Discussion on the establishment assessment

- Under the conditions of the scenarios of this risk assessment, an establishment of less than 1 (median value 0.8) new potential founder populations of *C. platani* is expected in 10 years in the risk assessment area under current regulations (scenario A_0); the number of established populations is expected to be about six times higher for the A_1 scenario (without measures) compared to the A_0 scenario (current situation). In turn, the number of established populations is expected to be about 40 times lower in the A_2 scenario (with additional RROs) compared to the A_0 scenario.
- Considering the median values, the expected number of potential established populations is relatively limited, but under the A_1 scenario (without measures) in the 99th percentile (the worst case), this number becomes considerable. This value considers that there might be additional affected Third Countries which may not currently be recognised as having the disease.
- In comparison with entry, there are generally more factors to be considered for driving the uncertainty of the establishment assessment (those already considered for entry and additional ones specific to establishment), so that the model becomes more complicated and it is difficult to pinpoint particular factors which would benefit from additional data collection or more formal knowledge elicitation.
- The ratio of the 99th percentile by the 1st percentile values for the estimated number of established populations is about 2,000, 6,000 and 23,000 times, for the A_0, A_1 and A_2 scenarios, respectively, implying relatively higher uncertainty compared to the entry assessment. The overall uncertainty associated with the establishment assessment is higher for scenarios A_1 and A_1 compared to scenario A_0, as the width of the distribution for the number of established populations is larger in the former scenarios.
- The relative contribution of the considered factors to the overall uncertainty varies between scenarios (Figure 4). In general, there are no dominant factors to which a major contribution to the overall uncertainty regarding establishment can be attributed.
- However, for scenario A_0 (current situation), transfer of the pathogen to susceptible hosts, human activities in the RA area, and the abundance of *C. platani* at the place of origin are key factors. Transfer is also a determining factor for the overall uncertainty in scenarios A_1 (without measures) and A_2 (with additional RROs). Further work would, thus, be required to address the specific lack of knowledge about the transfer process.

3.3 Spread

The assessment of the spread process followed the model of spread reported in Appendix A. In the model, the relative importance of the different mechanisms of spread and the likely effectiveness of the RROs on the different mechanisms of spread is assessed (Table 5). While long-distance spread is considered in the spread section, short-distance spread is relevant to the section on impacts. Detailed information on the spread assessment can be found in Appendix B.3.

Table 5: Estimated (based on expert judgment) contribution (%, with the sum of the different mechanisms of spread adding to 100%) of the main mechanisms of spread of *C. platani* to its long- and short-distance spread rate

Mechanisms of spread	Contribution to long-distance spread (i.e. to other NUTS3 regions) (%)	Contribution to short-distance spread (i.e. within NUTS3 regions) (%)
Machinery (including pruning/cutting tools)	85%	45%
Wood	7.5%	3%
Plants for planting	3%	1%
Soil and growing media	1.5%	–
Root anastomosis	0%	45%
Other mechanisms of natural spread [mainly wind (sawdust), but also watercourses, dead wood in water, insects, mammals, etc.]	3%	6%

3.3.1. Presentation of the results

The results of the spread assessment are shown in Table 6 and Figure 5. Table 6 reports five quantile values (1st, 25th, 50th, 75th and 99th) of numbers of NUTS3 regions newly occupied by *C. platani* in 10 years for scenarios A_0, A_1 and A_2, whereas Figure 5 shows the estimated probability distribution associated with the number of NUTS3 regions newly occupied by *C. platani*.

Table 6: Quantile values of the distribution of the number of NUTS3 regions newly occupied by *C. platani* in the EU in 10 years for scenarios A_0, A_1 and A_2 (all mechanisms of spread)

Overall assessment quantile	Low (1%)	1st Quartile (25%)	Median (50%)	3rd Quartile (75%)	High (99%)
Number of NUTS3 regions newly occupied by *C. platani* for scenario A_0	3.5	12	15	17	19
Number of NUTS3 regions newly occupied by *C. platani* for scenario A_1	6.2	22	27	35	73
Number of NUTS3 regions newly occupied by *C. platani* for scenario A_2	0.4	2.4	4.0	6.1	12

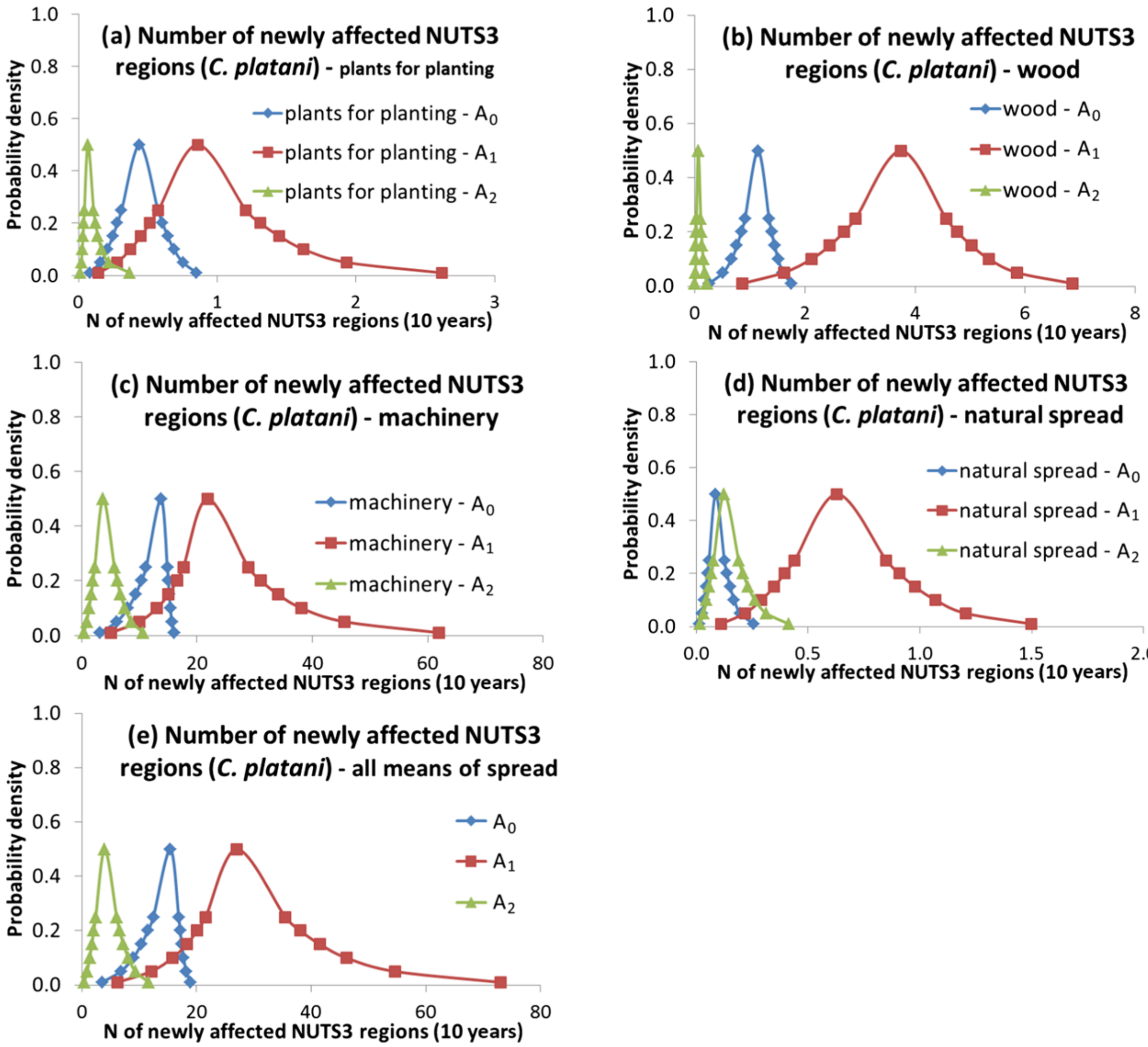

Figure 5: Graph showing the outcome of the assessment for spread with regard to the number of NUTS3 regions newly affected by *C. platani* over 10 years under the three scenarios (A_0, A_1 and A_2) for each of the main mechanisms of long-distance spread, i.e. (a) plants for planting, (b) wood, (c) machinery, and (d) natural spread (mainly wind-blown sawdust), and (e) for all the mechanisms of spread combined

3.3.2. Uncertainty

The uncertainty associated with the different scenarios is given by the range in the predicted number of newly affected NUTS3 regions over the next 10 years, as shown in Table 6 and Figure 5. Conversely, Figure 6 shows a visualisation of the contribution of the various factors to the uncertainty of the spread assessment.

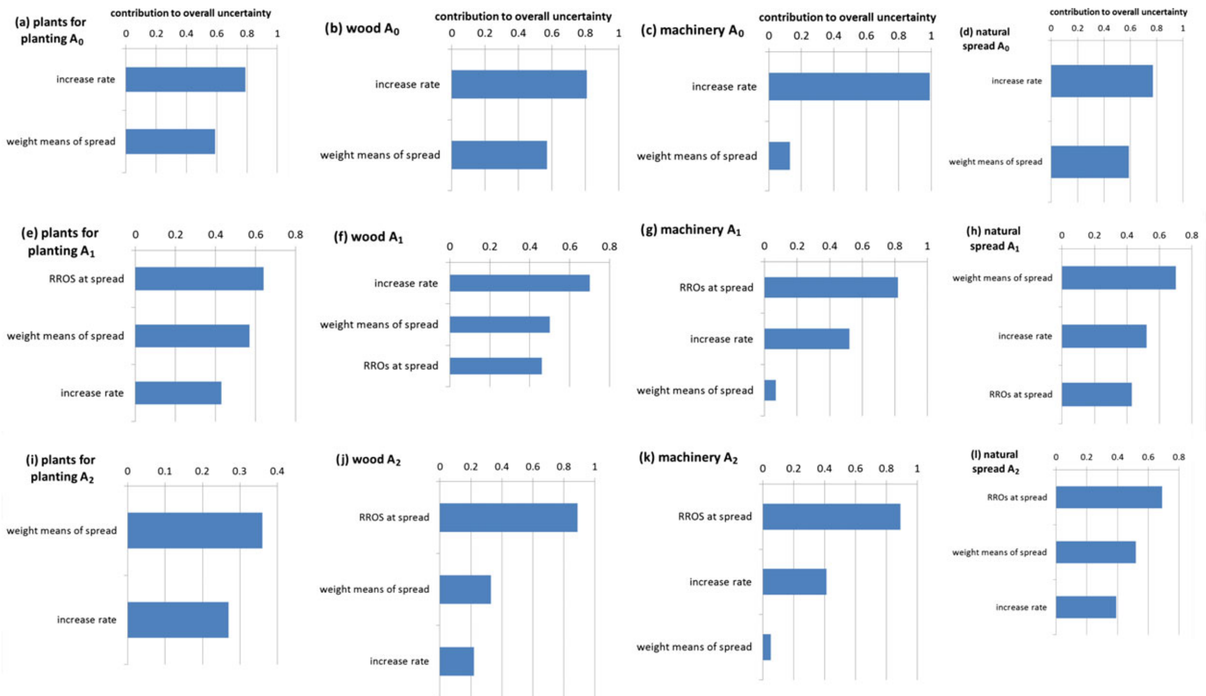

Figure 6: Bar chart indicating the contribution to the overall uncertainty of the factors (increase rate = estimated growth rate of the pathogen per year) influencing the number of newly affected NUTS3 regions due to spread of *C. platani,* for the four main mechanisms of long-distance spread, i.e. plants for planting, wood, machinery and natural spread (mainly wind-blown sawdust). The number of factors differs between scenarios as only in scenarios A_1 and A_2 factors related to RROs were considered

3.3.3. Discussion on the spread assessment

- Under the conditions of the scenarios of this risk assessment, and focusing on the median values, the number of newly affected NUTS3 regions over the next 10 years is expected to be roughly two times higher for the A_1 scenario compared to the A_0 scenario (15 and 27 NUTS3 regions for A_0 and A_1, respectively). Conversely, this number is expected to be about four times lower for the A_2 scenario (4 NUTS3 regions) compared to the A_0 scenario.
- Considering the median values, the expected number of NUTS3 regions newly affected by *C. platani* is considerable both in the A_0 and A_1 scenarios, and under the A_1 scenario (without measures) in the 99th percentile (the worst case), this number (73) becomes even greater. This value does not consider that there might be additional affected Third Countries which may not currently be recognised as having the disease, as it does not take into account the potential contribution of new entries.
- The most important mechanism of long-distance spread is machinery. Focusing the RROs on this mechanism of spread would thus be an effective way to reduce the risk of spread of *C. platani* to not yet affected EU NUTS3 regions.
- The ratio of the 99th percentile by the 1st percentile values for the estimated number of newly affected NUTS3 regions is about 5, 12 and 30 for the A_0, A_1 and A_2 scenarios, respectively, implying relatively limited uncertainty compared to the entry and establishment assessments. The overall uncertainty associated with the spread assessment is higher for scenarios A_1 and A_2 compared to scenario A_0, as the width of the distribution for the number of established populations is larger in the former cases.

- The relative contribution of the considered factors to the overall uncertainty varies between mechanisms of spread and scenarios (Figure 6). The uncertainty breakdown for scenario A_0 (current situation) shows that the most important factor contributing to uncertainty for all mechanisms of long-distance spread is the estimated growth rate of the pathogen per year (P_{5*} in Appendix B) (Figure 6). For scenarios A_1 (without measures) and A_2 (with additional RROs), for all mechanisms of spread (with the exception of wood and natural spread in the A_1 scenario), the effectiveness of the RROs applied to prevent spread is the most important factor contributing to uncertainty.

3.4. Impact

The disease appears particularly destructive on roadside *Platanus* trees periodically undergoing drastic pruning (Panconesi, 1981). In some large cities in USA, such as Boston, Chicago, Philadelphia, Baltimore, the disease killed 50–70% of roadside plane trees in about 20 years (Jackson and Sleeth, 1935; Walter et al., 1952). In Marseille, between 1960 and 1973, more than 3,500 out of a total of 11,000 plane trees averaging 100-year-old died and a similar number was found to be infected (Ferrari and Pichenot, 1974, 1976). Cristinzio et al. (1973) mentioned that in Italy, 900 plane trees more than a century old that grew along the avenue leading to the Royal Palace at Caserta, were cut down as a result of the disease. At Forte dei Marmi, surveys showed that more than 60% of the garden and roadside trees within city limits have died between 1971 and 1981 (Panconesi, 1981). Extensive tree mortality has also been reported in natural stands of *P. orientalis* in Greece. *C. platani* has destroyed thousands of trees along some of the major rivers in Peloponnese and Epirus regions and has the capacity to eliminate this tree species from many areas of the country (Ocasio-Morales et al., 2007; Tsopelas and Soulioti, 2013).

The assessment of the impact followed the model described in Appendix A. In the model, the initial conditions are considered as the abundance of *C. platani* in the areas where the pathogen is currently established in the EU at the beginning of the assessment period (year 2016). The increase in the area affected by the disease in 10 years is estimated considering a simplified epidemiological model describing the growth in the number of affected trees in the period considered by the assessment (10 years). The impact on the *Platanus* trees and on the environment is then calculated under the assumption that each affected tree dies in a relatively short time period. The differences between scenarios are obtained from a multiplication factor specific to scenarios A_1 and A_2 taking into account the effectiveness of the RROs. Detailed information on the impact assessment can be found in Appendix B.4.

3.4.1. Presentation of the results

The estimated abundance of *C. platani* in the spatial units, where the pathogen is currently established in the EU, at the beginning of the assessment period (year 2016; estimated using expert judgement) is the same for all scenarios (Table 7).

Table 7: Quantile values of the distribution of the estimated pest abundance in the initial conditions of the assessment (year 2016) expressed in terms of proportion of *Platanus* trees affected by *C. platani* in the spatial units where the pathogen is currently established in the EU (ranging from 0, no plants affected, to 1, 100% of plants affected) in the relevant habitats for scenarios A_0, A_1 and A_2

Overall assessment quantile	Low (1%)	1st Quartile (25%)	Median (50%)	3rd Quartile (75%)	High (99%)
Estimated abundance of the pathogen in the relevant crops/habitats for all scenarios (initial condition)	0.0001	0.005	0.01	0.04	0.20

The estimated impact (proportion of dead plants) is reported in Table 8.

Table 8: Quantile values of the distribution of the proportion of dead plants in the relevant habitats at the end of the time horizon (10 years) (ranging from 0, no dead plants, to 1, 100% of dead plants) for scenarios A_0, A_1 and A_2

Overall assessment quantile	Low (1%)	1st Quartile (25%)	Median (50%)	3rd Quartile (75%)	High (99%)
Estimated proportion of dead plants in the relevant habitats for scenario A_0	0.0004	0.005	0.014	0.041	0.52
Estimated proportion of dead plants in the relevant habitats for scenario A_1	0.0005	0.007	0.021	0.063	1.00
Estimated proportion of dead plants in the relevant habitats for scenario A_2	0.0003	0.004	0.012	0.035	0.44

Table 9 provides the results of the multiplication of the proportion of dead plants in the relevant habitats (Table 8) by the expected number of newly affected NUTS3 regions derived from the spread assessment (Table 6), thus providing a more informative assessment (in relative terms between the different scenarios) of the overall impact of *C. platani*.

Table 9: Quantile values of the distribution of the outcome of the multiplication of the proportion of dead plants in the relevant habitats at the end of the time horizon (10 years) (reported in Table 8) by the expected number of newly affected NUTS3 regions at the end of the same time horizon (reported in Table 6) for scenarios A_0, A_1 and A_2

Overall assessment quantile	Low (1%)	1st Quartile (25%)	Median (50%)	3rd Quartile (75%)	High (99%)
Estimated proportion of dead plants × number of newly affected NUTS3 regions for scenario A_0	0.005	0.08	0.23	0.66	3.15
Estimated proportion of dead plants × number of newly affected NUTS3 regions for scenario A_1	0.02	0.29	0.95	3.31	761
Estimated proportion of dead plants × number of newly affected NUTS3 regions for scenario A_2	0.0008	0.015	0.045	0.14	2.05

The estimated impact on ecosystem services (as a proportion expressing the reduction in the level of service provision) is shown in Tables 10–12. While *Platanus* is not a widespread tree species in European forest ecosystems, it is commonly planted in towns and along avenues. The loss of this tree species would lead not only to a reduction in ecosystem services, but also in the biodiversity associated with this tree species, although there is lack of knowledge to quantify such a biodiversity reduction. It is also possible that, by replacing homogeneous *Platanus* avenues with more diverse tree avenues, the biodiversity in towns would increase. But it would take a long time to replace ancient and majestic *Platanus* trees.

Table 10: Quantile values of the distribution of the estimated impact of *C. platani* on provisioning ecosystem services in the relevant habitats in the time horizon (10 years) for scenarios A_0, A_1 and A_2. The impact is described as a proportion expressing the reduction in the level of service provision; ranging between 0 (no change) and 1 (100% reduction)

Overall assessment quantile	Low (1%)	1st Quartile (25%)	Median (50%)	3rd Quartile (75%)	High (99%)
Estimated impact on provisioning ecosystem services in the relevant habitats for scenario A_0	0.0003	0.004	0.012	0.034	0.43
Estimated impact on provisioning ecosystem services in the relevant habitats for scenario A_1	0.0005	0.006	0.018	0.052	0.65
Estimated impact on provisioning ecosystem services in the relevant habitats for scenario A_2	0.0001	0.002	0.006	0.017	0.23

Table 11: Quantile values of the distribution of the estimated impact of *C. platani* on regulating and supporting ecosystem services in the relevant habitats in the time horizon (10 years) for scenarios A_0, A_1 and A_2. The impact is described as a proportion expressing the reduction in the level of service provision; ranging between 0 (no change) and 1 (100% reduction)

Overall assessment quantile	Low (1%)	1st Quartile (25%)	Median (50%)	3rd Quartile (75%)	High (99%)
Estimated impact on regulating and supporting ecosystem services in the relevant habitats for scenario A_0	0.0002	0.002	0.007	0.020	0.27
Estimated impact on regulating and supporting ecosystem services in the relevant habitats for scenario A_1	0.0003	0.004	0.010	0.03	0.43
Estimated impact on regulating and supporting ecosystem in the relevant habitats for scenario A_2	0.0001	0.001	0.003	0.01	0.13

Table 12: Quantile values of the distribution of the estimated impact of *C. platani* on cultural ecosystem services in the relevant habitats in the time horizon (10 years) for scenarios A_0, A_1 and A_2. The impact is described as a proportion expressing the reduction in the level of service provision; ranging between 0 (no change) and 1 (100% reduction)

Overall assessment quantile	Low (1%)	1st Quartile (25%)	Median (50%)	3rd Quartile (75%)	High (99%)
Estimated impact on cultural ecosystem services in the relevant habitats for scenario A_0	0.0003	0.004	0.012	0.034	0.42
Estimated impact on cultural ecosystem services in the relevant habitats for scenario A_1	0.0005	0.006	0.018	0.052	0.65
Estimated impact on cultural ecosystem services in the relevant habitats for scenario A_2	0.0001	0.002	0.006	0.016	0.22

3.4.2. Uncertainty

The only factors contributing to the overall uncertainty in the impact assessment are the initial abundance of the pathogen (initial conditions), its growth rate (the increase rate in the number of affected plants) and the multiplication factor associated with the effectiveness of the RROs.

In all cases, the most important factor in terms of contribution to the overall uncertainty is the initial abundance of the pathogen. The growth rate of the pathogen and the multiplication factor associated with the effectiveness of the RROs have a limited contribution to the overall uncertainty.

3.4.3. Discussion on the impact assessment

- The estimated abundance at the initial conditions (year 2016) is the same for all scenarios and ranges from 0.01% to 20% of affected plants, with a median value of 1%. This is the case in the spatial units with presence of *C. platani*.
- For each affected spatial unit, the Panel expects at the end of the time horizon a median value of the proportion of dead host plants of *C. platani* ranging between 1.2% (scenario A_2) and 2.1% (scenario A_1). The median value for scenario A_0 (1.4%) is close to the value of scenario A_2.
- The contribution of additional RROs concerning impact in scenario A_2 is not very evident because the time horizon considered is relatively short (10 years) and the additional RROs do not have a marked influence on the growth of the abundance of *C. platani* in the affected NUTS3 regions.
- However, the assessment of the overall impact in terms of dead host plants of *C. platani* at the EU level has to take into account not only the proportion of affected plants within affected NUTS3 regions, but also the number of affected regions (see Spread section). There are indeed important differences among scenarios in the number of expected affected regions (median values: 15 NUTS3 regions in A_0, 27 in A_1 and 4 in A_2). Therefore, combining the impact in terms of proportion of affected plants within each spatial unit and the number of

expected affected regions (Table 9), the impact in scenario A_2 is expected to be about (median values) five times smaller than in scenario A_0, and about 21 times smaller than in scenario A_1. Removing the current measures (scenario A_1) would result in an expected impact about four times larger compared to scenario A_0.

- The impacts in terms of reduction of (i) provisioning (wood), (ii) regulating and supporting (e.g. pollution reduction, water regulation, shade provision and avoidance of soil erosion) and (iii) cultural ecosystem services are expected to be about 1.5 times higher under the A_1 scenario compared to scenario A_0, while they are expected to be about two times lower under scenario A_2 compared to scenario A_0. The impact on ecosystem services is assessed only comparing the impact at the per-area unit level (i.e. service providing unit) where the pathogen is present in the assessment area. The overall impact on the ecosystem services at the EU level is not considered in the proposed model.
- The most important factor in terms of contribution to the overall uncertainty is the abundance of the pathogen. In all the scenarios, the interval of expected abundance in the year 2016 ranges from a low value of one plant affected over ten thousand to a high value of about 20% of the plants affected (the difference between the low and the high percentile is of a factor 2000). The growth rate of the pathogen and the effectiveness of the RROs have a limited contribution to the overall uncertainty.
- The considerable uncertainty regarding impacts (in terms of dead plants) follows the uncertainty in the estimation of the pathogen abundance. The largest uncertainty regarding impacts is associated with the estimated proportion of dead plants in the relevant habitats for scenario A_1, as the width of the estimated distribution is about three times larger than for the other two scenarios. The uncertainty in the two other scenarios is comparable.
- The considerable uncertainty regarding reduction of ecosystem service provision (the difference between the low and the high percentile is about 1,000 times or more) is associated with the uncertainty in the estimation of the pathogen abundance. The uncertainty level is roughly similar for the three scenarios and the three types of ecosystem services.

4. Conclusions

C. platani is a highly infective pathogen with the potential to cause great impact, but which currently has limited distribution in three EU Member States, i.e. Italy, France and Greece.

Following the pest categorisation carried out by EFSA PLH Panel in 2014, in which it was proposed to list the pathogen as a Union Quarantine pest, the EC asked for a full pest risk assessment with the aim to develop RROs on the basis of the mechanisms of spread.

The Panel carried out the PRA by considering three scenarios: A_0 scenario describes the current situation in the RA area with respect to the EU legislation (Council Directive 2000/29/EC) on the pathogen and its host as well as the emergency measures applied by the *C. platani*-affected EU MSs; A_1 scenario describes the situation without RROs and is used to demonstrate the worst-case scenario; A_2 scenario describes the current situation but with the application of additional RROs. In this scenario, the application of a combination of the most effective RROs is considered.

Based on the results of the PRA, the Panel draws the following conclusions.

- The risk of new introductions of *C. platani* into the RA area by means of the main pathways for entry (i.e. plants for planting, wood and machinery, i.e. construction/terracing/logging machinery and pruning/cutting tools) is relatively limited, with less than 1 (median value) new established population predicted in a 10-year period under the A_0 scenario. In case additional RROs will be considered (A_2 scenario), the number of new introductions is expected to be about 40 times lower compared to the A_0 scenario. In contrast, new introductions are expected to be about six times higher compared to the A_0 scenario in case the current regulation is removed (A_1 scenario). Under the A_1 scenario, and considering the 99th percentile (i.e. the worst case), the number of new established populations becomes considerable (equal to 230 in 10 years).
- In scenario A_2, the additional RROs for reducing the risk of entry include, among others: (i) a certification scheme for the production of *Platanus* plants intended for planting; (ii) the extension of these measures to all affected Third Countries and to firewood in the case of the current regulations on wood; (iii) a new regulation framework on machinery, which should be either sourced from pest free areas or be cleaned, disinfected and be free from soil and plant debris when brought into places where *Platanus* are grown (it would also be accompanied by a

certificate proving that it has been cleaned and disinfected). The additional RROs for reducing the risk of establishment include surveillance and the use of enhanced eradication programmes, which should also be effective in decreasing the number of potential founder populations by reducing the transfer of the pathogen to a suitable host in the RA area.

- The range of the estimated distributions for the number of established populations is relatively limited for scenario A_0, implying relatively limited uncertainty, compared to scenarios A_1 and A_2. Many factors influence the assessment of entry and establishment, and their relative contribution to the overall uncertainty varies between scenarios. However, there are no dominant factors to which a major contribution to the overall uncertainty can be attributed. This makes it difficult to pinpoint particular factors that would benefit from additional data collection or more formal knowledge elicitation. However, future risk assessment would benefit from data on trade volumes of *Platanus* plants for planting and wood, as well as on number of machinery units moving from Third Countries into the EU.
- The spread of *C. platani* through the main mechanisms of spread (i.e. in decreasing order of importance, machinery, wood, plants for planting and natural spread through wind, mainly as sawdust) working at NUTS3 level (which is, long-distance spread) is expected to lead to a considerable increase from the currently affected 84 NUTS3 (France = 18, Greece = 12, Italy = 54) to 99 (+15 as median value) in a 10-year period in the A_0 scenario, or to 111 (+27) in the A_1, worst-case scenario. The spread is estimated to be lower with the application of appropriate, additional RROs (A_2 scenario), with a total of 88 NUTS3 affected (+4). Under the A_1 scenario (without measures), in the 99th percentile (the worst case), the number of new affected NUTS3 regions becomes even more remarkable (+73).
- The spread assessment does not include the contribution of new introduced *C. platani* populations because the average probability to have a new established population due to new entries was assessed as 0.3 out of 1,240 NUTS regions (i.e. the total number of NUTS3 regions with *Platanus* plants), i.e. 0.0002, which may be considered as minor in terms of contribution to the spread.
- Machinery is the most important mechanism of long-distance spread. Focusing the additional RROs in the A_2 scenario on this mechanism of spread – which is not currently regulated – would be an effective way to reduce the risk of spread of *C. platani* to not yet affected EU NUTS3 regions. Additional RROs for spread through machinery include the requirements that machinery (i) originates from a pest free area or (ii) has been cleaned and disinfected and is free from soil and plant debris when moved into places where *Platanus* are grown and (iii) is accompanied by a certificate demonstrating that it has been cleaned and disinfected.
- Among RROs, surveillance, use of optimised eradication programmes and plantation of resistant *Platanus* clones in new plantations in affected areas play a relevant role in reducing the spread. Eradication remains a very effective RRO in case surveillance makes it possible early detection and optimised procedures are applied.
- For all scenarios, the range of the estimated distributions for the number of newly affected NUTS3 regions is relatively limited compared to the range of the estimated distributions for the number of potential founder populations and established populations, implying relatively limited uncertainty for the spread assessment compared to the entry and establishment assessment. The overall uncertainty associated with the spread assessment is higher for scenario A_2 compared to scenarios A_0 and A_1.
- The relative contribution of the considered factors to the overall uncertainty varies between mechanisms of spread and scenarios. The uncertainty breakdown for scenario A_0 (current situation) shows that the most important factor contributing to uncertainty for all mechanisms of long-distance spread is the estimated growth rate of the pathogen per year. For scenarios A_1 (without measures) and A_2 (with additional RROs), for all mechanisms of spread (with the exception of wood and natural spread in the A_1 scenario), the RROs applied to prevent spread is the most important factor contributing to uncertainty.
- The assessment of impact considers several aspects: (i) the percentage of affected host plants of *C. platani* at the initial conditions, i.e. year 2016 in the currently affected spatial unit; (ii) the growth rate of affected plants at the end of the time horizon of 10 years in the affected spatial units (mainly due to short-distance spread), in the different scenarios; and (iii) the number of spatial units occupied in the 10-year period because of long-distance spread, in the different scenarios. It is assumed that each affected tree dies in a relatively short time period.

- The estimated abundance at the initial conditions ranges from 0.01% to 20% of affected plants, with a median value of 1%. At the end of the time horizon, the median proportion of dead host plants ranges between 1.2% (scenario A_2) and 2.1% (scenario A_1). The median value for scenario A_0 (1.4%) is close to the value of scenario A_2 because it is estimated that the time horizon considered is relatively short (10 years) to make the additional RROs in the A_2 scenarios highly effective.
- However, the overall impact in terms of dead host plants at the EU level (which also considers spread) in scenario A_2 is expected to be about (median values) four times smaller than in scenario A_0, and about 12 times smaller than in scenario A_1.
- The impacts at the per-area unit level (i.e. service providing unit where the pathogen is present) in terms of reduction of (i) provisioning, (ii) regulating and supporting and (iii) cultural ecosystem services are expected to be about 1.5 times higher under the A_1 scenario compared to scenario A_0 and about two times lower under scenario A_2 compared to scenario A_0. The overall impact on the ecosystem service at the EU level is not considered in this assessment, but the same estimations would apply because there is no differentiation in impact among NUTS3 regions.
- Uncertainty regarding impacts (in terms of dead plants) is considerable, mainly due to the uncertainty in the estimation of pathogen abundance in the currently affected relevant habitats. In all the scenarios, the interval of estimated abundance in the year 2016 ranges from a low value of less than one plant affected in ten thousand to a high value of about 20% of the plants affected (the difference between the low and the high percentile is of a factor 2,000).
- The current measures for the prohibition of entry of *C. platani* into the EU (Council Directive 2000/29/EC) could be improved by introducing additional requirements for plants for planting, wood (including firewood, which seems currently not considered) and machinery (which is currently not regulated) pathways. It should also be considered that there are affected Third Countries not listed in the Council Directive, and new Third Countries may become affected in subsequent years. Removing the current regulation could lead to a relevant increase in the number of potential *C. platani* founder populations and, as a consequence, in the magnitude of impacts.
- Similarly to entry, the current measures for avoiding spread of *C. platani* (Council Directive 2000/29/EC) within the EU could be maintained, but these measures are not expected to stop the spread of the disease to new areas. Introduction of additional requirements – as those considered in scenario A_2 – would reduce by four times the number of newly affected NUTS3 regions in the next 10 years. A certification scheme for plants for planting produced in affected areas, measures for all types of wood produced in affected areas and cleaning and disinfection of the machinery moving from affected areas could also be considered.
- The emergency measures applied by the *C. platani*-affected EU MSs (France, Greece, Italy) could be harmonised and improved. An enhanced programme could be developed, which includes surveillance, early detection of the disease foci, effective eradication measures and planting resistant *Platanus* clones in new plantations in affected areas. Surveillance could also be extended to EU MSs not yet reported as affected by the pathogen.

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Abbreviations

EPPO	European and Mediterranean Plant Protection Organization
EU MS	European Union Member State
FAO	Food and Agriculture Organization
ISPM	International Standards for Phytosanitary Measures
NUTS	Nomenclature of Territorial Units for Statistics
PLH	Plant Health
PRA	pest risk assessment
RA	risk assessment
RRO	risk reduction option
ToR	Terms of Reference

Appendix A – Description of the model used for the assessment

A.1. Introduction

The modelling approach used to quantify the risk posed by *C. platani* combines individual distributions of the possible values of state variables or quantities relevant to the assessment (e.g. population abundance, multiplication factors, trade volume). These distributions represent the best estimation of state variables (e.g. the trade volume) or the effect of processes modifying these state variables (e.g. the increase in the population in a pathway unit) characterising the substep in each of the four main component or steps of the assessment, which are entry, establishment, spread and impact. The efficacy of combination of RROs is also expressed in terms of distributions. The combination of individual distribution results in a final distribution which allows comparisons to be made between different pathways and different scenarios considering all the pathways together for the four main components to the risk assessment.

The model here presented is a simplified version of the model considered in the assessment. For the sake of simplicity, only the deterministic version is given. The extension considering the random variables estimated by the experts or calculated is reported in the *C. platani* @Risk file (Annex A).

A.2. Entry

The objective of the entry model is to estimate the total number of new potential founder populations N_1 within the EU territory as a result of entry of the pest from Third Countries for the selected temporal and spatial scales. All the different pathways are considered together and different scenarios based on combination of RROs are compared.

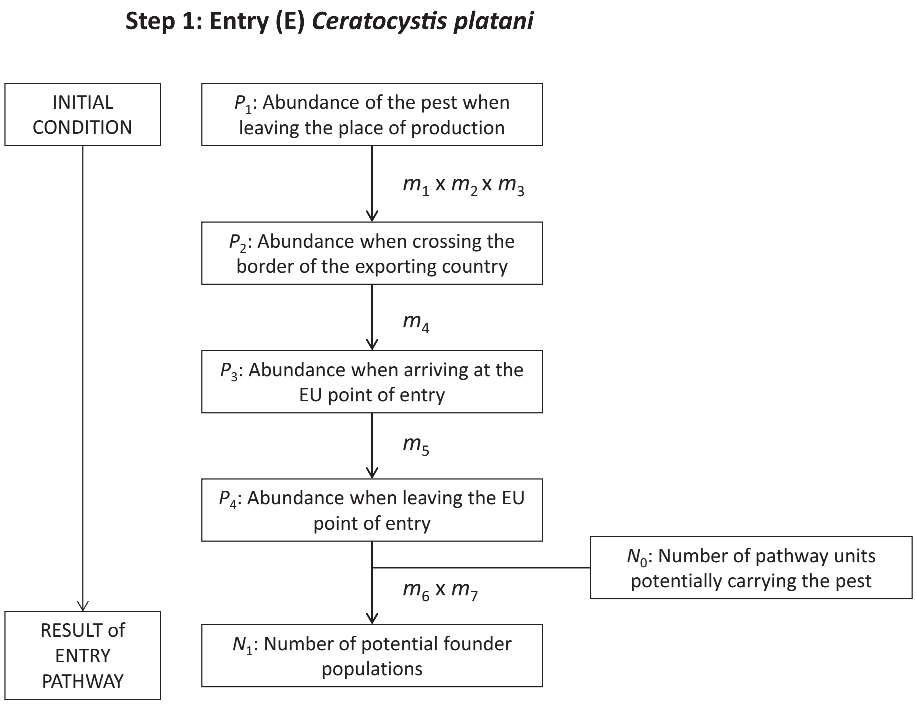

Figure A.1: Diagram that defines the series of substeps or nodes of the entry

The number of potential founder populations is estimated for the scenario *i* and the pathway *j* throughout a network of nodes or substeps in which the population abundance changes due to natural processes (e.g. population growth) or the implementation of RROs (see Figure A.1). The change in population abundance is obtained considering multiplication factors taking into account the result of natural processes of RROs.

Where

P_{1ij} the population abundance of the pest when leaving the place of production in the export country/countries for the scenario *i* and the pathway *j* in the substep E_1 of Entry (E);

P_{2ij} the population abundance of the pest when crossing the border of the exporting country of the export country/countries for the scenario i and the pathway j in the substep E_2 of Entry (E);
P_{3ij} the population abundance of the pest when arriving at the EU point of entry for the scenario i and the pathway j in the substep E_3 of Entry (E);
P_{4ij} the population abundance of the pest when leaving the EU point of entry for the scenario i and the pathway j in the substep E_4 of Entry (E);
N_{0ij} the number of pathway units potentially carrying the pest from the place of production to the risk assessment area for the scenario i and the pathway j;
N_{1ij} the total number of new potential founder populations within the EU territory as a result of entry of the pest from Third Countries for the selected temporal and spatial scales and for the scenario i and the pathway j;
and
m_{1ij} the multiplication factor changing the abundance of the pest before leaving the place of production for the scenario i and the pathway j;
m_{2ij} the units conversion coefficient for the scenario i and the pathway j;
m_{3ij} the multiplication factor changing the abundance from substep E_1 (after having left the place of production) to substep E_2 (before crossing the border of the export country) for the scenario i, and the pathway j;
m_{4ij} the multiplication factor changing the abundance from substep E_2 (after having left the border of the export country) to substep E_3 (before arriving at the EU point of entry) for the scenario i and the pathway j;
m_{5ij} the multiplication factor changing the abundance from substep E_3 (after arriving at the EU point of entry) to substep E_4 (before leaving the EU point of entry) for the scenario i, and the pathway j;
m_{6ij} the aggregation/disaggregation coefficient transforming the pathway units into the transfer units for the scenario i, and the pathway j;
m_{7ij} the multiplication factor changing the abundance from substep E_4 (after leaving the point of entry) to substep E_5 (transferring to the host) in the different scenarios for the scenario i, and the pathway j.
Then, the following population abundance are calculated

$$P_{2ij} = P_{1ij} \times m_{1ij} \times m_{2ij} \times m_{3ij}$$

$$P_{3ij} = P_{2ij} \times m_{4ij}$$

$$P_{4ij} = P_{3ij} \times m_{5ij}$$

Finally, the number of potential founder populations for each scenario is obtained as

$$N_{1i} = \sum_j P_{4ij} \times N_{0ij} \times m_{6ij} \times m_{7ij}.$$

A.3. Establishment

The number of established populations N_{2i} for the scenario i derives from the number of potential founder populations N_{1i} calculated in the entry step multiplied by the probability of establishment m_{8i}. The latter can be decomposed in terms of the contribution of the factors influencing the probability of establishment (see Figure A.2).

Where
w_{Tki} the probability of establishment in the scenario i due to the factor k belonging to the list of factors contributing to the establishment, and T_k the multiplication factor expressing the effectiveness of RROs combination changing the contribution of the factor k. Given the estimated probability assigned to the establishment factors and under the assumption of their independence, the modified probability of establishment m_{8i}' is calculated as

$$m_{8i}' = m_{8i}\left(\sum_k w_{Tki} \times T_{ki}\right)$$

From m_{8i}' the number of established populations N_{2i} for the scenario i is obtained as

$$N_{2i} = N_{1i} \times m_{8i}'.$$

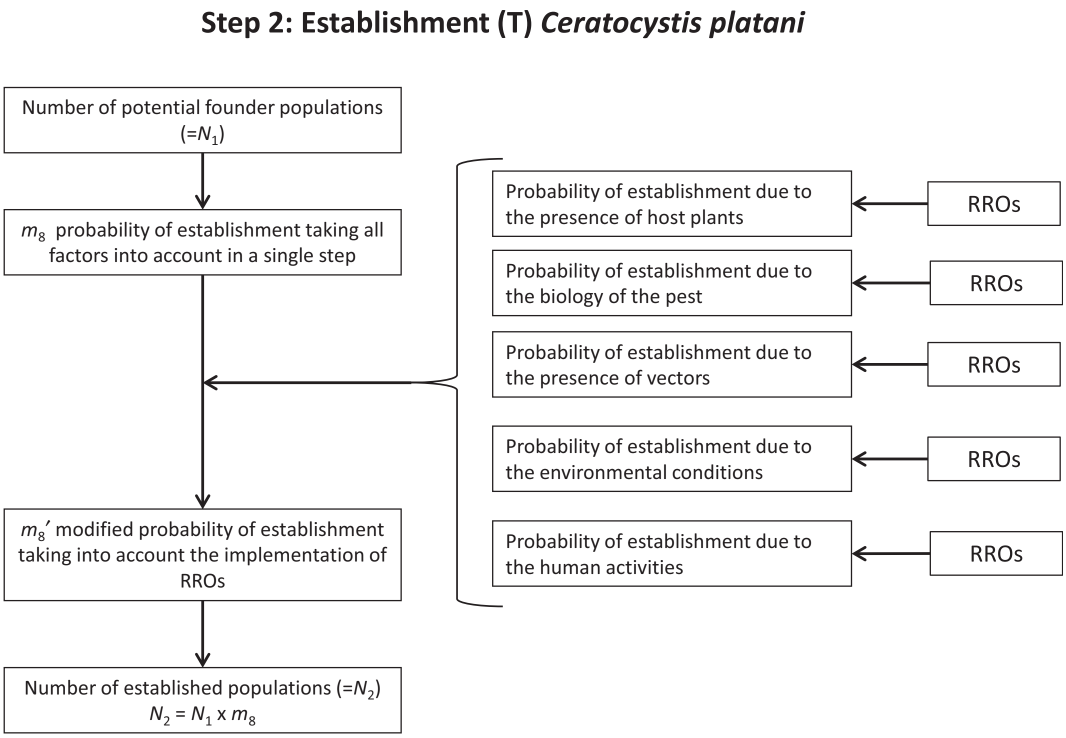

Figure A.2: Diagram that defines variables and factors influencing the establishment

A.4. Spread

Different models for the interpolation of data on the past spread of the pest have been considered. At NUTS3 level of spatial resolution, a linear model better represents the increase in the number of occupied spatial units in the assessment area. The value of the estimated spread rate and the time horizon considered in the assessment (10 years) justify the use of a linear model to project the future trend in the number of occupied spatial units. For longer time horizon, a non-linear model (e.g. a logistic model) should be consider in order to account for both the non-linear pattern in the pest dispersal due to the increase in the area occupied (which results in an increase in the number of source of propagule populations) and the limitation in the number of spatial units available (i.e. free from the pest).

The total number of occupied spatial units N_{5i} at the end of the time horizon for the different scenario i, that derive from number of spatial units representing the initial condition for the spread is calculated as

$$N_{5i} = N_{3i} + T \times m_{9i}$$

where:

N_3 is the number of spatial units representing the initial condition for the spread, this corresponds to the distribution of pest at the NUTS3 level in the affected EU MSs when the assessment is performed (the year 2016);

T represents the time horizon used for the assessment, that is 10 years;

m_{9i} is the multiplication factor used to derive the number of spatial units occupied by the pest at the end of the time horizon (10 years) for the different scenarios i;

The multiplication factor m_{9i} represents the number of newly occupied spatial units per year due to the spread. It changes according to scenario based on the effectiveness of RROs for each mechanism of spread considered; in decreasing order of importance: machinery, wood, host plants for planting, natural means (wind-borne inoculum) (see Appendix C).

The maximum number of spatial units N_4 at the NUTS3 level in the risk assessment area for the relevant crops/habitats has been also estimated even is not considered in the linear model. It is also useful to define the area of potential establishment of the pest.

The increase in the spread due to the new entries was not included in the assessment (see Appendix B.3.4).

A.5. Impact

Due to the host-specificity of the pest and the use of host plant the assessment of impacts on host crops was considered as not relevant because *Platanus* trees are currently only rarely cultivated for wood production in the RA area. The impact assessment is limited to the impacts on the environment and has been conducted estimating the change in ecosystem services provision levels (for selecting provisioning, regulating and supporting services) in the spatial units occupied by the pest in the different scenarios.

To estimate the impact on ecosystem services, a simple epidemiological model is considered to derive the prevalence of the disease at the end of the time horizon, where the prevalence refers to the proportion of affected trees in the affected NUTS3 regions (the prevalence ranges between 0 and 1). The initial condition of the epidemiological model, that is, the current prevalence of the pest P_5 in the relevant habitats within the area of the spatial units occupied by the pathogen at the time of the assessment (year 2016), has been estimated. The prevalence at the end of the time horizon is calculated with a simple exponential model

$$P_{5i**} = P_5 \exp(P_{5i*} T)$$

P_{5i**} is the estimated prevalence of the pest in the relevant habitats within the area of the spatial units occupied by the pathogen under the scenario *i* at the end of the time horizon;
P_5 is the current prevalence of the pest (year 2016);
P_{5i*} is the estimated growth rate per year of the pest prevalence in the relevant habitats within the area of the spatial units occupied by the pathogen under the scenario *i*;
T is the time horizon;
The epidemics of the disease suggested the use of an exponential model instead of a logistic model in which the maximum value of P_{5i**} is 1;
To calculate the impact on ecosystem services, following multiplication factors have been estimated
m_{13i} is the multiplication factor changing the provision of provisioning ecosystem services in relation to pest abundance in the spatial units occupied in the scenario *i*;
m_{13i*} is the multiplication factor changing the provision of regulating and supporting ecosystem services in relation to pest abundance in the spatial units occupied in the scenario *i*;
$m_{13i**}$is the multiplication factor changing the provision of cultural ecosystem services in relation to pest abundance in the spatial units occupied in the scenario *i*;
Then, the final impact on ecosystem services is obtained as follows

$I_{4i} = P_{5i**} \times m_{13i}$ for the provisioning ecosystem services in the scenario *i*;
$I_{4i*} = P_{5i**} \times m_{13i*}$ for the regulating and supporting ecosystem services in the scenario *i*;
$I_{4i**} = P_{5i**} \times m_{13i**}$ for the cultural ecosystem services in the scenario *i*.

Appendix B – Detailed information on the assessment

B.1. Entry

B.1.1. Substep E_1: Abundance of the pest when leaving the place of production in the export country/countries

For information on the distribution of *C. platani* in and outside the EU, the regulatory status of the pathogen in the RA area, and other information relevant to the abundance of the pathogen when leaving the place of production, the reader is referred to the EFSA pest categorisation on *C. platani* (EFSA PLH Panel, 2014).

Table B.1: Abundance of plants for planting, wood and machinery units affected by *C. platani* (in %) when leaving the place of production in the countries of origin, in all scenarios

	$[P_1]$		
Quantile	**Plants for planting**	**Wood**	**Machinery**
Lower	0.0001	0.0001	0.0001
Q_1	0.003	0.003	0.003
M	0.005	0.005	0.005
Q_3	0.007	0.007	0.007
Upper	0.01	0.01	0.01
Distribution	Weibull	Weibull	Weibull

Justifications for P_1 (Table B.1)

Plants for planting. The Panel considered that in order to produce an infected host plant at the place of production (i.e. a nursery) in an affected Third Country, cuttings need to be taken from infected host trees. However, it is rather unlikely that nurserymen will take cuttings from a diseased tree or in an area known to be affected. Nevertheless, if that happens, infected cuttings can infect other cuttings in the nursery, and if the latter cuttings show symptoms before leaving the place of production, they are likely to be removed and disposed. Infected *Platanus* plants show symptoms very rapidly and are easily detectable during the growing season in the nursery. However, latently infected (asymptomatic) host plants for planting are likely not to be detected and thus, be exported from affected areas. So far, the disease has been confirmed in just four Third Countries, namely Albania, Armenia, Switzerland and the USA. However, this does not exclude the possibility that the pathogen might be present, but not yet detected or reported, in other Third Countries, too.

- Lower: The presence of the pathogen in *Platanus* plants for planting (cuttings, potted plants, etc.) originating in affected Third Countries is considered to be very low.
- Q_1: This value was assumed to be roughly intermediate between the median and the lower percentile.
- Median: This median estimate is closer to the lower boundary, which implies that the assessors consider that the abundance of the pathogen (% of infected host plants for planting) at the place of origin is more likely to be low than high.
- Q_3: This value is closer to the median because the lack of reports suggests very low pathogen abundance in host plants for planting in affected Third Countries.
- Upper: This value refers to latently infected (asymptomatic) host plants for planting exported from affected Third Countries as well as to infected host plants for planting leaving the place of production during winter. In the latter case and because of the absence of leaves, the detection of infected host plants for planting is more difficult. Moreover, in the EU legislation, only Armenia, Switzerland and the USA are considered. Therefore, the upper value also refers to plants for planting originating in Albania as well as in other Third Countries where the disease might be present but not yet detected or reported.

Wood: For wood of *Platanus*, with the exception of firewood, the place of production is considered to be the sawmill.

The disease is currently present in Albania, Armenia, Switzerland and the USA. No import into the EU of *Platanus* wood is assumed to occur from Switzerland and the USA. However, there is no information on the distribution of the pathogen in Armenia and to the best of the Panel's knowledge, there is no regulation in place at present in Albania. Therefore, it is possible that infected *Platanus* wood used for various purposes can be exported from Armenia or Albania into the EU. In addition, the disease may be also present in other Third Countries, but not yet detected or reported.

The wood of infected plane trees shows discolouration for some weeks after cutting, but not later on. Molecular methods for the detection and identification of the pathogen in wood are available (EPPO, 2003; Pilotti et al., 2012; Luchi et al., 2013), but require expertise and lab facilities. Due to its low cost, firewood is unlikely to be treated and thus it cannot be imported into the EU. Other forms of wood, such as woodchips are included in the wood pathway and the pathogen can survive in them (increased use and import of woodchips for heat production is taking place also from developing Third Countries that might be affected by the disease). But it is unlikely that the pathogen will survive the high temperatures used for drying the sawdust from which pellets are produced).

Use of infected wood to make ammunition boxes is thought to have been the historic means of introduction of the pathogen from the USA into Europe during World War II.

- Lower: The pathogen may not be present in plane trees for wood production in affected Third Countries. In the USA, *P. occidentalis* is less susceptible and the prevalence of the disease is now very low. In Switzerland, the disease has limited distribution and is under strict regulation. Therefore, the abundance of the pathogen in *Platanus* wood originating in Switzerland is considered very low.
- Q_1: This value was assumed to be roughly intermediate between the median and the lower percentile.
- Median: This median estimate is closer to the lower boundary, which implies that the assessors consider that the abundance of the pathogen at the place of production (sawmill) is more likely to be low than high.
- Q_3: This value is closer to the median because the lack of reports suggests a very low pathogen abundance in wood at the place of production in affected Third Countries.
- Upper: The disease is currently also present in Armenia and Albania. There is no information on the distribution of the pathogen in Armenia and to the best of the Panel's knowledge, in Albania there is no regulation in place at present. Therefore, it is possible that infected *Platanus* wood, used for various purposes, can be exported from those countries to the EU. In addition, the disease may be present in other Third Countries not yet reported to be affected.

<u>Machinery-Pruning/cutting tools</u>: the place of production is wherever a machine or tool is used in an affected area in a Third Country. The pathogen may enter into the RA area with contaminated soil, sawdust and other woody host plant debris attached to construction, excavation, terracing or logging machinery as well as to cutting and pruning tools previously used in affected areas (Walter, 1946; Walter et al., 1952; Panconesi, 1999; Panconesi et al., 2003). Under the current situation, international construction companies move machinery and cutting tools within Europe and irrespective of the EU borders. Such machinery/tools can also spread the pathogen over long distances within the RA area. The pathogen is assumed to have spread from Southern to Northern Greece on road construction machinery and vehicles that had previously been used in affected areas in Peloponnese (Southern Greece) (Tsopelas and Soulioti, 2010, 2013). Similarly, in Italy and France, terracing machinery has been shown to be a major mechanism of long-distance spread of the pathogen (EPPO, 2014), which would strengthen the role of machinery/tools as a pathway for the entry of the pathogen into the RA area from affected non-EU European countries. Information is not available about which percentage of this machinery (including cutting and pruning tools) is contaminated with the pathogen.

- Lower: The disease is not very common in the USA and the possibility of a contaminated machinery/pruning or cutting tool to be moved from the USA to the EU is very low.
- Q_1, Median and Q_3: the values are based on expert judgement, due to lack of data.
- Upper: This value represents the highest possibility for machinery or pruning/cutting tools to get contaminated in recently affected Third Countries neighbouring EU MSs and where few or no phytosanitary regulations are in place for *C. platani*.

Table B.2: Multiplication factor changing the abundance of the pest before leaving the place of production in the different scenarios, for the host plants for planting pathway

[m_1] plants for planting pathway			
Quantile	**A_0**	**A_1**	**A_2**
Lower	1	1.25	0
Q_1	1	1.54	0.12
M	1	2.00	0.15
Q_3	1	2.50	0.25
Upper	1	4.00	0.50
Distribution	–	Pearson5	Pearson5

Table B.3: Multiplication factor changing the abundance of the pest before leaving the place of production in the different scenarios, for the wood pathway

[m_1] wood pathway			
Quantile	**A_0**	**A_1**	**A_2**
Lower	1	3.3	0
Q_1	1	5.0	0.03
M	1	10.0	0.05
Q_3	1	14.3	0.10
Upper	1	100	0.15
Distribution	–	InvGauss	BetaGen

Table B.4: Multiplication factor changing the abundance of the pest before leaving the place of production in the different scenarios, for the machinery pathway

[m_1] machinery pathway			
Quantile	**A_0**	**A_1**	**A_2**
Lower	1	1	0.05
Q_1	1	1	0.20
M	1	1	0.30
Q_3	1	1	0.45
Upper	1	1	0.70
Distribution	–	–	BetaGen

Justifications for m_1 (all pathways; Tables B.2, B.3 and B.4)

The multiplication factor is 1 for scenario A_0 because assessments for P_1 (abundance of plants for planting, wood and machinery units affected by *C. platani* (in %) when leaving the place of production in the countries of origin) are conducted for this scenario. The multiplication factor for A_1 and A_2 was calculated based on the effectiveness of RROs (see Appendix C).

Table B.5: Units conversion coefficient (all pathways)

[m_2] (all pathways)			
Quantile	**A_0**	**A_1**	**A_2**
Lower	1	1	1
Q_1	1	1	1
M	1	1	1
Q_3	1	1	1
Upper	1	1	1

Justifications for m_2 (all pathways; Table B.5)

No conversion is needed because there is no change in the units expressing abundance.

Table B.6: Multiplication factor changing the abundance from substep E_1 (after having left the place of production) to substep E_2 (before crossing the border of the export country) in the different scenarios, for the host plants for planting pathway

[m_3] plants for planting pathway			
Quantile	**A_0**	**A_1**	**A_2**
Lower	1.00	1.00	0.05
Q_1	1.25	1.25	0.20
M	1.50	1.50	0.30
Q_3	1.75	1.75	0.61
Upper	2.00	2.00	1.00
Distribution	Weibull	Weibull	Weibull

Justifications for m_3 (plants for planting pathway; Table B.6)

Host plants for planting (cuttings, young trees) are produced in nurseries in exporting Third Countries (in open field or under protection). Cuttings are usually transported during winter in batches comprising bundles of bare-rooted cuttings, whereas young trees are transported as single bare-rooted or potted plants. In case there is one infected cutting in the batch of cuttings, then, depending on the transport conditions and the speed of transport between the place of production and the border of the export country, the pathogen can infect other cuttings in the batch through wounds. The Panel estimates that one infected cutting will generate one new infected cutting. Nevertheless, in cases where the host plants for planting are transported under low temperatures (e.g. 5°C), it is unlikely that the disease will spread from one infected cutting to the neighbouring ones.

In the case of bare-rooted plants, if an infected plant makes contact with healthy plants, there is a possibility of further infection, dependent on contact, transport conditions and speed of transport. However, since transport is usually fairly fast (one week up to a few weeks), it is unlikely that the pathogen will spread from infected plants to healthy ones through wounds. In addition, wounds are highly susceptible to the infection by the pathogen when they are fresh. However, there is lack of data in the literature about how long wounds remain susceptible to infection by *C. platani*.

The abundance of the pathogen on individual infected potted *Platanus* trees will not change between substep 1A (after having left the place of production) and substep 1B (before crossing the border of the export country).

- For the A_0 scenario: when there are infected rooted cuttings, there is a possibility of transmission of the infection to another plant in the batch (upper boundary). The multiplication factor is estimated at the individual level (the number of affected plants generated by an infected plant). Most of the times, transportation of rooted cuttings occurs at temperatures above 10°C. At those temperatures, active growth of the fungus might occur for a while in storage and vehicles. When transport takes place at temperatures below 10°C, the fungus will not be able to grow.
  - Lower: no additional infection.
  - Q_1, Median and Q_3: at the same interval between the extremes, due to lack of data.
  - Upper: infection of another plant in the batch.
- For the A_1 and A_2 scenarios: the multiplication factor was calculated based on the effectiveness of RROs (see Appendix C).

Table B.7: Multiplication factor changing the abundance from substep E_1 (after having left the place of production) to substep E_2 (before crossing the border of the export country) in the different scenarios, for the wood pathway

	[m_3] wood pathway		
Quantile	**A_0**	**A_1**	**A_2**
Lower	1	1	0.05
Q_1	1	1	0.16
M	1	1	0.20
Q_3	1	1	0.35
Upper	1	1	0.50
Distribution	–	–	Triang

Justifications for m_3 (wood pathway; Table B.7)

Under the current situation, any form of *Platanus* wood material originated in affected areas should undergo 'kiln-drying' (minimum core temperature of 56°C for at least 30 min) to below 20% moisture content, before being imported into the EU. As temperatures higher than 45°C are lethal for the pathogen, the pathogen on wood will be likely eliminated before crossing the border of the export country. However, this regulation only applies to wood originating in Armenia, Switzerland and the USA and not to wood originating in other affected Third Countries, such as Albania. For this reason, the multiplicative factors are always 1 in the A_0 and A_1 scenarios.

- For the A_0 and A_1 scenarios. When there is even a small amount of infected wood in the consignment and the conditions are favourable, there is a theoretical possibility of transmission of the pathogen to other pieces/chips/round wood, although there is no evidence supporting this. In addition, the relatively short time (a few days) taken for the transport of wood from the place of its production (sawmill) to the border of the exporting Third Country and the fact that the pathogen can only colonise freshly cut *Platanus* wood (it needs living cells), support the expert judgment that the abundance of the pathogen is unlikely to change between substep 1A and substep 1B.
- For the A_2 scenario: the multiplication factor was calculated based on the effectiveness of RROs (see Appendix C).

Table B.8: Multiplication factor changing the abundance from substep E_1 (after having left the place of production) to substep E_2 (before crossing the border of the export country) in the different scenarios, for the machinery pathway

	[m_3] machinery pathway		
Quantile	**A_0**	**A_1**	**A_2**
Lower	0.20	0.20	0.01
Q_1	0.30	0.30	0.05
M	0.40	0.40	0.08
Q_3	0.60	0.60	0.21
Upper	1.00	1.00	0.50
Distribution	Pearson5	Pearson5	Pearson5

Justifications for m_3 (machinery pathway; Table B.8)

The Panel considers that there will be a decrease in the abundance of the pathogen as some of the inoculum will be washed-off by rain events or killed by high temperatures or lost during the movement of the machinery from the disease foci to the border of the affected Third Country.

The abundance of the pathogen on contaminated machinery/pruning/cutting tools after having left the place of production and before crossing the border of the exporting Third Country can be reduced, but not increased. However, the possibility of the contaminated machinery to lose all the inoculum without a specific action, until it reaches the border of the exporting Third Country is very low (this justifies the lower boundary not being 0.00).

- For the A_0 scenario:
  - Lower: The abundance of the pathogen on contaminated machinery can be reduced after having left the place of production due to weather conditions (rain, high temperatures) or if it will be cleaned from soil and wood debris before crossing the border of the exporting Third Country as a machinery maintenance operation (not as RRO).
  - Q_1, Median and Q_3: based on expert judgement, due to lack of data.
  - Upper: The abundance of the pathogen on contaminated machinery remains stable when the machinery is moved within a short time from the place of production to the border of the exporting Third Country and it is not cleaned before crossing the border.
- For the A_1 and A_2 scenarios: the multiplication factor was calculated based on the effectiveness of RROs (see Appendix C).

B.1.2. Substep E_2: Abundance of the pest when crossing the border of the exporting country

Table B.9: Distribution of the multiplication factor changing the abundance from substep E_2 (after having left the border of the export country) to substep E_3 (before arriving at the EU point of entry) in the different scenarios, for the host plants for planting pathway

	[m_4] plants for planting pathway		
Quantile	**A_0**	**A_1**	**A_2**
Lower	1.00	1.00	1.00
Q_1	1.02	1.02	1.02
M	1.04	1.04	1.04
Q_3	1.06	1.06	1.06
Upper	1.10	1.10	1.10
Distribution	Weibull	Weibull	Weibull

Justifications for m_4 (plants for planting pathway; Table B.9)

Whenever in a bundle of bare-rooted host plants for shipment there is an infected plant, there is the possibility of further infections to occur through contact. However, since travel is fairly fast (maybe just a week or a few weeks on a ship), there is not enough time for the newly infected plants to infect other plants. Wounds are highly susceptible to infection by *C. platani* only when they are fresh. Cuttings are usually transported during the winter.

Transport of host plants for planting at low temperatures potentially reduces fungal growth and the probability of infection of healthy host plants that are in contact with the infected ones.

- For the A_0 scenario: the quantile values show that the abundance at this short step is expected either not to increase or to increase only very slightly.
- For the A_1 and A_2 scenarios: the multiplication factor was calculated based on the effectiveness of RROs (see Appendix C).

Table B.10: Distribution of the multiplication factor changing the abundance from substep E_2 (after having left the border of the export country) to substep E_3 (before arriving at the EU point of entry) in the different scenarios, for the wood pathway

	[m_4] wood pathway		
Quantile	**A_0**	**A_1**	**A_2**
Lower	1	1	1
Q_1	1	1	1
M	1	1	1
Q_3	1	1	1
Upper	1	1	1

Justifications for m_4 (wood pathway; Table B.10)

For all the considered scenarios, the Panel assessed that it is unlikely that the abundance of the pathogen will change during the transport of infected wood material between the border of the exporting Third Country and the EU point of entry.

Table B.11: Distribution of the multiplication factor changing the abundance from substep E_2 (after having left the border of the export country) to substep E_3 (before arriving at the EU point of entry) in the different scenarios, for the machinery pathway

[m_4] machinery pathway			
Quantile	**A_0**	**A_1**	**A_2**
Lower	0.2	0.2	0.2
Q_1	0.3	0.3	0.3
M	0.4	0.4	0.4
Q_3	0.6	0.6	0.6
Upper	1.0	1.0	1.0
Distribution	Pearson5	Pearson5	Pearson5

Justifications for m_4 (machinery pathway; Table B.11)

The Panel considers that the abundance of the pathogen on construction/terracing/logging machinery can decrease due to the weather conditions (e.g. rain can wash-off some of the inoculum) and the machinery movement itself (e.g. some of the inoculum will be lost on the way between the border of the export country and the EU point of entry). The latter depends also on the distance between the two points (after having left the border of the export country and before arriving at the EU point of entry) and the time the machinery remains exposed outside.

- For the A_0 scenario: quartiles were estimated based on expert judgement due to the lack of data; the lower quartile is for long-distance movement, long-term exposure and extreme weather conditions; the upper quartile is for the opposite conditions. Q_1, Median and Q_3 were estimated within the two extremes.
- For the A_1 and A_2 scenarios: the multiplication factor was calculated based on the effectiveness of RROs (see Appendix C).

B.1.3. Substep E_3: Abundance when arriving at the EU point of entry

Table B.12: Multiplication factor changing the abundance from substep E_3 (after arriving at the EU point of entry) to substep E_4 (before leaving the EU point of entry) in the current situation, for the host plants for planting pathway

[m_5] plants for planting pathway			
Quantile	**A_0**	**A_1**	**A_2**
Lower	1	1.1	0.15
Q_1	1	1.3	0.30
M	1	1.5	0.40
Q_3	1	1.7	0.50
Upper	1	2.0	0.70
Distribution	–	Gamma	BetaGen

Justifications for m_5 (plants for planting pathway; Table B.12)

As imported plants for planting tend to stay only for a few hours at the EU point of entry, mainly because of the huge volume of imported consignments, there is no time for the pathogen to change (increase) in abundance during the period between arriving and leaving the EU point of entry. Border controls are not systematic and are usually based on visual observation of the disease symptoms. Since cuttings of host plants are imported mainly during winter when there is no foliage, visual inspection at the EU point of entry of imported cuttings originating in affected Third Countries is unlikely to detect infected plants. Similarly, visual inspection cannot detect latently infected (asymptomatic) plant material. Moreover, the detection of the pathogen based on visual inspection of plant material requires expertise as other pathogens of *Platanus* spp. cause symptoms similar to those caused by *C. platani* (e.g. *Apiognomonia veneta*).

- For A_0 scenario: no change is expected in the pathogen abundance, because of the previously mentioned reasons.
- For the A_1 and A_2 scenarios: the multiplication factor was calculated based on the effectiveness of RROs (see Appendix C).

Justifications for m_5 (wood pathway; Table B.13)

Table B.13: Multiplication factor changing the abundance from substep E_3 (after arriving at the EU point of entry) to substep E_4 (before leaving the EU point of entry) in the current situation, for the wood pathway

[m_5] wood pathway			
Quantile	**A_0**	**A_1**	**A_2**
Lower	1	1.1	0.15
Q_1	1	1.3	0.30
M	1	1.5	0.40
Q_3	1	1.7	0.50
Upper	1	2.0	0.70
Distribution	–	Gamma	BetaGen

Similar to the plants for planting, imported wood in various forms tends to stay only for a few hours at the EU point of entry.

- For A_0 scenario: no change in the abundance of the pathogen on infected wood consignments is expected to occur between arriving and leaving the EU point of entry.
- For the A_1 and A_2 scenarios: the multiplication factor was calculated based on the effectiveness of RROs (see Appendix C).

Justifications for m_5 (machinery pathway; Table B.14)

Table B.14: Multiplication factor changing the abundance from substep E_3 (after arriving at the EU point of entry) to substep E_4 (before leaving the EU point of entry) in the current situation, for the machinery pathway

[m_5] machinery pathway			
Quantile	**A_0**	**A_1**	**A_2**
Lower	1	1	0.05
Q_1	1	1	0.16
M	1	1	0.20
Q_3	1	1	0.35
Upper	1	1	0.50
Distribution	–	–	Triang

- For the A_0 scenario: no change in the abundance of the pathogen is assumed to occur between arriving and leaving the EU point of entry.
- For the A_1 and A_2 scenarios: the multiplication factor was calculated based on the effectiveness of RROs (see Appendix C).

B.1.4. Substep E4: Abundance when leaving the EU point of entry

Table B.15: Number of pathway units potentially carrying the pest from the place of production to the risk assessment area in the different scenarios, for the host plants for planting pathway

[N_0] plants for planting pathway			
Quantile	**A_0**	**A_1**	**A_2**
Lower	10	10	10
Q_1	500	500	500
M	600	600	600
Q_3	800	800	800
Upper	1500	1500	1500
Distribution	LogNorm	LogNorm	LogNorm

Justifications for N_0 (plants for planting pathway; Table B.15)

No data were found in Eurostat on the volume of host plants for planting imported into the EU from Third Countries (and thus also from affected Third Countries).

Based on an incomplete dataset of the ISEFOR database, there is no trade of *Platanus* plants for planting from affected Third Countries. However, it is assumed that some trade of host plants for planting might take place from Third Countries or just as imports by individuals. In addition, the unregulated trade of *Platanus* plants for planting via the Internet should be also considered.

In this assessment, the Panel assumes that this situation will not change over the next 10 years. However, changes may occur because of the dynamic nature of the nursery trade.

- For all scenarios and quantiles: expert judgment, due to lack of data.

Table B.16: Number of pathway units potentially carrying the pest from the place of production to the risk assessment area in the different scenarios, for the wood pathway

[N_0] wood pathway			
Quantile	**A_0**	**A_1**	**A_2**
Lower	10	10	10
Q_1	50	50	50
M	60	60	60
Q_3	80	80	80
Upper	100	100	100
Distribution	BetaGen	BetaGen	BetaGen

Justifications for N_0 (wood pathway; Table B.16)

No data were found on *Platanus* wood consignments originating in affected Third Countries and imported into the EU.

The Panel assumed that no imports into the EU of *Platanus* wood from Armenia, Switzerland and the USA occur. However, based on a United Nations database, each year about 72,000 tons (i.e. about 50,000 m^3) of wood (mainly firewood) is imported into the EU from Albania. As in Albania, there are currently many dead and dying *Platanus* trees due to the disease; it may also be assumed that about 10% of the wood imported into the EU from Albania is of infected *Platanus* trees.

- For all scenarios and quantiles: expert judgment, due to lack of data.

Table B.17: Number of pathway units potentially carrying the pest from the place of production to the risk assessment area in the different scenarios, for the machinery pathway

	$[N_0]$ machinery pathway		
Quantile	A_0	A_1	A_2
Lower	20	20	20
Q_1	145	145	145
M	260	260	260
Q_3	380	380	380
Upper	500	500	500
Distribution	BetaGen	BetaGen	BetaGen

Justifications for N_0 (machinery pathway; Table B.17)

No data were found on the number of machines entering the EU from affected Third Countries. It is also rare for contaminated machinery to be imported into the EU from affected non-European countries (e.g. the USA), whereas there are affected Third Countries neighbouring the EU (e.g. Albania and Switzerland) for which this might take place more often. Therefore, it may be assumed that contaminated machinery travels from affected non-EU European countries (e.g. Albania) to neighbouring EU MSs (e.g. Greece) and the other way round. In this case, large machinery (e.g. bulldozers) is mainly considered, but not exclusively.

- For all scenarios:
  - Lower: The Panel estimates that some potentially contaminated machinery will enter the RA area considering that many organisations are operating across the EU borders. There are also lots of chainsaws in use but no information was found on how many of them are moved between country borders. The estimation includes machinery moved only from affected Third Countries into the EU.
  - Q_1, Median and Q_3: based on expert judgement, due to lack of data
  - Upper: Although the Panel cannot estimate the number of potentially contaminated machinery entering the RA area, it is very likely that such machinery travels from Albania to Greece (and the other way round) because the disease is very common in Albania and a transnational co-operation is taking place in the construction sector between the two countries. Large construction projects, such as pipelines, highways and roads, are increasingly linking affected non-EU European countries and EU MSs.

Table B.18: Aggregation/disaggregation coefficient* transforming the pathway units into the transfer units, for the host plants for planting pathway

	$[m_6]$ plants for planting pathway		
Quantile	A_0	A_1	A_2
Lower	0.001	0.001	0.001
Q_1	0.1	0.1	0.1
M	0.3	0.3	0.3
Q_3	0.5	0.5	0.5
Upper	1	1	1
Distribution	BetaGen	BetaGen	BetaGen

*: 1 means that all pathway units go separately. For all pathway units to stay together, the coefficient is 1/N of pathway units.

Justifications for m_6 (plants for planting pathway; Table B.18)

Imported cuttings will most probably go to a nursery and stay together as a batch. Young individual plants may either be planted in one place (a public park, along a street, etc.) or be distributed to different retailers and then sold to individuals (private gardens). However, it is expected to be more likely that the imported host plants will stay together than go separately.

Lack of information about new infection foci is a source of uncertainty in estimating the aggregation/disaggregation coefficient.

For all scenarios:

- Lower: in case pathway units tend to stay together
- Q_1, M, Q_3: expert judgment, because of lack of data.
- Upper: in case all pathway units go separately.

Table B.19: Aggregation/disaggregation coefficient* transforming the pathway units into the transfer units, for the wood pathway

[m_6] wood pathway			
Quantile	**A_0**	**A_1**	**A_2**
Lower	1	1	1
Q_1	1	1	1
M	1	1	1
Q_3	1	1	1
Upper	1	1	1

*: 1 means that all pathway units go separately. For all pathway units to stay together, the coefficient is 1/N of pathway units.

Justifications for m_6 (wood pathway; Table B.19)

Single units of wood can be moved all over the RA area. By cutting the wood, sawdust will be produced, which makes the coefficient closer to the situation where all pathway units go separately. Of course, this issue is affected by the infection level of the wood.

Table B.20: Aggregation/disaggregation coefficient* transforming the pathway units into the transfer units, for the machinery pathway

[m_6] machinery pathway			
Quantile	**A_0**	**A_1**	**A_2**
Lower	0.01	0.01	0.01
Q_1	0.07	0.07	0.07
M	0.1	0.1	0.1
Q_3	0.2	0.2	0.2
Upper	1	1	1
Distribution	BetaGen	BetaGen	BetaGen

*: 1 means that all pathway units go separately. For all pathway units to stay together, the coefficient is 1/N of pathway units.

Justifications for m_6 (machinery pathway; Table B.20)

For all scenarios and quantiles, the estimates are based on expert judgement, due to lack of data on whether imported contaminated machinery will tend to stay together or go separately.

Table B.21: Multiplication factor changing the abundance from substep E_4 (after leaving the point of entry) to substep E_5 (transferring to the host) in the different scenarios, for the host plants for planting pathway

[m_7] plants for planting pathway			
Quantile	**A_0**	**A_1**	**A_2**
Lower	0.00	0.00	0.00
Q_1	0.05	0.09	0.01
M	0.10	0.22	0.02
Q_3	0.15	0.43	0.04
Upper	0.20	1.00	0.08
Distribution	Weibull	Weibull	Weibull

Justifications for m_7 (plants for planting pathway; Table B.21)

This multiplication factor will depend on where the imported infected host plant is planted (nursery vs. garden, road, square, river). If the infected plant is planted in a nursery, it is expected that the nurserymen will remove and dispose the symptomatic plants, if these are noticed, thus reducing the possibility of transfer.

Potted plants will reduce the likelihood of transfer of the pathogen to neighbouring plants through roots (less contact among the plants).

Cutting and pruning activities can increase the likelihood of transfer through contaminated tools.

It is estimated that the inoculum can be transferred to a maximum of 12 healthy plants. This figure is justified by the data on yearly rate of increase of foci in Piedmont, Italy. However, this figure cannot be used directly in this table because it is not based on a single infected plant, as there are several infection foci in that region. Moreover, these data overestimate the possibility of transfer, as the chance of transfer is increased by having many plants affected (the initial phase of the epidemic has a shallower slope of increase than later on).

For the A_0 scenario:

- Lower: This value represents the event that the infected plant and its inoculum will not come into contact with a healthy *Platanus* tree. This could happen if the infected plant has been detected and destroyed before coming in contact with healthy ones. This applies also when infected plants are isolated from native healthy ones.
- Q_1, Median, Q_3: An infected plant could become a reservoir of inoculum for many others.
- Upper: plants for planting are an unlikely mechanism of spread. However, if an infected plant is not detected, it could act as an inoculum reservoir from which many other plants can be infected.

For the A_1 and A_2 scenarios: the multiplication factor was calculated based on the effectiveness of RROs (see Appendix C).

Table B.22: Multiplication factor changing the abundance from substep E_4 (after leaving the point of entry) to substep E_5 (transferring to the host) in the different scenarios, for the wood pathway

[m_7] wood pathway			
Quantile	**A_0**	**A_1**	**A_2**
Lower	0	0	0
Q_1	0.025	0.025	0.003
M	0.060	0.060	0.009
Q_3	0.075	0.075	0.015
Upper	0.100	0.100	0.030
Distribution	BetaGen	BetaGen	Weibull

Justifications for m_7 (wood pathway; Table B.22)

The Panel estimates that the values for the wood pathway may be lower than those for the plants for planting and the machinery pathways. For transferring the pathogen to the host plants, the infected wood has to be placed close to an avenue with plane trees, a *Platanus* woodland or any other *Platanus* plantation, which may be considered a rare event. However, by cutting wood, sawdust will be produced, and this can be an effective means of transfer.

- For the A_0 scenario:
  - For all quantiles, based on expert judgment, due to lack of data.
- For the A_1 and A_2 scenarios: the multiplication factor was calculated based on the effectiveness of RROs (see Appendix C).

Table B.23: Multiplication factor changing the abundance from substep E_4 (after leaving the point of entry) to substep E_5 (transferring to the host) in the different scenarios, for the machinery pathway

[m_7] machinery pathway			
Quantile	**A_0**	**A_1**	**A_2**
Lower	0.0	0.0	0.00
Q_1	0.3	0.3	0.03
M	0.5	0.5	0.07
Q_3	1.0	1.0	0.3
Upper	3.0	3.0	1.5
Distribution	BetaGen	BetaGen	InvGauss

Justifications for m_7 (machinery pathway; Table B.23)

There is, in general, very little information about the machinery pathway, however, the Panel assumes that this is the most effective means to transfer the pathogen.

- For the A_0 scenario:
  - Lower: This value represents the event that the contaminated machinery will not come into contact with a *Platanus* tree. This could happen if the machine is initially used away from hosts, so that the inoculum is lost before a host is reached. Another possibility is the inoculum to be washed-off by heavy rain or the contaminated machinery not to be used for a long time.
  - Q_1, Median, Q_3: This step is more likely for machinery than for plants for planting. The same contaminated machinery can infect several plants.
  - Upper: Machinery represents a major means of inoculum transfer. However, even when contaminated machinery comes into contact with a *Platanus* tree and causes a wound, the possibility for an infection to occur is less than 50% because there might not be any transfer of inoculum from the part of the machinery that made contact with the new potential host. Nevertheless, the machinery can come into contact with multiple host trees (or non-hosts). The number of host trees with which the contaminated machinery will come into contact is difficult to be estimated, which reflects the uncertainty of this estimation.
  - For the A_1 and A_2 scenarios: the multiplication factor was calculated based on the effectiveness of RROs (see Appendix C).

B.2. Establishment

The assessment of establishment of *C. platani* in the RA area was conducted by distinguishing the influence of host plants, pathogen biology, presence of vectors, suitability of environmental conditions and human activities. However, the effect of RROs on establishment was assessed for the whole establishment and not for each influencing factor (see Appendix C).

B.2.1. Substep 2A: Influence of the presence of host plants on establishment

The table is empty for scenarios A_1 and A_2 because the estimated influence of host plants on the establishment is independent of the scenarios. The RROs apply to all factors influencing establishment and not specifically to host plants.

Table B.24: Distribution of the probability of establishment of the potential founder populations due to the presence of host plants

	[2A] host plants		
Quantile	**A_0**	**A_1**	**A_2**
Lower	0.80	–	–
Q_1	0.85	–	–
M	0.90	–	–
Q_3	0.95	–	–
Upper	1.00	–	–
Distribution	BetaGen	–	–

Justifications for substep 2A (Table B.24)

The host is commonly planted in the RA area. Host plants of *C. platani* are grown in nurseries, private and public gardens, along roads/avenues/water courses, in car parks and as natural stands along rivers in both urban and rural areas of the EU. Although no detailed data exists on the exact host distribution in the RA area, it is considered that *Platanus* trees are present in most of the EU MSs. The calculation excludes northern regions of the RA area (Estonia, Finland, Latvia, Lithuania and most of Sweden), where the host is absent and, therefore, there is no chance of establishment. For more information on the distribution of host plants in the RA area, please see the pest categorisation (EFSA PLH panel, 2014).

It is assumed that a newly planted infected host plant will tend to be surrounded by other host plants. The pathogen is host-specific, and *Platanus* is the only genus of the Platanaceae family. While a newly planted infected cutting tends to be small, a newly planted infected tree tends to be large and can thus be a huge source of inoculum. In nurseries, newly infected plants are likely to be small, but they tend to be distributed to different places.

- For the A_0 scenario:
  - For all quantiles, based on expert judgment, due to lack of data.

B.2.2. Substep 2B: Influence of the biology of the pest on establishment

The table is empty for scenarios A_1 and A_2 because the estimated influence of the biology of the pathogen on the establishment is independent of the scenarios. The RROs apply to all factors influencing establishment and not specifically to the pathogen biology.

Table B.25: Distribution of the probability of establishment of the potential founder populations due to the biology of the pest

[2B] biology of the pest			
Quantile	**A_0**	**A_1**	**A_2**
Lower	0.95	–	–
Q_1	0.976	–	–
M	0.986	–	–
Q_3	0.988	–	–
Upper	1	–	–
Distribution	LogNormal	–	–

Justifications for substep 2B (Table B.25)

C. platani is a highly infectious pathogen with various survival mechanisms and multiple means for dispersal. For more information on the biology of the pathogen, please see the pest categorisation (EFSA PLH panel, 2014) and references cited therein.

- For the A_0 scenario:
  - For all quantiles, based on expert judgment, due to lack of data.

B.2.3. Substep 2C: Influence of the vector on establishment

The table is empty for scenarios A_1 and A_2 because the estimated influence of vectors on the establishment is independent of the scenarios. The RROs apply to all factors influencing establishment and not specifically to the vectors.

Table B.26: Distribution of the probability of establishment of the potential founder populations due to the presence of vectors

[2C] presence of vectors			
Quantile	**A_0**	**A_1**	**A_2**
Lower	1	–	–
Q_1	1	–	–
M	1	–	–
Q_3	1	–	–
Upper	1	–	–

Justifications for substep 2C (Table B.26)

- For the A_0 scenario: No insect vectors/carriers are required for the establishment of the pathogen in a new area.

B.2.4. Substep 2D: Influence of the environmental conditions on establishment

The table is empty for scenarios A_1 and A_2 because the estimated influence of the environment on the establishment is independent of the scenarios. The RROs apply to all factors influencing establishment and not specifically to the environment.

Table B.27: Distribution of the probability of establishment of the potential founder populations due to the environmental conditions

[2D] environmental conditions			
Quantile	**A_0**	**A_1**	**A_2**
Lower	0.80	–	–
Q_1	0.85	–	–
M	0.90	–	–
Q_3	0.95	–	–
Upper	1.00	–	–
Distribution	BetaGen	–	–

Justifications for substep 2D (Table B.27)

For the influence of environmental conditions on establishment, see the pest categorisation (EFSA PLH panel, 2014). The climate is suitable to the pathogen in many regions of the RA area and the pathogen produces propagules at temperatures between 10 and 35 °C. Therefore, even in central-north EU MSs, the environmental conditions are not likely to be a limiting factor for the establishment of the pathogen during summer. However, there is seasonality in the establishment (Pilotti et al., 2016).

- For the A_0 scenario:
  - For all quantiles, based on expert judgment, due to lack of data.

B.2.5. Substep 2E: Influence of human activities on establishment

The table is empty for scenarios A_1 and A_2 because the estimated influence of the human activities on the establishment is independent of the scenarios. The RROs apply to all factors influencing establishment and not specifically to the human activities.

Table B.28: Distribution of the probability of establishment of the potential founder populations due to human activities

[2E] human activities			
Quantile	**A_0**	**A_1**	**A_2**
Lower	0.250	–	–
Q_1	0.438	–	–
M	0.456	–	–
Q_3	0.613	–	–
Upper	1.000	–	–
Distribution	Uniform	–	–

Justifications for substep 2E (Table B.28)

C. platani is a wound pathogen and humans, through their activities (e.g., pruning, sanitary operations, construction work, road maintenance, boats travelling along rivers and canals, etc.) are the main agent responsible for the majority of new infections of plane trees in both urban and rural environments (Panconesi et al., 2003)

Deliberate eradication of the pathogen is possible when it is detected at an early stage and the number of infected trees is limited. Local eradication was possible in several cases in Greece, France, Italy and Spain. The pathogen can be easily detected once the latent infection becomes symptomatic. Infected plants will die quickly and, after some time, could naturally disappear as a source of inoculum without maintaining the infection. However, in most cases, there are many hosts around and long-distance dispersal is possible.

A French study found that increasing the rogueing distance from 15 m to 15–25 m and to 25–50 m, the proportion of foci with resurgence of the disease decreased from 95%, to 68% and 56%, respectively (Ferrieu and Miniggio, 2007). The same authors conclude that the presence of an infected plane tree implies a threat to the surrounding plane trees at a distance of at least 50 m (this security distance can be extended to 100 m in case of an area with high density of plane trees; Ferrieu and Miniggio, 2007).

- For the A_0 scenario:
  - For all quantiles, based on expert judgment, due to lack of data.

B.3. Spread

B.3.1. Substep S_1: Initial condition for the spread

Table B.29: Number of spatial units representing the initial condition for the spread in the different scenarios

	[N_3]		
Quantile	**A_0**	**A_1**	**A_2**
Lower	84	84	84
Q_1	86	86	86
M	88	88	88
Q_3	90	90	90
Upper	95	95	95
Distribution	Normal	Normal	Normal

Justifications for N_3 (Table B.29)

Maps showing the disease distribution at the NUTS3 level in the affected EU MSs are provided in Figures B.1–B.3. Table B.30 reports the development of the epidemic of *C. platani* within Greece.

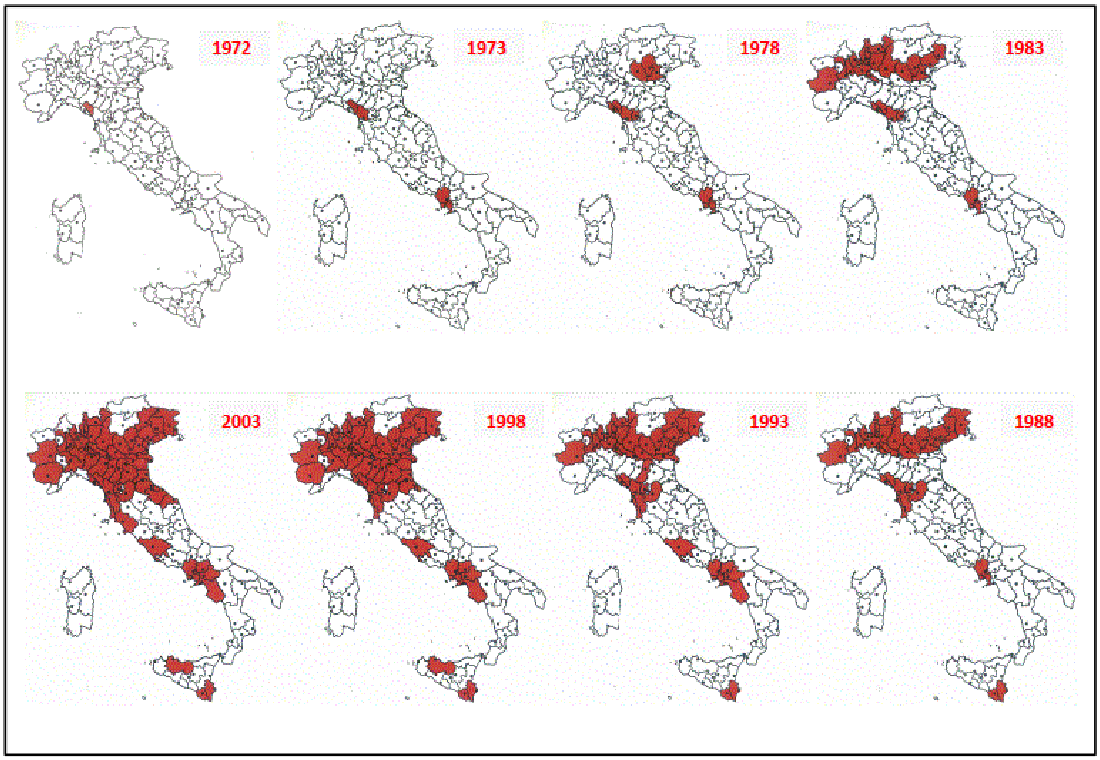

Figure B.1: NUTS3 regions affected by *C. platani* in Italy between 1972 and 2003 (kindly provided by Alberto Panconesi)

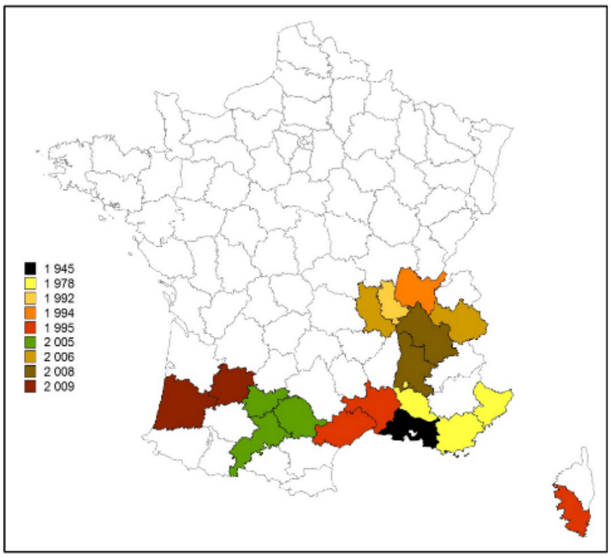

Figure B.2: French departments (NUTS3 regions) affected by *C. platani* between 1945 and 2009 [available on the web (Sep 2016) at http://www.fredonra.com/collectivites/le-chancre-colore-du-platane/]

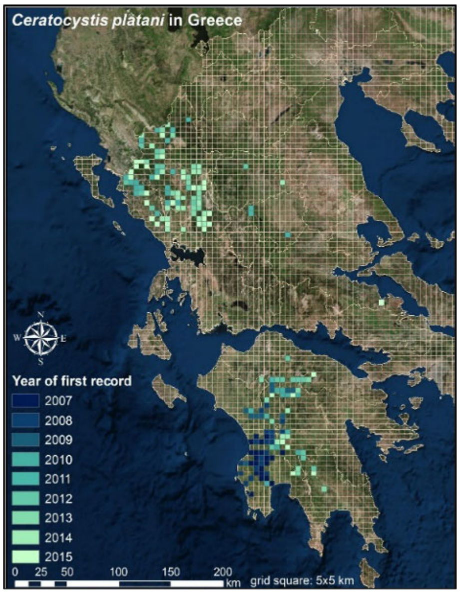

Figure B.3: Distribution of *C. platani* outbreaks in Greece during the period 2007–2015 (kindly provided by Panagiotis Tsopelas)

Table B.30: Outbreaks (new infections detected in *Platanus* trees within a distance of 100 m from infected trees recorded the previous years) of *C. platani* in Greece during the period 2010–2014 (kindly provided by Panagiotis Tsopelas)

Regional Unit (NUTS3)	2010	2011	2012	2013	2014	Status (2015)
Achaea	9	6	15	13	6	Expanding
Arcadia	3	10	2	10	10	Expanding
Arta	0	0	0	4	18	Expanding
Corinthia	0	0	1	6	5	Expanding
Eleia	6	1	0	5	0	Expanding
Ioannina	9	17	22	31	48	Expanding
Karditsa	0	4	0	0	0	Eradicated

Regional Unit (NUTS3)	2010	2011	2012	2013	2014	Status (2015)
Lakonia	–	–	–	1	0	Expanding
Messinia	13	2	1	5	0	Expanding
Preveza	0	0	0	4	4	Expanding
Thesprotia	8	5	12	8	6	Expanding
Trikala	0	0	1	0	1	Eradicated
Total	**48**	**45**	**56**	**87**	**98**	–

- For all scenarios:
  - Lower boundary: Based on the total number of NUTS3 regions currently considered to be affected by *C. platani* in the RA area (France = 18, Greece = 12, Italy = 54).
  - Q_1, Median, Q_3: based on expert judgement.
  - Upper boundary: There could be a few more spatial units (NUTS3) affected by the disease but not reported yet.

B.3.2. Substep S_2: Maximum number of spatial units corresponding to the area of potential establishment

Table B.31: Maximum number of spatial units in the risk assessment area for the relevant crops/ habitats in the different scenarios

	[N_4]		
Quantile	**A_0**	**A_1**	**A_2**
Lower	900	900	900
Q_1	985	985	985
M	1,070	1,070	1,070
Q_3	1,160	1,160	1,160
Upper	1,240	1,240	1,240
Distribution	Normal	Normal	Normal

Justifications for N_4 (Table B.31)

The estimates are based on the number of NUTS3 regions excluding most of Scandinavia (*Platanus* trees are present in Denmark and southern Sweden) and Baltic countries. Those countries were excluded based on the absence of the host [see the pest categorisation (EFSA PLH panel, 2014)] and street tree inventories from Scandinavia (Sjöman et al., 2012), as well as on some uncertainty on Baltic countries and other northern areas as to whether they have sufficient host densities to allow establishment of the pathogen.

- For all scenarios:
  - The lower boundary was estimated considering that in some NUTS3 units in potentially affected EU MSs the host might not be present everywhere.
  - Q_1, M and Q_3: expert judgment
  - Upper: assuming that the host is present in some regions also in Northern EU MSs.

B.3.3. Substep S_3: Increase of number of occupied spatial units due to the spread

Table B.32: Multiplication factor used to derive the number of spatial units from the initial condition for the spread in the different scenarios

	[m_9]		
Quantile	**A_0**	**A_1**	**A_2**
Lower	0.30	–	–
Q_1	0.88	–	–
M	1.70	–	–

[m_9]			
Quantile	**A_0**	**A_1**	**A_2**
Q_3	1.73	–	–
Upper	1.80	–	–
Distribution	BetaGen		

Justifications for m_9 (Table B.32)

Spread rates were calculated based on linear regressions performed on existing data (visualised in the previous maps) on the increase in affected NUTS3 units over time.

- For the A_0 scenario:
  - Lower: estimated to be lower than the lowest calculated rate (in France, 0.45)
  - Q_1: from data in Greece (0.88)
  - Median: for all data combined (1.70)
  - Q_3: estimated to be slightly higher than the highest calculated rate (in Italy, 1.73)
  - Upper: estimated to be higher than the highest calculated rate
- For the A_1 and A_2 scenarios: the multiplication factors are not shown here because they are calculated based on the effectiveness of RROs for each mechanism of spread considered; in decreasing order of importance: machinery, wood, host plants for planting, natural means (wind-borne inoculum) (see Appendix C).

B.3.4. Substep S_4: Increase in the spread due to the new entries

In the current situation, a median number of new established populations of 0.3 per year was estimated. The Panel made the assumption that these established populations have the same probability to occur in any of the 1,240 NUTS3 units of the RA area with presence of hosts. The average probability to have a new established population due to new entries was calculated as 0.3 over 1,240, i.e. 0.0002, which may be considered as minor in terms of contribution to the spread. A qualitatively similar result is obtained for the A_1 and A_2 scenarios. Therefore, this substep was not included in the assessment.

B.4. Impact

B.4.1. Assessment of impact for the different scenarios

Substep I_1: Abundance of the pest in the spatial units occupied by the pest under the different scenarios

Table B.33: Estimated abundance of *C. platani* in the relevant habitats within the area of the spatial units occupied by the pathogen at the time of the assessment (year 2016)

[P_5]			
Quantile	**A_0**	**A_1**	**A_2**
Lower	0.0001	0.0001	0.0001
Q_1	0.005	0.005	0.005
M	0.01	0.01	0.01
Q_3	0.04	0.04	0.04
Upper	0.20	0.20	0.20
Distribution	LogNorm	LogNorm	LogNorm

Justifications for P_5 (Table B.33)

Estimated abundance of *C. platani* at the time of the assessment (year 2016) refers to the proportion (%) of affected plane trees in the affected NUTS3 regions. Affected trees in this assessment are the trees still present, as the removed trees are no longer sources of inoculum. However, the inoculum can still be present several years after the death of trees, also in the root system, if no measures are taken to remove the dead tree including its roots or kill the root system with herbicides. The current prevalence of the disease in Florence is reported as 3–6%. In some areas of Greece, the prevalence is higher.

- For all scenarios:
  - Lower boundary: expert judgement, based on regions where the disease is rare due to eradication attempts.
  - Median, Q_1 and Q_3: expert judgement, based on the uncertainty on these figures.
  - Upper boundary: expert judgement, based on regions with high disease prevalence and no attempt to apply eradication or containment measures.

Table B.34: Estimated growth rate (exponential curve) per year of *C. platani* in the relevant habitats within the area of the spatial units occupied by the pathogen

	[P_{5*}]		
Quantile	**A_0**	**A_1**	**A_2**
Lower	0.006	0.006	0.0001
Q_1	0.0082	0.016	0.0011
M	0.010	0.026	0.0024
Q_3	0.023	0.044	0.0047
Upper	0.050	0.210	0.0230
Distribution	Pearson5	Pearson5	Pearson5

Justifications for P_{5*} (Table B.34)

- For scenario A_0:
  - all quantiles are based on a combination of expert judgment and data from the Canal du Midi (Maire and Jugnet, 2014), where control measures have been taken since the first outbreak started.
- For scenario A_1:
  - all quantiles are based on a combination of expert judgment and a multiplication factor based on literature (Italy), data (France), in urban (Italy) vs. non-urban (France) areas, where measures had not been taken yet (Marziano, 1988).
- For scenario A_2: multiplication factor based on the estimated effectiveness of the combined RROs for spread (see Appendix C).

Table B.35: Estimated abundance of *C. platani* in the relevant habitats within the area of the spatial units occupied by the pathogen under the different scenarios

	[P_{5**}]		
Quantile	**A_0**	**A_1**	**A_2**
Lower	0.0004	0.0005	0.0003
Q_1	0.005	0.007	0.004
M	0.014	0.021	0.012
Q_3	0.041	0.063	0.035
Upper	0.52	1.00	0.44
Distribution	These are results from a calculation, so no distribution was fitted to the obtained quantiles		

Justification for P_{5**} (Table B.35)

P_{5**} refers to the end of the time horizon considered (10 years). Calculated on the basis of rate of increase (estimated growth rate of the pathogen) and initial conditions (estimated abundance of the pathogen) (Appendix A).

B.4.2. Assessment of impacts on host crops

This was considered as not relevant because *Platanus* trees are currently only rarely cultivated for wood production in the RA area.

B.4.3. Assessment of impacts on the environment

Substep I_4: Estimated change in ecosystem services provision levels (for selecting provisioning, regulating and supporting services) in the spatial units occupied by the pest in the different scenarios

Table B.36: Multiplication factor changing the provision of provisioning ecosystem services (wood) in relation to pest abundance in the spatial units occupied in the different scenarios

[m_{13}] provisioning ecosystem services			
Quantile	**A_0**	**A_1**	**A_2**
Lower	0.80	0.80	0.80
Q_1	0.94	0.94	0.94
M	1.00	1.00	1.00
Q_3	1.06	1.06	1.06
Upper	1.20	1.20	1.20
Distribution	Normal	Normal	Normal

Justification for m_{13} (Table B.36)

Even though *Platanus* is not currently cultivated for wood production in the RA area, the Panel considers that in case a *Platanus* tree is cut, the wood may be used as firewood.

- For all scenarios and quantiles:
  - Lower: 0.8 because not all the wood that derives from a dead tree is available for use.
  - Q_1: based on expert judgment
  - Median: 1 because the Panel expects an infected tree to die soon afterwards.
  - Q_3: based on expert judgment
  - Upper: 1.2 because of the additional availability of dead wood due to the disease compared to the normal situation without *C. platani*.

[Explanatory note (will probably be moved to Appendix A in the Description of Methods): This is a slope (1 corresponds to 45 degrees), which relates the prevalence of the pathogen to the reduction in ecosystem services. A slope of 1.2 corresponds to a decrease greater than that with a slope of 0.8.]

Table B.37: Multiplication factor changing the provision of regulating and supporting ecosystem services in relation to pest abundance in the spatial units occupied in the different scenarios

[m_{13*}] regulating and supporting ecosystem services			
Quantile	**A_0**	**A_1**	**A_2**
Lower	0.3	0.3	0.3
Q_1	0.4	0.4	0.4
M	0.6	0.6	0.6
Q_3	0.8	0.8	0.8
Upper	1.0	1.0	1.0
Distribution	BetaGen	BetaGen	BetaGen

Justification for m_{13*} (Table B.37)

Pollution reduction, water regulation, shade provision and avoidance of soil erosion are considered as regulating and supporting ecosystem services provided by *Platanus* plantations.

Even if *Platanus* trees are lost due to the disease, these services can still be partially provided by other tree species (*Platanus* is rarely a dominant tree species, although this can happen in tree avenues and parks, as well as for *P. orientalis* in riparian vegetation of rivers in Bulgaria, Greece and Sicily).

- For all scenarios and quantiles: based on expert judgment, due to lack of data.

Table B.38: Multiplication factor changing the provision of cultural ecosystem services in relation to pest abundance in the spatial units occupied in the different scenarios

	[m_{13**}] cultural ecosystem services		
Quantile	**A_0**	**A_1**	**A_2**
Lower	0.60	0.60	0.60
Q_1	0.85	0.85	0.85
M	1.00	1.00	1.00
Q_3	1.15	1.15	1.15
Upper	1.40	1.40	1.40
Distribution	BetaGen	BetaGen	BetaGen

Justification for m_{13**} (Table B.38)

Ancient *Platanus* trees have important and irreplaceable cultural value.

- For all scenarios and quantiles: based on expert judgment, due to lack of data.

Substep I_5: Estimated change in biodiversity (e.g. percentage reduction in species richness) in the spatial units occupied by the pest as assessed in the spread step

Not considered, due to lack of information on impacts of *C. platani* on biodiversity.

Appendix C – Detailed information on the Risk Reduction Options (RROs)

C.1. RROs in scenarios A_0 and A_2

The RROs considered in scenarios A_0 (current situation in the RA area with respect to Council Directive 2000/29/EC on the pathogen and its host as well as the emergency measures applied by the *C. platani*-affected EU Member States) and A_2 (current situation with the application of additional RROs) are listed in the following tables for entry (Table C.1), establishment (Table C.2), spread (Tables C.3 and C.4) and impact (Table C.5).

Scenario A_1 is not included because it describes the situation without RROs (worst-case scenario).

Table C.6 summarises the emergency measures adopted in the EU MSs affected by *C. platani*.

Table C.1: Summary of the RROs in scenarios A_0 and A_2 (entry)

Step	Substep	Plants for planting		Wood		Machinery	
		Scenarios					
		A_0	A_2	A_0	A_2	A_0	A_2
Entry	**E_1** Measures applied before leaving the place of production	Pest-free place of production (based on symptoms) (it applies only to plants for planting originating in Armenia, Switzerland or the USA) (*Annex IV, Part A, Section I*)	Pest-free area OR (Pest-free place of production AND produced under a certification scheme)	Wood, except that in the form of chips, particles, sawdust, shavings, wood waste and scrap, but including wood which has not kept its natural round surface, originating in Armenia, Switzerland or the USA, Kiln-dried (*Annex IV, Part A, Section I*) Wood in the form of chips, particles, sawdust, shavings, wood waste and scrap obtained in whole or part from Platanus, originating in Armenia, Switzerland or the USA, Kiln-dried OR Fumigated OR Heat-treated (at least 56°C for a minimum duration of 30 continuous min) (*Annex IV, Part A, Section I*) Wood obtained in whole or part from *Platanus* spp., including wood that has not kept its natural round surface originating in Armenia, Switzerland or the USA: Plant health inspection in the country of origin for issuing a phytosanitary certificate (*Annex V, Part B, Section I*)	For all kinds of wood (incl. firewood) As in A_0, but for all affected Third Countries OR Originate in a Pest-free area	No requirements in Council Directive 2000/29/EC	Originate in a Pest-free area OR (The machinery shall be cleaned and disinfected, and be free from soil and plant debris when brought into places where *Platanus* are grown AND shall be accompanied by a certificate verifying that it has been cleaned and disinfected)

Step	Substep	Plants for planting		Wood		Machinery	
		Scenarios					
		A_0	A_2	A_0	A_2	A_0	A_2
	E_2 Measures applied before crossing the border of the exporting country	No requirements in Council Directive 2000/29/EC	Plant health inspection in the country of origin – phytosanitary certificate	Plant health inspection in the USA, Switzerland or Armenia – phytosanitary certificate	Plant health inspection in all affected Third Countries	No requirements in Council Directive 2000/29/EC	No additional RROs
	E_3 Measures applied before arriving at the EU point of entry (during transport)	No requirements in Council Directive 2000/29/EC	No additional RROs	No requirements in Council Directive 2000/29/EC	No additional RROs	No requirements in Council Directive 2000/29/EC	No additional RROs
	E_4 Measures applied before leaving the EU point of entry	Inspection requirements in Council Directive 2000/29/EC (art. 13)	Visual inspection AND sampling AND lab-testing, in case of suspect symptoms (mandatory)	Inspection requirements in Council Directive 2000/29/EC (Art. 13)	Visual inspection AND sampling AND lab-testing, in case of suspect symptoms (mandatory)	No requirements in Council Directive 2000/29/EC	Prohibition of movement of non-compliant machinery
	E_5 Measures applied before transferring to the host	No requirements in Council Directive 2000/29/EC Emergency measures applied by affected EU MSs (see Table C.6 for details)	Surveillance AND Use of enhanced eradication programmes	No requirements in Council Directive 2000/29/EC	No additional RROs	No requirements in Council Directive 2000/29/EC	No additional RROs

Table C.2: Summary of the RROs in scenarios A_0 and A_2 (establishment)

Step	Substep	A_0	A_2
Establishment	T Measures modifying establishment	No requirements in Council Directive 2000/29/EC Surveillance and Eradication programmes in affected EU MSs (see Table C.6 for details)	Surveillance AND Use of enhanced eradication programmes (see Appendix C.2.5)

Table C.3: Summary of the RROs in scenarios A_0 and A_2 (spread)

Step	Substep	Plants for planting		Wood		Machinery	
		Scenarios					
		A_0	**A_2**	**A_0**	**A_2**	**A_0**	**A_2**
Spread (1)	Measures modifying the spread factor	Pest-free area OR Pest-free place of production (based on symptoms) (*Annex IV, Part A, Section II*) Special requirements for the introduction and movement of *Platanus* plants for planting into and within the UK (protected zone): Plants for planting originating in the Union, or in Armenia, Switzerland or the USA: Pest-free area established in accordance with relevant International Standards for Phytosanitary measures or have been grown throughout their life in the UK (Annex IV, Part B) Plant health inspection at the place of production-plant passport (*Annex V, Part A, Section I*) Emergency measures applied by affected EU MSs (see Table C.6 for details)	Originated in a pest-free area OR (Pest-free place of production AND Plants for planting originating in the Community shall be produced under a certification scheme)	Wood (including wood that has not kept its natural round surface): Originated in a pest-free area OR Kiln-dried (*Annex IV, Part A, Section II*) Special requirements for the introduction and movement of *Platanus* wood into and within the UK (protected zone): Wood of *Platanus* which has not kept its natural round surface, originating in the Union, or in Armenia, Switzerland or the USA: Pest-free area established in accordance with relevant International Standards for Phytosanitary measures or Kiln-dried or originates from a protected zone (i.e. UK) (Annex IV, Part B) Plant health inspection at the place of production-plant passport (*Annex V, Part A, Section I*) Emergency measures applied by affected EU MSs (see Table C.6 for details)	For all kinds of wood (incl. firewood) Originated in a Pest-free area OR Kiln-dried OR Heat-treated	No requirements in Council Directive 2000/29/EC Emergency measures applied by affected EU MSs (see Table C.6 for details)	Originated in a pest-free area OR (The machinery shall be cleaned and disinfected, and be free from soil and plant debris when moved into places where *Platanus* are grown AND shall be accompanied by a certificate verifying that it has been cleaned and disinfected)

Table C.4: Summary of the RROs in scenarios A_0 and A_2 (spread – continued)

Step	Substep	Root anastomosis		Natural spread	
		Scenarios			
		A_0	**A_2**	**A_0**	**A_2**
Spread (2)	**S** Measures modifying the spread factor	Emergency measures applied by affected EU MSs (see Table C.6 for details)	Surveillance AND Use of enhanced eradication programmes (see Appendix C.2.5) AND Planting resistant *Platanus* clones in new plantations in affected areas	Emergency measures applied by affected EU MSs (see Table C.6 for details)	Surveillance AND Use of enhanced eradication programmes AND Planting resistant *Platanus* clones in new plantations in affected areas

Table C.5: Summary of the RROs in scenarios A_0 and A_2 (impact)

Step	Substep	Scenarios	
		A_0	**A_2**
Impact	Measures modifying impact (i.e. reduction of local spread from affected to healthy plants)	1) Plants for planting: as in the spread step 2) Wood: as in the spread step 3) Machinery: no requirements 4) Root anastomosis: eradication programmes applied by the affected EU MSs (see Table C.6 for details) 5) Natural spread: eradication programmes applied by affected EU MSs (see Table C.6 for details)	As for spread step, with focus on machinery and root anastomosis, which are the main mechanisms responsible for local (short-distance) spread of the disease

Table C.6: Emergency measures for the containment and eradication of *C. platani* in the affected EU MSs

EU Member State	France	Greece	Italy
Source	http://www.ecophytozna-pro.fr/data/%20arrete_22_12_15_ccp_4.pdf	http://www.bpi.gr/files/Fytoygeionomikh%20nomothesia/4,1/C.%20platani%20K.Y.A.%20119999-22-9-2004.pdf	http://www.agricoltura.regione.lombardia.it/shared/ccurl/783/199/DM%20Cancro%20del%20platano.pdf
Date issued	Dec 2015	Sept 2004(currently under revision)	Feb 2012 (updated 2015)
Containment and eradication measures			
Focus zone	radius of 35 m around infected plane trees (can be augmented to 50 m)	A focus zone of a radius of at least 100 m is demarcated around an infected plane tree or a group of infected plane trees	radius of 300 m from an infected *Platanus* tree
Safety zone	(at least) the municipalities with infected plane trees	A safety zone of a radius of at least 1 km is demarcated around the focus zone	at least 1 km wide
Neutral zone	–	If necessary, a neutral zone is demarcated around the safety zone (no further details are provided)	–

EU Member State	France	Greece	Italy
Maintenance of zones	10 years without observation of symptoms	If there are no additional findings of *C. platani* in the area during the surveys conducted over the next 2 years after the first detection of the pathogen in an area, the demarcated zones cease to exist and no eradication measures are applied any more	5 years without observation of symptoms
Soil	Prohibition of moving soil from infested zones to other areas	–	–
Disinfection of machinery and tools	Mandatory cleaning and disinfecting of tools and machines before and after working in the infested and buffer zones and after working on each *Platanus* tree	Cleaning and disinfecting with appropriate chemicals of pruning tools used during felling of infected or suspect *Platanus* trees as well as of the felling site	Mandatory disinfection of pruning tools after working on each *Platanus* tree
Felling/removal/ destruction of infected trees and adjacent ones	Mandatory felling of *Platanus* trees in infested zones, removal/killing of the stump (within 2 months of the official notification)	Immediate felling and, if possible, uprooting and destruction by fire or other appropriate means of all *Platanus* trees that are found after laboratory testing to be infected by the pathogen, as well as of the adjacent trees that are within a radius of 15 m.However, based on information provided by Panagiotis Tsopelas, in practice, all host trees within a radius of 15 m around an infected tree are killed with herbicidesLogging and pruning of *Platanus*trees in the affected area (focus zone) and in the safety zone is prohibited unless it is supervised by the phytosanitary authorities	Mandatory felling, removal/ killing of the stump of *Platanus* trees with symptoms and the adjacent *Platanus* trees (exception for monumental trees, in case adjacent to infected *Platanus* trees, felling is not compulsory)
Management of debris	On site incineration of the felled tree and debris	Collection and destruction by fire or other appropriate means of the debris (including sawdust) following logging of *Platanus* trees (i.e. infected trees and adjacent ones within a radius of 15 m)	On site elimination of the felled tree & debris for *Platanus* trees with symptoms and the adjacent *Platanus* trees
Replanting of infested zones with host trees	Prohibition of planting *Platanus* trees in infested zones for the next 10 after the last detection of the organism	–	Prohibition of planting *Platanus* trees in infested zones, unless these are resistant to the disease
Movement/trade of host plants for planting originating in the affected area	Prohibition of selling of *Platanus* plants for planting from sites located within infested zones, even if these sites are only in part within infested zones	Prohibition of movement of *Platanus* plants for planting, except those that fulfil the special requirements of Council Directive 2000/29/EC, as well as the movement of seeds from the focus and safety zones to other areas outside the zones	Selling of *Platanus* plants for planting from sites located within infested zones only with a phytosanitary certificate

EU Member State	France	Greece	Italy
Movement/trade of *Platanus* wood originating in the affected area	–	Prohibition of movement of *Platanus* wood, including wood that has not kept its natural round surface from the focus and safety zones to other areas outside the zones, with the exception of wood that fulfils the special requirements of Council Directive 2000/29/EC	–
Surveys		Visual inspection, sampling and lab testing of (i) native *Platanus* plants and (ii) *Platanus* plant propagation material produced in or moved within or imported into the country, are performed randomly each year throughout the whole country	
Plant propagation material		Immediate destruction of the whole consignment/lot of *Platanus* plant propagation material found after laboratory testing to be infected by the pathogen	

C.2. Description of additional RROs in scenario A_2

C.2.1. Certification scheme for plants for planting

A certification scheme could be developed for the production of pest-free host plant propagation material. Currently, there is no official certification scheme for *Platanus* plants for planting.

C.2.2. Visual inspection, sampling and lab-testing of consignments

Plants for planting

Disease symptoms on host plants for planting are not easily detected during winter months and early spring due to absence of foliage. Since trading and planting of *Platanus* spp. take place mostly during this period, there is always the possibility for *C. platani* to be transferred to pest-free areas on such plant material. Also, during this period, the fungus grows slowly in plant tissues (Pilotti et al., 2016) and latently infected (asymptomatic) host plants most likely will escape detection by visual inspection.

Systematic surveillance in nurseries should be conducted throughout the year. Consignments of *Platanus* plants should be inspected in the country of origin and before leaving the EU point of entry.

Destructive sampling of symptomatic and asymptomatic plants, followed by laboratory analysis according to the EPPO Standard 7/14(2) (OEPP/EPPO, 2014) should be conducted. The development of an on-site molecular detection method (e.g. based on loop-mediated isothermal amplification of DNA) would facilitate the detection of the pathogen on site.

Wood

Wood consignments should be examined for the presence of *C. platani* by sampling and laboratory analysis according to the EPPO Standard 7/14(2) (OEPP/EPPO, 2014). The development of an on-site molecular detection method (e.g. based on loop-mediated isothermal amplification of DNA) would facilitate the detection of the pathogen on site.

C.2.3. Wood treatment

C. platani can survive in wood at temperatures of 40°C for more than 24 h, but 45°C for the same time period were lethal for the fungus (P. Tsopelas, unpublished data).

Heat treatment (HT and DH) of wood packaging material, as described in ISPM 15 ('to achieve a minimum temperature of 56°C for a minimum duration of 30 continuous minutes throughout the entire profile of the wood (including its core))' and 'Where dielectric heating is used (e.g. microwave), wood packaging material composed of wood not exceeding 20 cm^2, when measured across the smallest dimension of the piece or the stack, must be heated to achieve a minimum temperature of 60°C for 1 continuous minute throughout the entire profile of the wood (including its surface)'.

The prescribed temperature in ISPM 15 must be reached within 30 min from the start of the treatment is most likely to prevent the introduction and spread of *C. platani* in the RA area.

No experimental results are available regarding the efficacy of methyl bromide treatment (MB), which is included in ISPM 15.

C.2.4. Cleaning and disinfection of machinery

Construction, terracing and logging machinery as well as pruning and cutting tools play a major role in the dispersal of the pathogen. In the affected areas, all the tools, machinery and plastic sheets used during felling or pruning operations should be disinfected before being used to neighbouring trees or moved out of the affected site (Panconesi, 1999); this can greatly reduce inoculum and minimise disease spread.

In principle, all machinery used in the vicinity of infected trees should be cleaned with water jet (so as to free it from soil and plant debris) and then sprayed with disinfectants before leaving the site. In France, disinfectants containing quaternary ammonium compounds, ortho-phenyl-phenol and 8-hydroxyquinoline sulfate are used (Tsopelas et al., 2006; Ferrieu and Miniggio, 2007; Vigouroux, 2013). During pruning, wounding of the trees has to be minimised and any fresh wound must be treated with an appropriate fungicide to prevent subsequent fungal colonisation.

Large machinery that has been used in affected areas should be accompanied by a certificate that it has been cleaned and disinfected. These practices are also recommended for pruning and cutting tools before their use in areas where *Platanus* trees are growing, even when they have not been used in an affected site.

C.2.5. Enhanced eradication programmes

In the affected areas, the most important sanitation measure is the immediate removal and destruction of infected host trees and any neighbouring tree (Panconesi, 1999; Tsopelas et al., 2006). Pruning of the infected tree parts can only delay the tree death.

Eradication programmes can be effective if they are applied when the disease is detected at the initial stages. Therefore, early detection of new disease foci is a key factor for preventing the establishment and spread of the pathogen in a new area (Tsopelas et al., 2006). Eradication measures are not effective when the disease has taken epidemic proportions, especially in natural stands (Ocasio-Morales et al., 2007). Therefore, annual surveys should be conducted in affected as well as non-affected EU MSs to record disease occurrence at an early stage.

Removal and destruction of infected trees is likely to produce enormous amount of contaminated sawdust, which is highly infective and can be carried by the wind or in watercourses, causing new infections (Panconesi et al., 2003; Luchi et al., 2013). For this reason, some precautions are mandatory during eradication. These include the collection of sawdust and all residues during felling operations. Felling operations in outbreaks require the suspension of vehicle traffic, the use of large plastic sheets to catch sawdust under the infected trees and the felling of trees in one piece or with as few cuts as possible (Panconesi, 1999). The wood and all the debris and sawdust should be destroyed by fire or properly buried in sanitary landfills, while the felling site, including any debris and sawdust left, must be sprayed with a fungicide (Vigouroux, 1979; Blankart and Vigouroux, 1982; Panconesi, 1999).

Any infected tree and healthy trees neighbouring diseased ones should be killed through injection with herbicide (Panconesi, 1999; Tsopelas et al., 2006). In France, the herbicide glyphosate is used to kill infected and neighbouring trees (Tsopelas et al., 2006). All living infected trees and their neighbouring trees to a radius of 20–30 m are injected and killed with herbicides. In this way, a buffer zone is created around infected trees, minimising in this way the risk of the pathogen's spread through root anastomosis since the fungus does not spread into the roots of neighbouring trees killed by the herbicide (Grosclaude et al., 1989, 1992; Ferrieu and Miniggio, 2007; Tsopelas et al., 2015b).

Non-host plants or *Platanus*-resistant clones are recommended to be used in replanting after eradication.

C.2.6. Planting resistant plants

Resistant *Platanus* clones should be used in affected areas. Although the resistance of the currently available clone seems to be controlled by several genes (horizontal resistance) (Vigouroux and Olivier, 2004), more research is needed for the development of new resistant trees because the use of a single clone is risky due to the narrow genetic diversity, which makes it possible for the pathogen to overcome host resistance and/or to be affected by other, new pathogens.

The use of the resistant clone cannot be suggested in natural conditions because there is a risk of hybridisation of the resistant clone with native species, with the possible consequence that it may enhance its adaptability by introgressing useful genes from *P. orientalis* and become invasive in the natural range.

Planting resistant clones in new plantations in affected areas is supposed not to have a measurable effect on impact in the time horizon of 10 years considered in this RA because the planting rate of new plantations with the resistant clones is too low compared to the huge amount of existing plane trees in Europe.

C.3. Assessment of effectiveness of RROs in scenarios A_0 and A_2

The effectiveness of RROs was assessed based on expert judgement, due to lack of data. In this assessment, 0 means no effect and 1 means 100% effect (Tables C.7–C.11).

The RRO multiplication factors for scenario A_1 are calculated based on the estimated effectiveness of the RROs in scenario A_0 with the formula: $m(A_1) = 1/(1 - \text{eff RRO}(A_0))$. The RRO multiplication factors for scenario A_2 are instead calculated based on the estimated effectiveness of the RROs in scenario A_2 with the formula: $m(A_2) = (1 - \text{eff RRO}(A_2))$.

Table C.7: Summary of the estimated effectiveness of the RROs in scenarios A_0 and A_2 (entry)

Step: Entry		Plants for planting		Wood		Machinery	
		Scenarios					
Substep		A_0	A_2	A_0	A_2	A_0	A_2
E_1	Lower	0.20	0.50	0.70	0.85	0	0.30
	Q_1	0.35	0.75	0.80	0.90	0	0.55
	M	0.50	0.85	0.90	0.95	0	0.70
	Q_3	0.60	0.88	0.93	0.97	0	0.80
	Upper	0.75	1.00	0.99	1.00	0	0.95
E_2	Lower	0	0.5	0	0.5	0	0
	Q_1	0	0.65	0	0.65	0	0
	M	0	0.8	0	0.8	0	0
	Q_3	0	0.84	0	0.84	0	0
	Upper	0	0.95	0	0.95	0	0
E_3	Lower	0	0	0	0	0	0
	Q_1	0	0	0	0	0	0
	M	0	0	0	0	0	0
	Q_3	0	0	0	0	0	0
	Upper	0	0	0	0	0	0
E_4	Lower	0.10	0.30	0.10	0.30	0	0.50
	Q_1	0.25	0.50	0.25	0.50	0	0.65
	M	0.35	0.60	0.35	0.60	0	0.80
	Q_3	0.40	0.70	0.40	0.70	0	0.84
	Upper	0.50	0.85	0.50	0.85	0	0.95

Step: Entry		Plants for planting		Wood		Machinery	
		Scenarios					
Substep		A_0	A_2	A_0	A_2	A_0	A_2
E_5	Lower	0.30	0.60	0	0	0	0
	Q_1	0.45	0.75	0	0	0	0
	M	0.55	0.85	0	0	0	0
	Q_3	0.65	0.90	0	0	0	0
	Upper	0.80	1.00	0	0	0	0

Table C.8: Summary of the estimated effectiveness of the RROs in scenarios A_0 and A_2 (establishment)

Step: establishment Substep		A_0*	A_2
T	Lower	0.25	0.30
	Q_1	0.40	0.45
	M	0.50	0.55
	Q_3	0.65	0.70
	Upper	0.85	0.90

*: These values are relevant for the affected EU MSs only.

Table C.9: Summary of the estimated effectiveness of the RROs in scenarios A_0 and A_2 (spread)

Step: spread		Plants for planting		Wood		Machinery	
		Scenarios					
Substep		A_0	A_2	A_0	A_2	A_0	A_2
S (1)	Lower	0.20	0.50	0.60	0.85	0.10	0.30
	Q_1	0.35	0.75	0.67	0.90	0.30	0.55
	M	0.50	0.85	0.70	0.95	0.40	0.70
	Q_3	0.60	0.88	0.73	0.97	0.55	0.80
	Upper	0.75	1.00	0.80	1.00	0.80	0.95

Table C.10: Summary of the estimated effectiveness of the RROs in scenarios A_0 and A_2 (spread – continued)

Step: spread		Root anastomosis		Natural spread	
		Scenarios			
Substep		A_0	A_2	A_0	A_2
S (2)	Lower	0.1	0.4	0.05	0.1
	Q_1	0.22	0.58	0.13	0.18
	M	0.3	0.7	0.2	0.25
	Q_3	0.42	0.78	0.3	0.35
	Upper	0.6	0.9	0.5	0.55

Table C.11: Summary of the estimated effectiveness of the RROs in scenarios A_0 and A_2 (impact)

Step: impact		A_0	A_2
	Lower	0.10	0.20
	Q_1	0.28	0.40
	M	0.35	0.50
	Q_3	0.42	0.60
	Upper	0.60	0.80