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SCIENTIFIC OPINION

Commodity risk assessment of oak and walnut logs from the US

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Abstract

The European Commission submitted to the EFSA Panel on Plant Health a Dossier from the United States proposing the use of a vacuum–steam–heat treatment as a stand-alone phytosanitary measure to mitigate the risk of entry of *Bretziella fagacearum*, *Geosmithia morbida* and its vector *Pityophthorus juglandis* (thousand cankers disease complex) into the EU when trading oak (*Quercus alba*, *Q. rubra*) and walnut (*Juglans nigra*) logs with bark from the US. The proposed treatment consists of heating the sapwood to 56°C for 30 min at a depth of 5 cm from the cambium under vacuum and steam conditions. EFSA assessed the likelihood that logs of oak and walnut target species would be free from EU quarantine pests, basing its evaluation solely on the efficacy of the proposed treatment. In addition to *B. fagacearum*, *G. morbida* and *P. juglandis,* 14 other EU quarantine pests were identified as relevant because they are present in the US and are potentially associated with the commodities. The assessment was based on the information provided by the applicant country and on systematic literature reviews conducted by EFSA to determine the survival temperature and wood colonisation depth of the target pests. The evidence gathered was evaluated through an Expert Knowledge Elicitation (EKE) to estimate the likelihood of pest freedom of logs after the treatment assuming that all logs were infested. The vacuum–steam–heat treatment substantially reduces the presence of target pests infesting the sapwood. The EKE indicated with 95% certainty that between 9021 and 10,000 treated *Q. alba* logs per 10,000 and that between 9347 and 10,000 treated *Q. rubra* logs per 10,000 will be free from *B. fagacearum*. The EKE indicated with 95% certainty that between 9862 and 10,000 treated *J. nigra* logs per 10,000 will be free from *G. morbida* and that between 9948 and 10,000 treated *J. nigra* logs per 10,000 will be free from *P. juglandis*. However, the treatment is expected to be much less effective against pests which infest wood deeper than 5 cm from the cambium such as the species *Arrhenodes minutus*. The EKE indicated with 95% certainty that between 1109 and 10,000 logs per 10,000 will be free from *A. minutus*.

KEYWORDS

commodity risk assessment, European Union, *Juglans*, plant health, plant pest, *Quercus*, vacuum–steam treatment

CONTENTS

1 | INTRODUCTION

1.1 | Background and Terms of Reference as provided by European Commission

1.1.1 | Background

Special requirements apply to the introduction into the Union of logs of oak (*Quercus* L.) and walnut (*Juglans* L.) originating from the United States (US), in order to reduce the risk for introducing Union quarantine pests into the Union territory. Particular emphasis lies on *Bretziella fagacearum*, the fungus associated with oak wilt and on *Geosmithia morbida*, the fungus associated with thousand canker disease as well as its vector *Pityophthorus juglandis*. Corresponding requirements are laid down in points 83 and 90 of Annex VII to Regulation (EU) 2019/2072.[1] A derogation for the introduction of oak logs with bark originating from the US has been established by Regulation (EU) 2023/1312,[2] conditional to the application of a systems approach defined in that Regulation.

In June 2023, the US introduced a request for a derogation from the aforementioned requirements for logs with bark which underwent a specific vacuum and steam treatment where a minimum temperature of 56°C is reached for at least 30 min in a depth of 5 cm in the wood.

In support of the request, a report describing the treatment and summarising studies relating to efficacy and costs, was submitted.

1.1.2 | Terms of Reference

EFSA is requested, pursuant to Article 29 of Regulation (EC) No 178/2002,[3] to provide a scientific opinion.

In particular, EFSA is requested to assess, based on the information provided by the US, the level of certainty of freedom of oak logs from *Bretziella fagacearum* and of walnut logs from *Geosmithia morbida* and *Pityophthorus juglandis* when treated with vacuum and steam as proposed by the US. EFSA shall quantify the efficacy of the treatment to mitigate the risk of introduction of Union quarantine pests.

In this assessment, EFSA shall take into account the available scientific information, and in particular the scientific and technical information provided by the US, as well as existing international and regional phytosanitary standards. If necessary to complete its assessment, EFSA may ask additional technical information or clarifications from the US regarding their request to introduce logs of oak and walnut wood treated with vacuum and steam as proposed by the US into the Union.[4] Following the provision of such information, EFSA shall proceed with the assessment.

1.2 | Interpretation of the Terms of Reference

The applicant country clarified that only logs of *Quercus alba*, *Q. rubra* and *Juglans nigra* are intended for export to the EU and that the proposed vacuum steam treatment is intended as a stand-alone measure for oak and walnut logs with bark and that no systems approach will be applied, which includes additional risk mitigation measures. In agreement with the Commission, EFSA evaluated the likelihood of pest freedom from Union quarantine pests potentially associated with *Q. alba*, *Q. rubra* and *J. nigra* logs from the US with emphasis on *B. fagacearum*, *G. morbida* and its vector *P. juglandis* and focusing only on the efficacy of the vacuum–steam–heat treatment as proposed by the applicant country. The risk of secondary infestation after vacuum–steam–heat treatment was not evaluated and hence is not covered by the current assessment.

2 | DATA AND METHODOLOGIES

2.1 | Data

2.1.1 | Data provided by the applicant

The Panel considered all the data and information (hereafter called 'the Dossier') provided by the United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS) in June 2023. Additional information was provided by USDA APHIS in April and in May 2025, after EFSA's request. The Dossier was managed by EFSA.

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[1] Commission Implementing Regulation (EU) 2019/2072 of 28 November 2019 establishing uniform conditions for the implementation of Regulation (EU) 2016/2031 of the European Parliament and the Council, as regards protective measures against pests of plants, and repealing Commission Regulation (EC) No 690/2008 and amending Commission Implementing Regulation (EU) 2018/2019. OJ L 319, 10.12.2019, pp. 1–279.

[2] Commission Implementing Regulation (EU) 2023/1312 of 27 June 2023 establishing a derogation from Implementing Regulation (EU) 2019/2072 as regards the requirements for the introduction into the Union territory of oak logs with bark originating in the United States. OJ L 162, 28.6.2023, pp. 51–56.

[3] 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, pp. 1–24.

[4] EFSA is advised that any request for additional information should be made to the IPPC contact point of the United States us.ippcofficialcontactpoint@usda.gov.

The structure and overview of the Dossier is shown in Table 1. The number of the relevant section is indicated in the Opinion when referring to a specific part of the Dossier.

TABLE 1 Structure and overview of the Dossier.

Dossier section	Overview of contents	Filename
1	Technical Dossier	Target Vacuum Steam Dossier final draft May 31 V1 Oak and walnut – Annex 2.1 Oak and walnut – Annex 2.2.
2	Additional information: answers to EFSA queries provided in April and May 2025	Responses by the USDA APHIS to Questions by EFSA related to the Dossier Marked Appendix 1 Society of American Foresters Forest Cover Types spreadsheet for coding list1 – Copy Appendix 2 Second Red Oak Study_Report Appendix 3 Second Red Oak Study_Analysis Appendix 4 Maximum Sapwood Widths Q1 responses for pathogens and insects Q1 Scolytinae hosts Q2 Copy of Species presence (003) Q2 Silvics of N America_*Juglans nigra* Q2 Silvics of N America_*Quercus alba* Q2 Silvics of N America_*Quercus rubra*

The data and supporting information provided by USDA APHIS formed the basis of the commodity risk assessment.

2.1.2 | Literature searches performed by EFSA on the association of EU quarantine pests with oak and walnut and their presence in the US

The list of EU quarantine pests was retrieved from Commission Implementing Regulation 2019/2072. For each of those pests, the databases listed in Table 2 were checked for the association of the pest with *Quercus* and *Juglans* (genus and species). For the pests identified as associated with *Quercus* and/or *Juglans*, a literature search on whether they are present in the US was performed. The searches were run between January and March 2025.

Additional searches, limited to retrieve documents, were run when developing the Opinion. The available scientific information, including previous EFSA opinions on the relevant pests and the relevant literature and legislation, were taken into account.

TABLE 2 Databases used by EFSA for the compilation of the EU quarantine pest list associated with *Quercus* and *Juglans*.

Database	Platform/link
Bark and Ambrosia Beetles of the Americas	https://www.barkbeetles.info/regional_chklist_index.php
CABI Crop Protection Compendium	https://www.cabi.org/cpc/
Database of the World's Lepidopteran Hostplants	https://www.nhm.ac.uk/our-science/data/hostplants/search/index.dsml
EPPO Global Database	https://gd.eppo.int/
GBIF	https://www.gbif.org/
Nemaplex	https://nemaplex.ucdavis.edu/
Scalenet	https://scalenet.info/
Scolytinae hosts and distribution database	https://www.scolytinaehostsdatabase.eu/site/it/home/
USDA ARS Fungal Database	https://fungi.ars.usda.gov/

2.1.3 | Literature searches performed by EFSA on the temperature needed to kill pests

A systematic literature search was performed by EFSA in order to retrieve information on whether bark and wood colonising pests could survive the temperature reached in the vacuum–steam–heat treatment. A tailored search was conducted on the temperature extremes survived by *B. fagacearum*, *G. morbida* and its vector *P. juglandis* (see Appendix B). The literature retrieved on pests relevant for this opinion was screened for information on temperature limits for survival. In addition, literature on survival limits of different groups of organisms from EFSA PLH Panel (2024a) was used. The information retrieved, including studies submitted by the applicant are summarised in Section 6 and in Appendix B.

2.2 | Methodologies

2.2.1 | Identification of pests potentially associated with the commodity in addition to those listed in the terms of reference

To evaluate the pest risk associated with the importation of the commodity from the US, a pest list was compiled. The pest list includes all identified EU quarantine pests reported as potentially associated with *Quercus* and *Juglans* species based on information provided in the Dossier Sections 1 and 2 and on searches performed by the Panel as indicated above in Section 2.1.2. The search strategy and search syntax were adapted to each of the databases listed in Table 2, according to the options and functionalities of the different databases and CABI keyword thesaurus.

The scientific names of the EU quarantine pests were used when searching in the databases.

The compiled pest list (see Microsoft Excel® in Appendix D) includes all identified EU quarantine pests that use as host *Quercus* and *Juglans* species.

The relevance of an EU quarantine pest or a protected zone quarantine pest for this opinion was based on evidence that:

a. the pest is associated with either *Quercus* or *Juglans* or both;
b. the pest is present in the US;
c. one or more life stages of the pest can be associated with the stems used for log production.

Pests that fulfilled all criteria were selected for further evaluation. If one of the three criteria was not fulfilled, the other criteria were not assessed.

2.2.2 | Comparison of the information found on temperature limits of pests with the temperature achieved in the vacuum–steam–heat treatment

The information on temperature survival limits of relevant pests found in literature and the results of studies submitted in the Dossier were analysed considering the proposed exposure in the vacuum–steam–heat treatment (i.e. 56°C for 30 min at a sapwood depth of 5 cm). For details, see Section 6. This analysis was taken into consideration in the Expert Knowledge Elicitation (EKE).

2.2.3 | Expert Knowledge Elicitation

To estimate the pest freedom of the commodity, an EKE was performed following EFSA Guidance (Annex B.8 of EFSA Scientific Committee, 2018).

The pest freedom of oak logs (*Q. alba* and *Q. rubra*) and walnut logs (*J. nigra*) treated as proposed by the applicant was assessed. The applicant proposed the vacuum–steam–heat treatment as a stand-alone method without applying any other risk mitigation measures. In addition, although generally important for the estimation of pest freedom, the prevalence of pests in the country of origin of the commodity was also not considered in the EKE because the information provided by the applicant country was not sufficient (see Section 6.2).

Therefore, the EKE was focused only on the efficacy of the vacuum–steam–heat treatment of logs considering the information on temperature limits of survival of pests and the information on sapwood thickness of oak logs.

The specific EKE question was: 'Assuming all the logs are infested by a given pest according to its expected colonisation patterns, how many logs out of 10,000 remain infested with viable pests after treatment?'

An overview of the elicitations conducted for the different combinations of pests and commodity species is provided in Table 3.

TABLE 3 Overview on the pests and the EKEs conducted for the different commodity species. Pest and tree species combinations for which an EKE was conducted are marked with 'X' and combinations for which no EKE was conducted are marked with 'n.a.' (not applicable because the tree species is not reported as a host).

Pest species/group of pests	*Quercus rubra*	*Quercus alba*	*Juglans nigra*
Bretziella fagacearum	X	X	n.a.
Geosmithia morbida	n.a.	n.a.	X
Pityophthorus juglandis	n.a.	n.a.	X
Ambrosia beetles	X	X	X
Arrhenodes minutus	X	X	n.a.
Xylella fastidiosa	X	X	n.a.

In addition to the three pests which are listed in the mandate also other pest species were identified for further evaluation. The pests were grouped according to the depth of wood they can colonise and representative species were selected for assessment, taking into consideration that 5 cm depth from the cambium is the reference for the treatment temperature and duration of treatment (56°C for 30 min).

The pests were grouped as follows:

Bark and sapwood-associated fungi are considered to be covered by the assessment of *B. fagacearum* and *G. morbida*.

Bark and sapwood-dwelling insects are considered to be covered by the assessment conducted for *P. juglandis* and ambrosia beetles.

Insects which can inhabit the heartwood are represented by *A. minutus*.

Insects which are dwelling on the outer bark will not be able to survive the temperatures proposed in the treatment as they will be exposed to temperatures significantly higher than 56°C (see also Section 6.2). Therefore, this group of insects was not assessed further in the EKE.

The uncertainties associated with the EKE were considered and quantified in a probability distribution, fitted to the elicited percentiles applying the semi-formal method described in Section 3.5.2 of the EFSA Guidance on quantitative pest risk assessment (EFSA PLH Panel, 2018a). Finally, the EKE results were reported in terms of the likelihood of pest freedom, calculated by 1 minus the likelihood to be infested. The lower 5% percentile of the uncertainty distribution reflects the opinion that pest freedom is with 95% certainty above this limit.

The results of the EKE are reported in Section 7.

3 | THE COMMODITY

3.1 | Description

The minimum diameter of logs with bark of *Q. rubra*, *Q. alba* and *J. nigra* intended for export to the EU is approximately 33 cm and the maximum diameter is approximately 76 cm measured on the small end of the log (Dossier Sections 1 and 2). The minimum and maximum length of the logs would be 1.83 and 12.19 m, with the majority of logs being in the range of 2.44–4.88 m.

3.2 | Production areas

All growing sites of *Quercus* and *Juglans* logs which are intended for export to the EU are located in the US. *Quercus* trees are grown in mixed stands with variable composition in different geographic areas. Typical species in these mixed stands include *Acer saccharum, A. saccharinum, A. rubrum, Carya ovata, C. laciniosa, C. glabra, C. cordiformis, Diospyros virginiana, Fagus grandifolia, Fraxinus pennsylvanica, Fraxinus americana, Juglans nigra, Liriodendron tulipifera, Platanus occidentalis, Populus deltoides, Prunus serotina, Robinia pseudoacacia* and *Ulmus americana*. *Quercus* stands are uneven aged in mixed and natural stands (Dossier Section 2).

Juglans trees are harvested in pure stands (i.e. plantations) as well as in naturally regenerated mixed stands. *Juglans* is not dominant in most forests but rather is generally found as scattered single trees or as small, isolated groups within hardwood stands (Dossier Section 2).

3.3 | Harvesting and handling processes

Harvesting of both *Quercus* and *Juglans* is limited to the winter (October–April). *Quercus* trees are primarily harvested by selective cutting rather than clear-cutting (Dossier Section 2).

Juglans trees are primarily harvested selectively, meaning only mature, high-quality trees are chosen to be harvested while allowing younger trees to continue growing in the forest stand; this practice promotes sustainable forest management. However, they can be clear-cut if the situation (e.g. even age plantation) warrants. The higher quality and larger trees are harvested from natural stands.

The trees are cut approximately 20–30 cm above ground during harvesting operations. Branches are cut from the main stem and often chipped on site after trees are felled (Dossier Section 2).

In most cases, the logs are removed from the forest within 7–10 days from the time of harvest. Logs are then usually transported to and stored at a concentration yard prior to treatment (Dossier Section 2).

Logs are generally stored outdoors a minimum of 2 weeks, and a maximum of 8 weeks, prior to being treated with vacuum steam (Dossier Section 2).

Trees for the production of logs intended for export are not inspected for the presence of pests in the forest before harvest or at harvest with regard to regulatory requirements. Official inspection by a federal or state phytosanitary officer is conducted post-vacuum steam treatment when a phytosanitary certificate is requested. The inspection is conducted to fulfil the requirements of the importing country (Dossier Section 2).

3.4 | Vacuum–steam–heat treatment

The applicant proposes the following vacuum–steam–heat treatment as the only phytosanitary measure (Dossier Section 2) with the following requirements (Dossier Section 1):

Heating of the sapwood region at 56°C for 30 min at 5 cm depth measured from the cambium.

In a vacuum system, the steam can penetrate even small spaces very effectively. Steam heat contains 100 times more energy than air for the same volume. Conventional hot air causes evaporative cooling, resulting in heat loss that must be maintained by continually adding more dry air. With vacuum and steam, the wood heating is much quicker and efficient compared to dry air heating (Dossier Section 1).

Dossier Section 1 reports that trials were conducted with different hardwood logs to thermal map the logs as they reached 56°C for 30 min to the core. The logs were treated individually at 200 mmHg vacuum and 110°C steam in a flexible bag directly connected to a vacuum pump and boiler. In a second testing phase, the most efficient heating regime was found to be steam with 90°C and a vacuum of 570 mmHg.

Studies with logs and different pest species were conducted where infested logs were heated in a polypropylene bag and small steel chambers to achieve the required temperature of 56°C at 5 cm below the cambium for 30 min. The results are summarised together with information from other studies in Section 6.4.

The protocol for vacuum–steam–heat treatment suggested by the applicant in Dossier Section 1 includes the following:

- Steam shall be saturated and below 100°C.
- Initial chamber pressure shall be 100 mmHg (Torr) or less and maintained below 760 mmHg.
- Treatment criteria mandate that the temperature of all log bark (if present) and sapwood be heated to at least 56°C and held for 30 min.
- Basic equipment shall include a vacuum chamber, steam generator, vacuum pump and temperature monitoring system with controls.

  - Logs stacked in a freight container or loose outside are placed into the vacuum chamber.
  - Split reducers like metal connector plates or S irons should be applied to the ends of logs with visible splits.
  - The temperature of the sapwood of three large logs, one on top, one in the middle and one at the bottom of the load will be selected for temperature monitoring.
  - At least one, minimum 20 cm deep hole is drilled into the end of each log selected on the door end of the vacuum chamber. This hole should be 6 mm underneath the sapwood/heartwood boundary line. If the sapwood cannot be easily distinguished from the heartwood, then the hole will be drilled 5 cm below the cambium. The hole should follow and remain parallel to any observed log taper. The hole should preferably be small (6 mm diameter) and sized to friction fit the temperature sensor. If the logs are to be shipped with bark on, all temperature probes in the end of the log must always be placed so that they are in an area directly under the bark. This method ensures that measured sapwood heats at a rate that is commensurate with bark attached. If there is no bark on the end circumference of the log chosen, then another log with some or all bark attached to the surface must be used. After the sensor is installed in the log end, the hole around the sensor should be plugged with a plumber's type putty (clay like sealing material) to prevent steam incursion.
  - The temperature inside the chamber shall be monitored at the top and bottom, along with front and rear locations with dedicated atmospheric sensors. Observed temperature gradients within the chamber should be limited.
  - The temperature shall be monitored continuously during the course of the treatment.
  - Before closing the chamber, the interior shall be inspected for safety. The chamber is then closed and sealed and a vacuum of at least 100 mmHg shall be created.
  - Saturated steam at less than 100°C is then immediately introduced until all zones of the chamber reach the ambient treatment temperature of at least 85°C. Temperature gradients within the chamber should not exceed +/–5°C. Chamber pressure should never exceed 760 mmHg. When all three log end temperature sensors reach 56°C, the temperature should be maintained for 30 min, then equipment can be shut down.
  - At the end of treatment, condensate must be collected and evaporated, recycled or drained into acceptable vegetative filtration strips, and then, a final vacuum of at least 100 mmHg shall be created to dry and cool the surface of the logs.
  - Chamber pressure will then be immediately restored to atmospheric, and door(s) opened. Care should be exercised when handling any remaining hot surfaces.
  - Loose logs can be removed and trans-loaded into a freight container for shipment.
  - For logs stacked in freight containers, the container doors can be closed and sealed for shipment. Note that the entire freight container is sanitised and should be pest free.

The concept of a final vacuum and steam system for log treatment was presented in the Dossier Section 2. However, the final device and studies confirming that the required efficacy will be achieved on larger scales with big loads of logs were not presented. In the assessment, it is assumed that the final device will have the same efficacy as the devices used in the studies provided.

3.5 | Overview of interceptions

Data on the interception of harmful organisms on *Quercus* and *Juglans* wood can provide information on some of the organisms that can be present on wood logs.

According to EUROPHYT (2025) and TRACES-NT (2025) (accessed: 26 August 2025), there were 224 interceptions of wood and bark/logs/sawn wood of *Quercus* and *Juglans* species from the US due to the presence of harmful organisms (see Table 4) between the years 1995 and July 2025.

TABLE 4 Overview of harmful organisms intercepted on wood and bark/logs/sawn wood of *Quercus* and *Juglans* species from the US (1995 to July 2025), based on notifications of interceptions by EU Member States [based on EUROPHYT, 2025 and TRACES-NT, 2025].

N	Name of harmful organisms (pests)	Group	Plant species	Commodity	Additional information on the commodity in the notes	Country of origin	Country of entry	Year of interception	Number of interceptions
1	Acari	Mites	*Juglans* sp.	Products: wood and bark	–	US	Spain	2012	1
2	*Andrenosoma fulvicaudum*	Insects	*Juglans nigra*	Products: wood and bark	–	US	Italy	2019	1
3	Anobiidae	Insects	*Quercus alba*	Products: wood and bark	–	US	Spain	2015	1
4			*Quercus* sp.					2009	2
5	Arachnida	Arachnids	*Juglans nigra*	Products: wood and bark	Logs with bark	US	Italy	2016	1
6	Arctiidae – *Pyrrharctia isabella*	Insects	*Quercus* sp.	Products: wood and bark	Lumber	US	Spain	2002	2
7	*Arrhenodes* sp.	Insects	*Quercus alba*	Products: wood and bark	–	US	France	2005	1
8	Bostrichidae	Insects	*Quercus alba*	Products: wood and bark	–	US	Spain	2014, 2015	2
9			*Quercus rubra*		Sawn timber		Germany	2011	1
10	Buprestidae	Insects	*Juglans nigra*	Products: logs	–	US	Not specified	2022, 2023	16
11				Products: wood and bark			Italy	2019, 2020	2
12			*Juglans* sp.					2017	1
13	*Cartodere nodifer*	Insects	*Quercus alba*	Products: wood and bark	–	US	Italy	2020	1
14	Cerambycidae	Insects	*Juglans*	Products: logs	–	US	Not specified	2021	1
15			*Juglans nigra*					2022, 2023	15
16				Products: wood and bark			Spain	2014	1
17					Logs		Italy	2016, 2019	2
18					–			2020	1
19	*Chariessa pilosa*	Insects	*Juglans nigra*	Products: wood and bark	Logs	US	Italy	2019	1
20					–			2019	1

(Continues)

TABLE 4 (Continued)

N	Name of harmful organisms (pests)	Group	Plant species	Commodity	Additional information on the commodity in the notes	Country of origin	Country of entry	Year of interception	Number of interceptions
21	*Chrysobothris*	Insects	*Juglans nigra*	Products: logs	–	US	Not specified	2022	5
22			*Juglans*	Products: others				2024	1
23				Products: wood and bark			Italy	2019	1
24			*Juglans nigra*		Logs			2019	1
25	*Chrysobothris femorata*	Insects	*Juglans nigra*	Products: wood and bark	Logs with bark	US	Germany	2017	1
26					–		Italy	2019	1
27	*Chrysobothris quadriimpressa*	Insects	*Juglans nigra*	Products: wood and bark	–	US	Italy	2019	1
28	*Chrysobothris sexsignata*	Insects	*Juglans nigra*	Products: wood and bark	–	US	Italy	2019	1
29	Coccidae	Insects	*Juglans nigra*	Products: logs	–	US	Not specified	2022	1
30	Coleoptera	Insects	*Juglans nigra*	Products: others	–	US	Not specified	2023	1
31			*Juglans*	Products: logs				2022	1
32			*Juglans nigra*					2022, 2023	12
33				Products: others				2022	2
34				Products: sawn wood				2024	1
35			*Quercus alba*					2023	1
36			*Juglans nigra*	Products: wood and bark			Spain	2014	1
37			*Juglans regia*					2014	1
38			*Quercus alba*					2014, 2016	2
39	Diplopoda	Myriapoda	*Quercus alba*	Products: wood and bark	–	US	Spain	2016	1
40	Diptera	Insects	*Juglans nigra*	Products: logs	–	US	Not specified	2022	1
41			*Quercus alba*	Products: wood and bark			Spain	2017	1
42	Entomobryidae	Collembola	*Juglans regia*	Products: wood and bark	–	US	Spain	2014	2
43	*Formica*	Insects	*Juglans nigra*	Products: logs	–	US	Not specified	2022	6
44	*Formica* sp.	Insects	*Juglans regia*	Products: wood and bark	–	US	Spain	2014	1
45			*Juglans* sp.		Stumps			2012	1
46	Formicidae	Insects	*Juglans nigra*	Products: wood and bark	Logs with bark	US	Italy	2016	1
47	*Graphisurus fasciatus*	Insects	*Juglans nigra*	Products: logs	–	US	Not specified	2023	1
48				Products: wood and bark			Italy	2019	1
49	*Harmonia axyridis*	Insects	*Quercus*	Products: wood and bark	–	US	Spain	2016	1
50			*Quercus alba*					2020	1
51	Helicidae	Snails	*Juglans nigra*	Products: wood and bark	Logs with bark	US	Italy	2016	1

TABLE 4 (Continued)

N	Name of harmful organisms (pests)	Group	Plant species	Commodity	Additional information on the commodity in the notes	Country of origin	Country of entry	Year of interception	Number of interceptions
52	Hemiptera	Insects	*Juglans nigra*	Products: logs	–	US	Not specified	2022	4
53	Hymenoptera	Insects	*Juglans nigra*	Products: logs	–	US	Not specified	2022	1
54			*Quercus alba*	Products: wood and bark			Spain	2011	1
55	Insecta	Insects	*Juglans nigra*	Products: logs	–	US	Not specified	2022, 2023, 2025	20
56				Products: others				2024	1
57				Products: sawn wood				2022, 2023	2
58			*Quercus alba*					2022, 2023	10
59			*Juglans nigra*	Products: wood and bark			Spain	2014	4
60			*Quercus alba*				France	2015, 2016, 2017	5
61	Isoptera	Insects	*Juglans nigra*	Products: wood and bark	–	US	Spain	2015	2
62			*Juglans regia*					2015	1
63	Lepidoptera	Insects	*Juglans nigra*	Products: logs	–	US	Not specified	2022, 2023	4
64			*Juglans*	Products: wood and bark			Italy	2019	1
65			*Juglans nigra*		Logs with bark			2016	1
66			*Juglans* sp.		–			2017	1
67			*Quercus alba*				Spain	2011, 2013	2
68	*Leptostylus transversus*	Insects	*Juglans nigra*	Products: wood and bark	–	US	Italy	2019	1
69	*Lepturges*	Insects	*Juglans nigra*	Products: wood and bark	–	US	Italy	2019	1
70	*Lepturges confluens*	Insects	*Juglans nigra*	Products: logs	–	US	Not specified	2023	1
71				Products: wood and bark			Germany	2019	1
72							Italy	2019	1
73	*Lyctus – Lyctus cavicollis*	Insects	*Quercus alba*	Products: wood and bark	Lumber	US	Germany	2013	1
74	*Melittomma sericeum*	Insects	*Quercus alba*	Products: wood and bark	–	US	Germany	2018	1
75	Orthoptera	Insects	*Juglans nigra*	Products: logs	–	US	Not specified	2022	1
76	Pentatomidae	Insects	*Juglans nigra*	Products: logs	–	US	Not specified	2022, 2023	2
77	*Pityophthorus juglandis*	Insects	*Juglans nigra*	Products: logs	–	US	Not specified	2024	1
78	Platypodidae	Insects	*Quercus alba*	Products: wood and bark	–	US	Spain	2014	1
79	*Polistes carolina*	Insects	*Quercus alba*	Products: wood and bark	–	US	Spain	2020	1
80	*Saperda tridentata*	Insects	*Juglans nigra*	Products: wood and bark	Logs	US	Italy	2016	1

(Continues)

TABLE 4 (Continued)

N	Name of harmful organisms (pests)	Group	Plant species	Commodity	Additional information on the commodity in the notes	Country of origin	Country of entry	Year of interception	Number of interceptions
81	Scolytidae	Insects	*Juglans nigra*	Products: logs	–	US	Not specified	2022, 2023, 2024	13
82			*Juglans*	Products: sawn wood				2023	1
83			*Juglans nigra*	Products: wood and bark			Spain	2015	1
84			*Juglans regia*					2014, 2015	2
85			*Juglans* sp.					2013	1
86	Silvanidae	Insects	*Quercus alba*	Products: wood and bark	–	US	Spain	2015	1
87	Siricidae	Insects	*Quercus alba*	Products: wood and bark	–	US	Spain	2011	1
88	Tenebrionidae	Insects	*Juglans* sp.	Products: wood and bark	–	US	Spain	2011	1
89	Tephritidae (non-European)	Insects	*Quercus alba*	Products: wood and bark	–	US	Spain	2011	3
90	Termitidae	Insects	*Juglans nigra*	Products: logs	–	US	Not specified	2022	1
91	*Xyleborinus*	Insects	*Juglans nigra*	Products: logs	–	US	Not specified	2022	1
92	*Xyleborinus saxeseni*	Insects	*Juglans nigra*	Products: wood and bark	–	US	Germany	2019	1
93	*Xyleborus*	Insects	*Juglans nigra*	Products: logs	–	US	Not specified	2022	1
94	*Xyleborus affinis*	Insects	*Juglans nigra*	Products: wood and bark	–	US	Italy	2019	1
95	*Xylosandrus compactus*	Insects	*Juglans nigra*	Products: logs	–	US	Not specified	2022	2
96	*Xylosandrus crassiusculus*	Insects	*Juglans nigra*	Products: logs	–	US	Not specified	2022, 2025	7
97				Products: sawn wood				2022	1
98				Products: wood and bark			Italy	2019	3

4 | IDENTIFICATION OF PESTS POTENTIALLY ASSOCIATED WITH THE COMMODITY

The search for EU quarantine pests and protected zone quarantine pests associated with oak and walnut rendered 368 pests. Many of these pests are regulated as groups of species (e.g. Scolytinae spp. (non-European), *Cronartium* spp., etc.) by the Commission Implementing Regulation (EU) 2019/2072 (see Microsoft Excel® file in Appendix D). Altogether, 58 pests including pests regulated as individual species and pests regulated as groups of species were evaluated.

4.1 | Relevant EU-quarantine pests potentially associated with the commodity

In total, 58 EU quarantine pests are reported to be associated with *Quercus* and/or *Juglans* (Table 5). Of these 58 EU quarantine pests evaluated, the following are present in the US and can be associated with the stems used for log production and hence were selected for further evaluation: *Anoplophora glabripennis*, *Arrhenodes minutus*, *Bretziella fagacearum*, *Cryphonectria parasitica*, *Davidsoniella virescens*, *Entoleuca mammata*, *Euwallacea fornicatus sensu lato*, *Geosmithia morbida*, *Lopholeucaspis japonica*, *Lycorma delicatula*, *Neocosmospora euwallaceae*, *Phytophthora ramorum*, *Pityophthorus juglandis*, *Pseudopityophthorus minutissimus*, *Pseudopityophthorus pruinosus*, Scolytinae spp. (non-European) and *Xylella fastidiosa*.

TABLE 5 Overview of the evaluation of the 58 EU-quarantine and protected zone quarantine pests for which information was found in the Dossier, databases and literature searches that use *Quercus* and *Juglans* species as a host plant.

No.	Pest name according to EU legislation[a]	EPPO code	Group	Pest present in the US	*Quercus* confirmed as a host	*Juglans* confirmed as a host	Pest can be associated with the stems used for log production[b]	Pest relevant for the opinion
1	*Acleris semipurpurana*	CROISE	Insects	Yes	Yes (EPPO, 2025a; Marquis et al., 2019)	No	No	No
2	*Anastrepha* spp.	1ANSTG	Insects	Yes	No	Yes (EFSA PLH Panel, 2020a; EPPO, 2025a)	No	No
3	*Anoplophora chinensis*	ANOLCN	Insects	No	Yes (Dong et al., 2023; EPPO, 2025a)	Yes (EPPO, 2025a; Lim et al., 2014)	Not assessed	No
4	*Anoplophora glabripennis*	ANOLGL	Insects	Yes	Yes (EPPO, 2025a; Sjöman et al., 2014)	No	Yes, only for *Quercus*	Yes
5	*Apriona germari*	APRIGE	Insects	No	Yes (EPPO, 2025a; Lim et al., 2014)	Yes (EPPO, 2025a; Lim et al., 2014)	Not assessed	No
6	*Aromia bungii*	AROMBU	Insects	No	Yes (Dong et al., 2023; EPPO, 2025a)	Yes (EPPO, 2025a)	Not assessed	No
7	*Arrhenodes minutus*	ARRHMI	Insects	Yes	Yes (EPPO, 2025a; Rogers, 1990)	No	Yes, only for *Quercus*	Yes
8	*Bactrocera dorsalis*	DACUDO	Insects	Yes	No	Yes (EFSA, 2023a; EPPO, 2025a)	No	No
9	*Bactrocera tryoni* as *Bactrocera* spp.	1BCTRG	Insects	No	No	Yes (EPPO, 2025a; Hancock et al., 2000)	Not assessed	No
10	*Bemisia tabaci* (non-European populations)[c]	BEMITA	Insects	Yes	Yes (EFSA PLH Panel, 2013)	Yes (EFSA PLH Panel, 2013)	No	No
11	*Bemisia tabaci* (European populations)[c]	BEMITA	Insects	No	Yes (EFSA PLH Panel, 2013)	Yes (EFSA PLH Panel, 2013)	Not assessed	No
12	*Bothrogonia ferruginea*	TETTFE	Insects	No	Yes (EPPO, 2025a; Huh & Kwon, 1994)	No	Not assessed	No
13	*Bretziella fagacearum*	CERAFA	Fungi	Yes	Yes (EFSA PLH Panel, 2018b; Farr & Rossman, 2025)	No	Yes, only for *Quercus*	Yes
14	*Candidatus* Phytoplasma fraxini strain 16SrVII-G	PHYPFR	Phytoplasmas	No	Yes (Silva-Castaño et al., 2024)	No	Not assessed	No
15	*Choristoneura rosaceana*	CHONRO	Insects	Yes	Yes (EPPO, 2025a)	No	No	No
16	*Cronartium* spp.	1CRONG	Fungi	Yes	Yes (EPPO, 2025a; Farr & Rossman, 2025)	No	No	No
17	*Cryphonectria parasitica*	ENDOPA	Fungi	Yes	Yes (EPPO, 2025a; Farr & Rossman, 2025)	No	Yes, only for *Quercus*	Yes
18	*Davidsoniella virescens*	CERAVI	Fungi	Yes	Yes (Farr & Rossman, 2025)	No	Yes, only for *Quercus*	Yes
19	*Diabrotica undecimpunctata undecimpunctata*	DIABUN	Insects	Yes	Yes (Clark et al., 2004)	Yes (Clark et al., 2004; EPPO, 2025a)	No	No

TABLE 5 (Continued)

No.	Pest name according to EU legislation[a]	EPPO code	Group	Pest present in the US	*Quercus* confirmed as a host	*Juglans* confirmed as a host	Pest can be associated with the stems used for log production[b]	Pest relevant for the opinion
20	*Diabrotica virgifera zeae*	DIABVZ	Insects	Yes	Yes (Clark et al., 2004)	No	No	No
21	*Entoleuca mammata*	HYPOMA	Fungi	Yes	Yes (EPPO, 2025a; Farr & Rossman, 2025)	No	Yes, only for *Quercus*	Yes
22	*Eotetranychus lewisi*	EOTELE	Mites	Yes	Yes (EPPO, 2025a; Tuttle et al., 1976)	No	No	No
23	*Eurhizococcus brasiliensis*	EURHBR	Insects	No	No	Yes (EPPO, 2025a; Soria & Gallotti, 1986)	Not assessed	No
24	*Euwallacea fornicatus sensu lato*	XYLBFO	Insects	Yes	Yes (EPPO, 2025a; Eskalen et al., 2013)	Yes (EPPO, 2025a; Eskalen et al., 2013)	Yes, for both *Quercus* and *Juglans*	Yes
25	*Geosmithia morbida*	GEOHMO	Fungi	Yes	No	Yes (EPPO, 2025a; Farr & Rossman, 2025)	Yes, only for *Juglans*	Yes
26	*Graphocephala atropunctata*	GRCPAT	Insects	Yes	Yes (EPPO, 2025a; Purcell, 1976)	Yes (EPPO, 2025a; Purcell, 1976)	No	No
27	*Graphocephala versuta*	GRCPVE	Insects	Yes	Yes (EFSA PLH Panel, 2019a)	Yes (EFSA PLH Panel, 2019a)	No	No
28	*Grapholita prunivora*	LASPPR	Insects	Yes	Yes (Brown, 2022)	No	No	No
29	*Homalodisca vitripennis*	HOMLTR	Insects	Yes	Yes (EPPO, 2025a; Hoddle et al., 2003)	Yes (EPPO, 2025a; Hoddle et al., 2003)	No	No
30	*Lepyronia quadrangularis*	LEPOQU	Insects	Yes	Yes (Doering, 1942; EPPO, 2025a)	Yes (Doering, 1942; EPPO, 2025a)	No	No
31	*Lopholeucaspis japonica*	LOPLJA	Insects	Yes	Yes (Batsankalashvili et al., 2017; EPPO, 2025a)	Yes (Batsankalashvili et al., 2017; EPPO, 2025a)	Yes, for both *Quercus* and *Juglans*	Yes
32	*Lycorma delicatula*	LYCMDE	Insects	Yes	Yes (Barringer & Ciafré, 2020; EPPO, 2025a)	Yes (Barringer & Ciafré, 2020; EPPO, 2025a)	Yes, for both *Quercus* and *Juglans*	Yes
33	*Massicus raddei*	MALLRA	Insects	No	Yes (EPPO, 2025a; Lim et al., 2014)	No	Not assessed	No
34	*Monochamus* spp. (non-European populations)	1MONCG	Insects	No	Yes (EFSA PLH Panel, 2018c)	Yes (EFSA PLH Panel, 2018c)	Not assessed	No
35	*Neocosmospora ambrosia*	FUSAAM	Fungi	Uncertain[d]	Uncertain[e]	Uncertain[e]	Not assessed	No
36	*Neocosmospora euwallaceae*	FUSAEW	Fungi	Yes	Yes (EPPO, 2025a; Eskalen et al., 2013)	Uncertain[f]	Yes, only for *Quercus*	Yes
37	*Oemona hirta*	OEMOHI	Insects	No	Yes (EPPO, 2025a; Lu & Wang, 2005)	Yes (EPPO, 2025a; Lu & Wang, 2005)	Not assessed	No
38	*Oncometopia nigricans*	ONCMNI	Insects	Yes	Yes (Adlerz, 1980)	No	No	No
39	*Oncometopia orbona*	ONCMUN	Insects	Yes	Yes (EPPO, 2025a; Turner & Pollard, 1959)	Yes (EPPO, 2025a; Turner & Pollard, 1959)	No	No

(Continues)

TABLE 5 (Continued)

No.	Pest name according to EU legislation[a]	EPPO code	Group	Pest present in the US	*Quercus* confirmed as a host	*Juglans* confirmed as a host	Pest can be associated with the stems used for log production[b]	Pest relevant for the opinion
40	*Phymatotrichopsis omnivora*	PHMPOM	Fungi	Yes	Yes (EPPO, 2025a; Farr & Rossman, 2025)	Yes (EPPO, 2025a; Farr & Rossman, 2025)	No	No
41	*Phytophthora ramorum* (non-EU isolates)	PHYTRA	Oomycetes	Yes	Yes (EPPO, 2025a; Farr & Rossman, 2025)	No	Yes, only for *Quercus*	Yes
42	*Pityophthorus juglandis*	PITOJU	Insects	Yes	No	Yes (EPPO, 2025a; Seybold et al., 2019)	Yes, only for *Juglans*	Yes
43	*Popillia japonica*	POPIJA	Insects	Yes	Yes (EPPO, 2025a; Fleming, 1972)	Yes (EPPO, 2025a; Fleming, 1972)	No	No
44	*Pseudopityophthorus minutissimus*	PSDPMI	Insects	Yes	Yes (DAFNAE, 2025)	Yes (DAFNAE, 2025)	Yes, for both *Quercus* and *Juglans*	Yes
45	*Pseudopityophthorus pruinosus*	PSDPPR	Insects	Yes	Yes (DAFNAE, 2025)	No	Yes, only for *Quercus*	Yes
46	*Rhagoletis* spp.	1RHAGG	Insects	Yes	No	Yes (EFSA PLH Panel, 2020a)	No	No
47	*Scirtothrips citri*	SCITCI	Insects	Yes	Yes (EPPO, 2025a; Tanigoshi & Nishio-Wong, 1982)	No	No	No
48	Scolytinae (non-European)	1SCOLS	Insects	Yes	Yes (DAFNAE, 2025)	Yes (DAFNAE, 2025)	Yes, for both *Quercus* and *Juglans*	Yes
49	*Spodoptera frugiperda*	LAPHFR	Insects	Yes	No	Yes (EPPO, 2025a; Montezano et al., 2018)	No	No
50	*Thaumatotibia leucotreta*	ARGPLE	Insects	No	Yes (EPPO, 2025a)	Yes (EPPO, 2025a)	Not assessed	No
52	*Thaumetopoea processionea*	THAUPR	Insects	No	Yes (EPPO, 2025a)	Yes (EPPO, 2025a)	Not assessed	No
53	*Toxoptera citricida*	TOXOCI	Insects	Yes	Yes (EFSA PLH Panel, 2018d; EPPO, 2025a)	No	No	No
54	*Trirachys sartus*	AELSSA	Insects	No	Yes (EPPO, 2025a)	Yes (EPPO, 2025a)	Not assessed	No
55	*Xiphinema americanum sensu stricto*	XIPHAA	Nematodes	Yes	Yes (Xu & Zhao, 2019)	No	No	No
56	*Xiphinema rivesi*	XIPHRI	Nematodes	Yes	Yes (EPPO, 2025a; Lamberti & Bleve-Zacheo, 1979; Xu & Zhao, 2019)	Yes (EPPO, 2025a; Lamberti & Bleve-Zacheo, 1979)	No	No
57	*Xiphinema tarjanense*	XIPHTA	Nematodes	Yes	Yes (Xu & Zhao, 2019)	No	No	No
58	*Xylella fastidiosa*	XYLEFA	Bacteria	Yes	Yes (EFSA, 2025a)	Yes (EFSA, 2025b)	Yes, for both *Quercus* and *Juglans*	Yes

[a] Commission Implementing Regulation (EU) 2019/2072.

[b] The association with stems used for log production was not further assessed if the pest is not present in the US.

[c] *Bemisia tabaci* (European populations) is regulated as a protected zone quarantine pest. Therefore, *B. tabaci* is listed twice, as European and non-European populations. The association with *Quercus* and *Juglans* was assessed at the pest species level and not at the population level.

[d] The presence of *Neocosmospora ambrosia* in the US is uncertain, as there is no evidence in the literature. However, the fungus is closely associated with *Euwallacea fornicatus sensu lato*, which is present in the US.

[e] The host status of *Quercus* and *Juglans* for *Neocosmospora ambrosia* is uncertain, as no supporting evidence exists in the literature. However, the fungus is closely associated with *Euwallacea fornicatus sensu lato*, which uses *Quercus* and *Juglans* as hosts.

[f] The host status of *Juglans* for *Neocosmospora euwallaceae* is uncertain, due to a lack of evidence in the literature. However, the fungus is closely associated with *Euwallacea fornicatus sensu lato*, which uses *Juglans* as a host.

4.2 | Summary of pests selected for further evaluation

The 17 pests satisfying all the relevant criteria listed above in Section 4.1 are included in Table 6.

TABLE 6 List of relevant pests selected for further evaluation.

Number	Current scientific name	EPPO code	Name used in the EU legislation	Taxonomic information	Group	Regulatory status	Host plant	Name of Pest datasheet
1	*Anoplophora glabripennis*	ANOLGL	*Anoplophora chinensis* (Thomson)	Coleoptera Cerambycidae	Insects	EU Quarantine Pest according to Commission Implementing Regulation (EU) 2019/2072	*Quercus*	*Anoplophora glabripennis*
2	*Arrhenodes minutus*	ARRHMI	*Arrhenodes minutus* Drury	Coleoptera Brentidae	Insects	EU Quarantine Pest according to Commission Implementing Regulation (EU) 2019/2072	*Quercus*	*Arrhenodes minutus*
3	*Bretziella fagacearum*	CERAFA	*Bretziella fagacearum* (Bretz) Z.W de Beer, T.A. Duong & M.J. Wingfield	Microascales Ceratocystidaceae	Fungi	EU Quarantine Pest according to Commission Implementing Regulation (EU) 2019/2072	*Quercus*	*Bretziella fagacearum*
4	*Cryphonectria parasitica*	ENDOPA	*Cryphonectria parasitica* (Murrill) Barr.	Diaporthales Cryphonectriaceae	Fungi	Protected Zone Quarantine Pest according to Commission Implementing Regulation (EU) 2019/2072	*Quercus*	*Cryphonectria parasitica*
5	*Davidsoniella virescens*	CERAVI	*Davidsoniella virescens* (R.W. Davidson) Z.W. de Beer, T.A. Duong & M.J. Wingfield	Microascales Ceratocystidaceae	Fungi	EU Quarantine Pest according to Commission Implementing Regulation (EU) 2019/2072	*Quercus*	*Davidsoniella virescens*
6	*Entoleuca mammata*	HYPOMA	*Entoleuca mammata* (Wahlenb.) Rogers and Ju	Xylariales Xylariaceae	Fungi	Protected Zone Quarantine Pest according to Commission Implementing Regulation (EU) 2019/2072	*Quercus*	*Entoleuca mammata*
7	*Euwallacea fornicatus sensu lato*	XYLBFO	*Euwallacea fornicatus sensu lato*	Coleoptera Curculionidae Scolytinae	Insects	EU Quarantine Pest according to Commission Implementing Regulation (EU) 2019/2072	*Quercus* and *Juglans*	Ambrosia beetles
8	*Geosmithia morbida*	GEOHMO	*Geosmithia morbida* Kolarík, Freeland, Utley & Tisserat	Hypocreales Bionectriaceae	Fungi	EU Quarantine Pest according to Commission Implementing Regulation (EU) 2019/2072	*Juglans*	*Pityophthorus juglandis* and *Geosmithia morbida*
9	*Lopholeucaspis japonica*	LOPLJA	*Lopholeucaspis japonica* Cockerell	Hemiptera Diaspididae	Insects	EU Quarantine Pest according to Commission Implementing Regulation (EU) 2019/2072	*Quercus* and *Juglans*	*Lopholeucaspis japonica*
10	*Lycorma delicatula*	LYCMDE	*Lycorma delicatula* (White)	Hemiptera Fulgoridae	Insects	EU Quarantine Pest according to Commission Implementing Regulation (EU) 2019/2072	*Quercus* and *Juglans*	*Lycorma delicatula*
11	*Neocosmospora euwallaceae*	FUSAEW	*Neocosmospora euwallaceae* (S. Freeman, Z. Mendel, T. Aoki & O'Donnell) Sandoval-Denis, L. Lombard & Crous	Hypocreales Nectriaceae	Fungi	EU Quarantine Pest according to Commission Implementing Regulation (EU) 2019/2072	*Quercus*	*Neocosmospora euwallaceae*
12	*Phytophthora ramorum*	PHYTRA	*Phytophthora ramorum* (non-EU isolates) Werres, De Cock & Man in 't Veld	Peronosporales Peronosporaceae	Oomycetes	EU Quarantine Pest according to Commission Implementing Regulation (EU) 2019/2072	*Quercus* and *Juglans*	*Phytophthora ramorum*

(Continues)

TABLE 6 (Continued)

Number	Current scientific name	EPPO code	Name used in the EU legislation	Taxonomic information	Group	Regulatory status	Host plant	Name of Pest datasheet
13	*Pityophthorus juglandis*	PITOJU	*Pityophthorus juglandis* Blackman	Coleoptera Curculionidae Scolytinae	Insects	EU Quarantine Pest according to Commission Implementing Regulation (EU) 2019/2072	*Juglans*	*Pityophthorus juglandis* and *Geosmithia morbida*
14	*Pseudopityophthorus minutissimus*	PSDPMI	*Pseudopityophthorus minutissimus* (Zimmermann)	Coleoptera Curculionidae Scolytinae	Insects	EU Quarantine Pest according to Commission Implementing Regulation (EU) 2019/2072	*Quercus* and *Juglans*	Bark beetles
15	*Pseudopityophthorus pruinosus*	PSDPPR	*Pseudopityophthorus pruinosus* (Eichhoff)	Coleoptera Curculionidae Scolytinae	Insects	EU Quarantine Pest according to Commission Implementing Regulation (EU) 2019/2072	*Quercus*	Bark beetles
16	Scolytinae spp. (non-European)	1SCOLS	Scolytinae spp. (non-European)	Coleoptera Curculionidae Scolytinae	Insects	EU Quarantine Pest according to Commission Implementing Regulation (EU) 2019/2072	*Quercus* and *Juglans*	1) Ambrosia beetles 2) Bark beetles
17	*Xylella fastidiosa*	XYLEFA	*Xylella fastidiosa* (Wells et al.)	Lysobacterales Lysobacteraceae	Bacteria	EU Quarantine Pest according to Commission Implementing Regulation (EU) 2019/2072	*Quercus* and *Juglans*	*Xylella fastidiosa*

5 | THE PESTS ASSESSED IN THE OPINION

5.1 | *Bretziella fagacearum*

5.1.1 | Taxonomy

Bretziella fagacearum is a fungus belonging to the phylum: Ascomycota; order: Microascales; and family: Ceratocystidaceae (Index Fungorum, 2025).

The synonyms are *Ceratocystis fagacearum* and *Endoconidiophora fagacearum* (Index Fungorum, 2025). Taxonomic synonyms according to Mycobank (2025) are *Chalara quercina* and *Thielaviopsis quercina*.

The English common names of *B. fagacearum* are oak wilt and wilt of oak (EPPO, 2025b).

5.1.2 | Origin and distribution

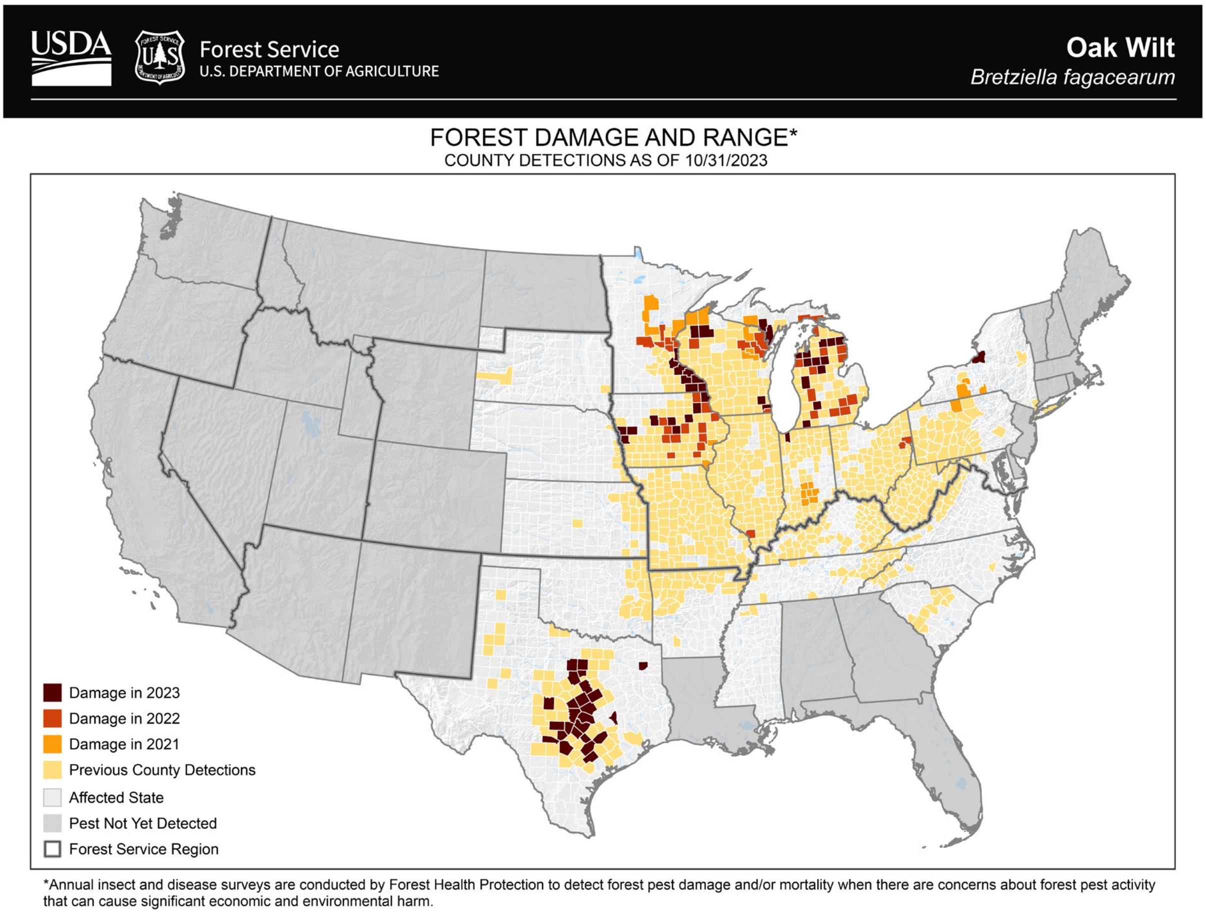
Bretziella fagacearum was initially described in 1940 as *Chalara quercina* (the asexual stage) by Henry (1944) from Illinois, Iowa, Minnesota and Wisconsin. Bretz (1953) later identified and named its sexual state, *Endoconidiophora fagacearum*. The fungus was subsequently renamed *Ceratocystis fagacearum* (Hunt, 1956). However, a recent phylogenetic reclassification of Ceratocystidaceae, based on multiple genes, revealed that the oak wilt fungus did not belong to any of the established genera. Consequently, it was classified as a separate species and was renamed *Bretziella fagacearum* to honour Bretz, who first described its sexual stage (de Beer et al., 2017).

The pathogen is only known to be present in the US and Canada (EPPO, 2025c). In Canada, it was reported for the first time in Niagara Falls, Ontario, in June 2023 and it is under official control there (EPPO, 2023a; North American Plant Protection Organization, 2023).

The origin of *B. fagacearum* is unknown. According to Juzwik et al. (2008), there are two possible scenarios of the origin of the pathogen: (1) native from North America; or (2) non-native originated from Central or South America or Mexico. However, the weight of evidence indicates that *B. fagacearum* is an introduced pathogen in North America.

5.1.2.1 | *Presence, distribution and prevalence of the pest in the US*

Bretziella fagacearum has been reported in the US in the following states: Arkansas, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Michigan, Mississippi, Missouri, Nebraska, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, South Dakota, Tennessee, Texas, Virginia, West Virginia and Wisconsin (USDA, 2025). The distribution data are available by county in the Forest Service USDA website – the most recent distribution map is from October 2023, with the previous county detections, including the damage caused from 2021 to 2023 (USDA, 2025) (Figure 1).



*Annual insect and disease surveys are conducted by Forest Health Protection to detect forest pest damage and/or mortality when there are concerns about forest pest activity that can cause significant economic and environmental harm.

FIGURE 1 Distribution of *Bretziella fagacearum* in the US. Map updated in 2023, provided by USDA (2025).

Damage of the pathogen between 2021 and 2023 (Figure 1) was detected in Illinois, Indiana, Iowa, Michigan, Minnesota, New York, Ohio, Pennsylvania, Texas and Wisconsin (USDA, 2025).

Dossier Section 2 states that: 'maximum prevalence in terms of number of individual diseased trees in a stand is difficult to estimate. Numbers of dying or dead *Quercus rubra* in a pocket partly depends on how long the disease has been present in the stand, soil type and topography. Stands with dense red oak species on course textured, sandy soils exhibit the highest rates of disease incidence due to higher rates of root graft formation among neighbouring red oak trees. *Quercus rubra* stands selected for harvest of high-quality logs are on sites with heavier textured soils and lower rates of disease transmission. Maximum prevalence in *Q. alba* stands is generally very low due to lower rates of disease transmission among white oak species.'

5.1.3 | Biology

Bretziella fagacearum is a causal agent of oak wilt. The pathogen causes a vascular wilt by colonising the sapwood of the trees, which may result in a brownish discoloration of the xylem, visible in cross sections (branches, stem) of wilted trees (EFSA PLH Panel, 2020b). The fungus develops mycelial mats under the bark of recently killed trees on which spores (i.e. conidia first and ascospores later) are produced. As the fungal mats grow, the bark is pushed away and cracks open. The fruit-like odour emitted by the mats attracts sap beetles (Coleoptera, Nitidulidae), which may subsequently carry fungal spores of the pathogen to other oak trees (Harrington, 2013). Fresh, xylem-penetrating wounds, leaking sap, generally less than 72 h old, are required for successful infection mediated by sap beetles (Kuntz & Drake, 1957). Wounds created by human activities (cut branch ends, fresh stump surfaces, stem wounds) or strong winds (broken branches and stems) may provide suitable infection courts, particularly in spring and early summer (Juzwik et al., 2011). Bark wounds are required for infection because sap beetles are unable to bore intact bark or woody plant tissues.

Sexual ascospores can stick to the tegument of insects and are more effectively dispersed than conidia. *Bretziella fagacearum* is heterothallic and can only reproduce sexually upon mating of two strains with opposite mating types. This may occur when sap beetles are visiting different mats and cross-fertilise the fungus (Harrington, 2013).

Sporulating mats are only produced when the bark/wood interface is moist (Gibbs & French, 1980). There is a fairly narrow range of sapwood moisture content (37%–45% in spring, 44%–52% in autumn) that allows for fungal mat formation (Campbell & French, 1955). Mats are produced in a temperature range of 8–25°C with faster and larger development in warmer conditions (EFSA PLH Panel, 2020b). *Bretziella fagacearum* is poorly competitive as a saprophyte and is rapidly replaced by many other organisms within 1 year after the death of the tree (Gibbs & French, 1980; Sinclair & Lyon, 2005). Sporulating mats are important for the spread of the pathogen by insect vectors. Mats may also form on firewood and logs, on which the disease can be transported to new areas (Juzwik et al., 2011). Spread of oak wilt within a forest stand mostly occurs through root grafts between trees of the same oak species (Appel, 1995; Bruhn et al., 1991). Root grafting may also occur between trees of different oak species, but the importance of this type of grafting for disease transmission is unknown (Juzwik, 2008). Root graft transmission results in distinct disease foci, which can be observed in forest stands as clusters of symptomatic and killed oak trees. *Bretziella fagacearum* can infect many oak species, which exhibit different levels of susceptibility or resistance; see Section 5.1.5 for more details.

5.1.3.1 | *Ability to create resting propagules*

Bretziella fagacearum produces hyphae, mycelium, conidiophores, conidia, endoconidiophores, endoconidia, ascospores, asci, perithecia and sclerotia (de Beer et al., 2017; EPPO, 2023b). There is no indication that the fungus can create resting propagules or chlamydospores.

5.1.4 | Effect of temperature on the biology of the pest

Numerous studies have examined the thermal tolerances of this pathogen, revealing the specific temperature ranges that influence its growth, reproduction and persistence in various substrates, from laboratory cultures to infected oak wood.

On agar plates, the growth of *B. fagacearum* isolates was best between 22 and 26°C, poor at 16°C and 32°C and none above 34°C (Houston & Kuntz, 1960; Lewis, 1985). While no growth was observed, the isolates survived for 10 days at 34°C (Lewis, 1985).

In laboratory settings using Petri dishes, perithecial production occurred within a temperature range of 15°C–27°C, with an optimal temperature of 24°C. No perithecia developed at 10°C or 30°C (Cobb Jr et al., 1961).

Ascospores and endoconidia germinated between 3°C and 36°C, with an optimal germination temperature range of 21°C–32°C under laboratory conditions (Fergus, 1954; Tainter, 1986).

Both spore types survived longest under cool, dry conditions (McLaughlin & True, 1952). High temperature and humidity drastically reduced viability; at 37°C and 95% relative humidity, endoconidia survived less than 3 days and ascospores only 3 days; however, at 25%, both lasted 10 days. Overall, ascospores proved to be more resilient than endoconidia (Merek & Fergus, 1954).

According to Bretz and Morison (1953), survival of *B. fagacearum* in small diameter material (twigs, branches) is relatively short at temperatures of 20°C–25°C and above.

The viability of *B. fagacearum* in air-dried oak lumber varied with harvest season (temperature and moisture) and oak species (*Q. rubra*, *Q. coccinea* and *Q. alba*). In summer-harvested lumber, viability ceased after 14 days. However, *B. fagacearum* can persist longer in autumn-harvested lumber (up to 140 days). *Quercus alba* generally exhibited lower recovery rates compared to *Q. rubra* and *Q. coccinea*. Air-drying lumber to a moisture content of 20% or less resulted in a significant reduction in fungal viability (Tainter et al., 1984).

5.1.5 | Host range and host status of *Quercus* and *Juglans*

Quercus, Castanea, *Chrysolepis* and *Notholithocarpus* are the only broadleaf trees known to be hosts of *B. fagacearum* (EPPO, 2025d). There is no information on whether *B. fagacearum* can also attack *Juglans*.

Quercus natural hosts (North American species) of *B. fagacearum* are *Q. agrifolia, Q. alba, Q. chrysolepis, Q. coccinea, Q. dumosa, Q. ellipsoidalis, Q. engelmannii, Q. falcata, Q. fusiformis, Q. garryana, Q. imbricaria, Q. kelloggii, Q. laevis, Q. laurifolia, Q. lobata, Q. macrocarpa, Q. marilandica, Q. muehlenbergii, Q. nigra, Q. palustris, Q. phellos, Q. prinus, Q. rubra, Q. shumardii, Q. stellata, Q. texana, Q. velutina, Q. virginiana* and *Q. wislizenii* (EFSA, 2022).

Quercus experimental hosts (European species) of *B. fagacearum* are *Q. ilex, Q. petraea, Q. pubescens*, *Q. robur* and *Q. suber* (EFSA, 2022; EFSA PLH Panel, 2018b; Pinon et al., 2003).

Quercus genera is divided into two subgenera (*Quercus* and *Cerris*) and additional sections (Hipp et al., 2020). Red oaks, section *Lobatae* (*Q. agrifolia, Q. coccinea, Q. ellipsoidalis, Q. falcata, Q. imbricaria, Q. kelloggii, Q. laevis, Q. laurifolia, Q. marilandica, Q. nigra, Q. palustris, Q. phellos, Q. rubra, Q. shumardii, Q. texana, Q. velutina* and *Q. wislizenii*), are highly susceptible to oak wilt (Juzwik et al., 2011) and can die within few weeks after being infected (EPPO, 2021a; Sinclair & Lyon, 2005). White oaks, section *Quercus* (*Q. alba, Q. dumosa, Q. engelmannii, Q. garryana, Q. lobata, Q. macrocarpa, Q. muehlenbergii, Q. prinus, Q. stellata*), are from highly (*Q. alba*) to moderately resistant to oak wilt (Juzwik et al., 2011). In *Q. alba*, infections by *B. fagacearum* may result in dieback of a few branches, but the trees can survive for many years (Juzwik et al., 2011). This is because the trees can produce new annual rings of sapwood and compartmentalise the fungus. Thus, the vascular staining associated with the fungus is observed deeper in the sapwood (EPPO, 2021a). Southern live oaks, section *Virentes* (*Q. fusiformis, Q. virginiana*), have moderate resistance to oak wilt (Juzwik et al., 2011). Intermediate oaks, section *Protobalanus* (*Q. chrysolepis*), have susceptibility between red and white oaks (Gearman & Blinnikov, 2019 citing others). European species (*Q. robur*, *Q. petraea*, *Q. pubescens*) were susceptible and died within 1 year following the inoculation experiment (MacDonald et al., 2001).

5.1.6 | Symptoms and diagnosis

The oak wilt symptoms are not visible during the dormant stage. Identification of oak wilt-infected trees is more reliable for red oaks, where symptoms develop rapidly. In the white oak (*Q. alba*), identification of infected trees can be more difficult because of the slow development of disease symptoms. The fungus can remain undetected for many years (e.g. 20-year infection observed in a *Q. alba* tree) (EFSA PLH Panel, 2020b).

Symptoms of *B. fagacearum* on *Quercus* species are crown and foliage wilting; death of foliage; water-soaked appearance of mature leaves; bronzing and necrosis of leaf tips and margins; leaf abscission of completely green leaves; branch dieback; vascular straining in the xylem of branches and main stem; presence of mats; and death of trees (Henry, 1944; Juzwik et al., 2011).

Fungal mats are usually absent or rare on white oaks (Cones, 1967; Engelhard, 1955). Mats develop almost exclusively on red oaks, with a proportion of one-third of infected trees actually producing mats that rupture the bark, based on a mat survey of standing dead trees (EFSA PLH Panel, 2020b).

Diagnosis of *B. fagacearum* is done either by culture-based or molecular methods using wood samples from symptomatic trees (EPPO, 2023b; Yang & Juzwik, 2017). Recently, a novel non-destructive detection method has been reported, which is based on a real-time PCR assay using leaf petioles from fallen leaves (Chahal et al., 2025).

5.1.7 | Pathway of entry with logs

Main pathways of entry for *B. fagacearum* are (1) wood with and without bark; (2) isolated bark; (3) plants for planting other than seeds; and (4) cut branches (EFSA PLH Panel, 2018b).

Wood from diseased oak trees presents the most likely pathway for *B. fagacearum* introduction (EPPO, 1997; Robinet et al., 2016), and sporulating mycelial mats on logs further amplify the risk of its spread (Juzwik et al., 2011). Wood both with and without bark is a potential carrier of the fungus (EFSA PLH Panel, 2018b), with fungal survival dependent on factors like temperature, moisture content, harvest time and oak species (Tainter et al., 1984). This fungus has shown remarkable persistence, surviving for up to 24 weeks in sawn lumber (Gibbs & French, 1980) and for up to 140 days in autumn-harvested, air-dried oak lumber (Tainter et al., 1984). *Bretziella fagacearum* can also survive at least 4 weeks in heartwood and 12 weeks in sapwood of white and black oaks (Partridge, 1961). In branches of *Q. ellipsoidalis* from Minnesota, the fungus in trees that died later in the summer survived sometimes even until the following spring (Gibbs, 1980).

5.2 | *Pityophthorus juglandis* and *Geosmithia morbida*

5.2.1 | Taxonomy

Pityophthorus juglandis is a bark beetle belonging to the order: Coleoptera and family: Curculionidae. The English common name is Walnut Twig Beetle (WTB).

Geosmithia morbida is a fungus belonging to the order: Hypocreales and family: Bionectriaceae. The English common name is Thousand Cankers Disease (TCD).

5.2.2 | Origin and distribution

Pityophthorus juglandis is a bark beetle, the main vector of the pathogenic fungus *Geosmithia morbida*. It is endemic to Mexico and the SW states of the US (Gomez et al., 2023), but it is also present in north-western and eastern US, where it has been introduced probably via wood trade (Newton & Fowler, 2009; Sitz et al., 2021). Outside of North America, *P. juglandis* was reported in Europe for the first time in 2013 in Italy (Montecchio & Faccoli, 2014), where it is currently present in Veneto, Piedmont, Lombardy, Emilia Romagna, Friuli Venezia Giulia (Bracalini et al., 2023) and Tuscany (Pennacchio et al., 2023). In 2022, the pest was also found in France (Saurat et al., 2023).

Geosmithia morbida was described by Kolařík et al. (2011) as native to Western North America (mostly California and Colorado). Its distribution in North America almost completely overlaps that of the main vector insect *P. juglandis* except for Mexico (Chihuahua), where only the beetle was recorded (EPPO, 2015). The pathogen is present in Italy wherever its vector is found (see above) with the sole exception of Friuli Venezia Giulia (Bracalini et al., 2023). In France (Auvergne-Rhone Alpes), both the fungus and the vector are present (Saurat et al., 2023).

5.2.2.1 | *Presence, distribution and prevalence of the pest in the US*

In the US, the symbiotic complex *Pityophthorus juglandis/Geosmithia morbida* is currently reported in the following 18 states: Arizona, California, Colorado, Idaho, Indiana, Maryland, Michigan, Missouri, Nevada, New Mexico, North Carolina, Ohio, Oregon, Pennsylvania, Tennessee, Utah, Virginia and Washington (Atkinson, 2025; Bright, 2021; DAFNAE, 2025; EPPO, 2025e). Besides, *Geosmithia morbida* is also present in Illinois and Minnesota without *P. juglandis* being found (Moore et al., 2019). In the US, the detection of *P. juglandis* is usually considered equivalent to that of *G. morbida* (Cranshaw & Tisserat, 2012), but the pathogen may also be present in the absence of the beetle or walnuts symptomatic for TCD (Moore et al., 2019). However, only in the states where both the pests are recorded infestations have been established, mostly on amenity trees in urban areas, agricultural landscape and orchards. Considering the widespread presence of several susceptible hosts, the potential alternative vectors (Section 5.2.3), the passive human-assisted transport on infected wood despite containment measures, it is likely that the pests are also present in other states bordering those where they are currently established and maybe more widespread in the US than previously known (EPPO, 2015; Moore et al., 2019).

The distribution data are available by county in the Forest Service USDA website – the most recent distribution map is from October 2023, with the previous county detections (USDA, 2025) (Figure 2).

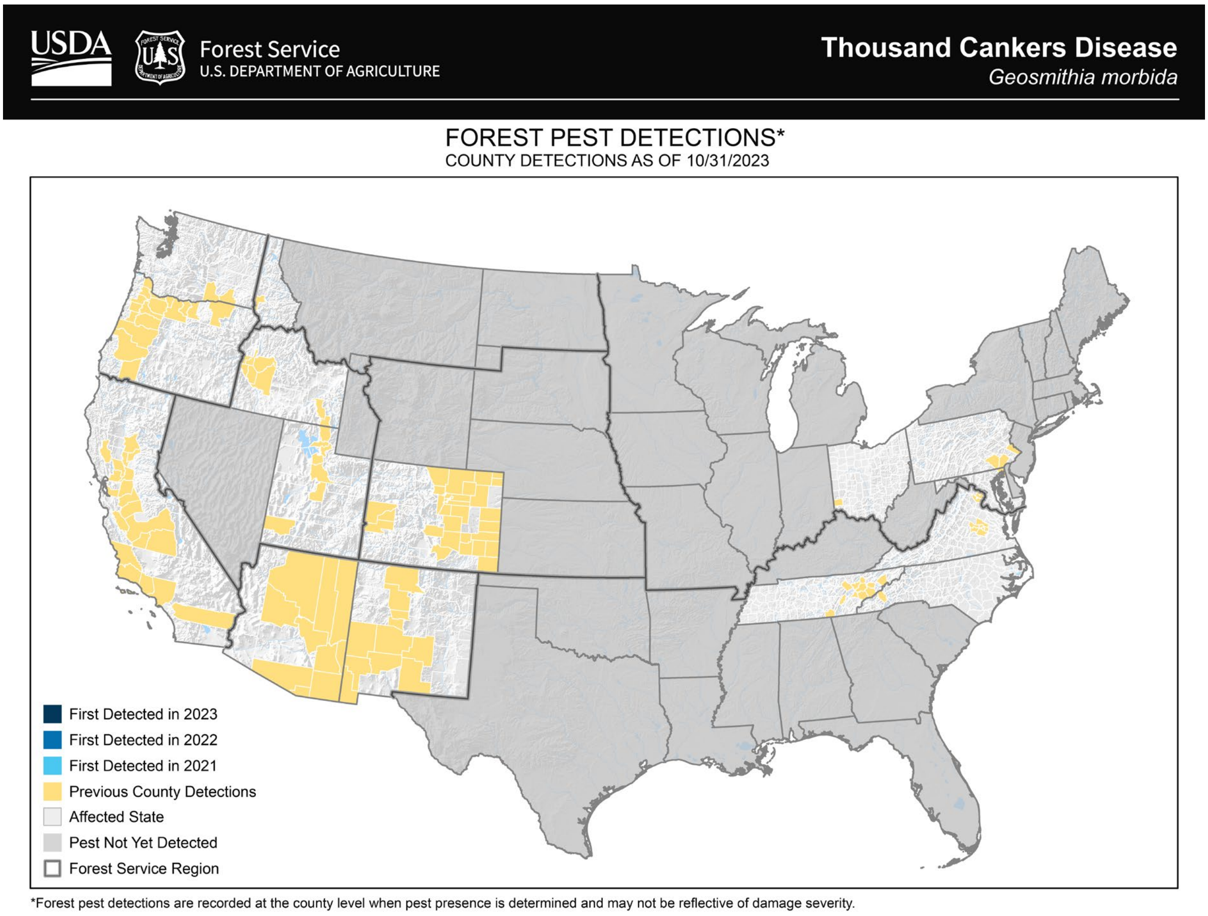


FIGURE 2 Distribution of *Geosmithia morbida* in the US. Map updated in 2023, provided by USDA (2025).

The pathogen based on Figure 2 was detected in these states: Arizona, California, Colorado, Idaho, Maryland, New Mexico, North Carolina, Ohio, Oregon, Pennsylvania, Tennessee, Utah, Virginia and Washington (USDA, 2025).

Dossier Section 2 states that: 'the prevalence of *G. morbida* in natural forest stands in the eastern and southern US is considered very low or insignificant. Populations of the primary vector of *G. morbida* (i.e. walnut twig beetle) collapsed in Ohio, Pennsylvania, Maryland and Virginia between 2013 and 2019) and no new detections/reports in southern states between 2012 and 2024. In western states, losses are most serious in urban and community forests (e.g. CA, WA) and in timber plantations of *J. nigra* (outside of native range) in eastern Washington State (max. prevalence, 80%).'

5.2.3 | Biology

Pityophthorus juglandis is a small bark beetle (adults 1.5–2 mm long) belonging to the group of 'twig beetles' typically infesting branches of trees (usually over 1.5–2 cm in diameter) as well as stems attacked by other bark beetles (EPPO, 2015; Smith & Hulcr, 2015). *Pityophthorus juglandis* has four life stages: egg, larva (3 instars), pupa and adult. Depending on the latitude and climatic conditions, one to three overlapping generations per year are observed in the native range (Bracalini et al., 2023; EFSA, 2020a). In North Italy, only two generations per year are observed (Faccoli et al., 2016). From spring to autumn, the swarming adults are mostly attracted by stressed trees, but healthy plants can also be infested (EPPO, 2015). Suitable hosts are found not only via host volatiles and aggregation pheromones but also via *Geosmithia* volatiles, confirming a close relationship between insect and fungus (Blood et al., 2018). Both young and mature trees can be attacked on stems of all sizes and branches not thinner than 1.3–2.0 cm (EFSA, 2020a). *Pityophthorus juglandis* is a polygamous species and the circular nuptial chamber created by the male beneath the bark can host from two to eight females (Cranshaw & Tisserat, 2012; Faccoli et al., 2016). The larvae spread in the phloem by tunnelling winding galleries that never engrave the sapwood and develop to the pupal stage in 4–8 weeks in a temperate climate (EFSA, 2020a). The emerging adults usually colonise new hosts near the natal tree, having limited flight capacity (maximum distance 3.6 km in 24 h, with 1/3 of the beetles flying < 100 m) (Kees et al., 2017). However, dispersal by air currents may also play a role, and even more the human-assisted spread with transport of fresh wood (mostly logs and firewood) (EFSA, 2020a). *Pityophthorus juglandis* overwinters in the infested trees as mature larvae, pupae and adults, which emerge in late April (Cranshaw & Tisserat, 2012).

The bark beetles may be present in large numbers on infested logs (densities up to 5–6 individuals/cm^2) (EPPO, 2015). Although adults of *P. juglandis* do not have mycangia, the vectoring of *G. morbida* is still very efficient because the elytra of emerging beetles are heavily contaminated by spores of the pathogen (Cranshaw & Tisserat, 2012; Newton & Fowler, 2009). However, *P. juglandis* is not the only vector of *G. morbida* in the US, as other 11 beetle species are known to carry propagules of the pathogen; of these, eight species are ambrosia beetles (native and non-native), two species are native bark beetles and one species is a bark weevil (Chahal, 2018). Moreover, Moore et al. (2019) have detected *G. morbida* in 18 insect species using molecular methods. Even if the role of the alternative vectors needs to be further investigated, it is suspected that they may sustain the establishment of the disease and contribute to the spread of the pathogen (Chahal et al., 2019).

Geosmithia morbida is an ascomycete reproducing only asexually via conidia. Once carried beneath bark by the beetles, conidia germinate producing a hyaline/whitish mycelium that slowly grows degrading cellulose and lignin of the cell walls, hence causing tissue necrosis in the phloem (the sapwood is only superficially reached) and disrupting vascular function. Soon conidia appear on verticillate conidiophores, contaminating the body of adult beetles of the new generation which then spread the infection to new hosts (Bracalini et al., 2023; EPPO, 2015; 2020a).

5.2.3.1 | *Ability to create resting propagules*

There is no evidence in the literature that *G. morbida* produces resting propagules (Bracalini et al., 2023; EFSA, 2020a; EPPO, 2015; 2020a; Kolařík et al., 2011). The absence of documented resting structures suggests that *G. morbida* primarily relies on its association with *P. juglandis* for dispersal and survival.

5.2.4 | Effect of temperature on the biology of the pests

Optimal growth temperature of *G. morbida* is around 31°C, with a stop of growth in the lab beyond 35°C. The fungus is reported to survive up to 41°C and can maintain its viability in inoculated wheat seeds at 48°C (Bracalini et al., 2023); however, in walnut logs, *G. morbida* does not survive at 48°C or higher (Mayfield et al., 2014). No specific information was found about the tolerance of *G. morbida* to low temperatures; however, considering its strong association with the vector, it can be assumed that it is the same of the beetle. *Pityophthorus juglandis* has a remarkable cold tolerance, as not only adults but also larvae and pupae can be found under the bark in cold winters. The lower lethal temperatures range from −14°C to −23°C for adults (Hefty et al., 2017) and −16.9°C for larvae (Luna et al., 2013). As for high temperatures, the lethal threshold is 47.9°C for adults and 47.3°C for larvae (Luna et al., 2013), and a minimum sapwood temperature of 56°C for 40 min completely eliminates both the pathogen and the vector from walnut logs (Mayfield et al., 2014).

5.2.5 | Host range and host status of *Quercus* and *Juglans*

Pityophthorus species feeding on pines in the US are very frequently associated with *Geosmithia* sp. (Kolařík et al., 2017). Out of conifers, however, no other broadleaf trees than *Juglans and Pterocarya* are known to be hosts for *Pityophthorus* in North America (Wood & Bright, 1992). Therefore, *Quercus* is not a host of *P. juglandis* in the US. As for *G. morbida*, *Juglans* and *Pterocarya* are also the sole hosts (EPPO, 2015).

Juglans hosts of both *P. juglandis* and *G. morbida* are *J. ailanthifolia* (syn. *J. mandshurica* var. *sieboldiana*), *J. californica*, *J. cinerea*, *J. hindsii*, *J. major*, *J. mandshurica*, *J. microcarpa*, *J. mollis*, *J. nigra* and *J. regia* (Atkinson, 2025; DAFNAE, 2025; EPPO, 2015; EPPO, 2025f, 2025g; Farr & Rossman, 2025). *Pterocarya* hosts are *P. fraxinifolia*, *P. rohifolia* and *P. stenoptera* for both the pests (Atkinson, 2025; DAFNAE, 2025; EPPO, 2020a, 2025f, 2025g).

Juglans hosts show increasing susceptibility from *J. major* to *J. nigra*, the latter being the most severely affected host (EFSA, 2020a; EPPO, 2015; 2020a). The other species, as well as their hybrids (*J. hindsii* x *J. regia*, *J. nigra* x *J. regia*, etc.) and the three species of *Pterocarya* show intermediate susceptibility levels in both the field and lab inoculation tests (EFSA, 2020a; EPPO, 2015). There is uncertainty about grafted trees, which show susceptibility considerably varying with the rootstock, and also on the susceptibility of *Juglans regia*, due to the wide intraspecific variations of the species (Bracalini et al., 2023; EPPO, 2015).

5.2.6 | Symptoms and diagnosis

The Thousand Cankers Disease of walnuts may be recognised by a combination of beetle infestation and fungus infection symptoms, primarily shown by foliage yellowing/wilting of individual branches eventually leading to progressive canopy loss. However, these are nonspecific symptoms, similar to those caused by other abiotic stress factors, such as drought. Specific external symptoms on stems and branches are the entry/exit holes of adult beetles together with cankers due to the spread of the pathogen. Entry holes can be associated with sap weeping. Adults and immature stages of *P. juglandis* can be observed under the bark in the galleries. Although the fungus has no systemic spread within the host, several dark-brown cankers caused by *G. morbida* infection appear and rapidly merge on infected tissues of phloem and superficially the outer wood, eventually leading the host to death within 3–8 years (Bracalini et al., 2023; EFSA, 2020a; EPPO, 2020a). However, the symptomatology of TCD may vary with the different susceptibility of hosts to the pathogen. In low and intermediate-susceptible hosts, as *Juglans major*, *J. regia*, *J. cinerea*, *J. californica*, etc. and all the hybrids, scattered dieback and low progression of the disease are recorded, and the death of trees is rare. Large canker incidence and high mortality are only found in *Juglans nigra* (EFSA, 2020a).

Both *G. morbida* and its vector *P. juglandis* can be identified through morphological characteristics and DNA sequencing of specific genomic regions. Molecular identification of *G. morbida* from cultured colonies can be performed using species-specific primers (Moore et al., 2019) or universal primers targeting the internal transcribed spacer (ITS) region (Moricca et al., 2020; Saurat et al., 2023). Identification of *P. juglandis* can be achieved by sequencing partial fragments of the mitochondrial cytochrome c oxidase I (COI) gene (Moricca et al., 2020). Species-specific PCR protocols, including simplex and duplex qPCR assays, were also developed to detect *G. morbida* from woody tissues and bark beetles as well as *P. juglandis* from insect frass (Rizzo et al., 2020).

5.2.7 | Pathway of entry with logs

Main pathways of entry for both *P. juglandis* and *G. morbida* are wood with bark of *Juglans* and untreated packaging wood of *Juglans*, for which the probability is considered by EPPO (2015) very high with low uncertainty.

From moderate to low probability of entry are listed the following commodities of *Juglans* and *Pterocarya*: wood without bark, plants for planting, scion wood, bark, particle wood and non-agglomerated waste wood of deciduous trees. Finally, squared wood of *Juglans* and *Pterocarya*, wood packaging material ISPM 15 treated and agglomerated waste wood of deciduous trees fall in the group of very low probability of entry (EPPO, 2015).

5.3 | Other target pests

All the information on the additional EU quarantine pests relevant for this opinion are summarised in Appendix A.

6 | ASSESSMENT OF THE VACUUM–STEAM–HEAT TREATMENT

6.1 | International and national standards on heat treatment

Heat treatment is a widely recognised phytosanitary method used to eliminate wood-dwelling pests. It is a key component of international and national wood treatment standards. The temperature and duration of exposure proposed by the applicant correspond to the requirements of ISPM 15. The standard ISPM 15 mandates heating of wood packaging to a core temperature of 56°C for 30 mins, which is generally effective against most wood pests. However, some pests may survive this treatment (e.g. Ramsfield et al., 2010) prompting certain countries to adopt stricter import requirements (Allen, 2014). For example, New Zealand requires heating of sawn wood to a core temperature of 100°C for 30 min and Australia requires heating of timber from some genera to a core temperature of 74°C (see Table 7).

TABLE 7 Requirements for heat treatment of wood in terms of core temperature and duration in ISPM 15 and national requirements of New Zealand and Australia.

ISPM 15	New Zealand (NZ MPI 2018)[a]	Australia (DAFF-BIOCON)[b]
Wood packaging material	Sawn wood	Timber from Myrtaceae and pathogen risk species (many genera grown in NZ, US, Europe)
Core temp.: 56°C Duration: 0.5 h	Core temp.: 70, 80, 90, 100, 110, 120°C Duration: 4 h, 2 h, 1 h, 0.5 h, 20 min, 15 min	Core temp.: 74°C Duration: 4 h (≤ 25 mm thickness) 18 h (> 200 mm thickness) Duration depends on thickness of logs (longer duration with increasing thickness)

[a] https://www.mpi.govt.nz/dmsdocument/1225/direct (accessed on 22 October 2024).

[b] BICON - Import Conditions (agriculture.gov.au) (accessed on 22 October 2025).

6.2 | Pattern of temperature distribution in heat-treated logs

Knowledge on the patterns of distribution of temperature in the cross section of heat-treated logs is pivotal to determine whether areas of the sections are less exposed to high temperatures. By working on logs of *Q. rubra* (43.9–56.4 cm diameter) treated with vacuum steam, Juzwik et al. (2019) determined that the average time for probes placed 5 cm below the cambium to reach 56°C and hold for 30 min was 6.9 h. It should be noted that at this time frame, based on the temperature profiles reported in the study (Juzwik et al., 2019), the temperature at the centre of the section did not increase substantially and was similar to the ambient temperature (see Figure 3).

In another study focused on vacuum steam treated *Juglans nigra* logs, the cycle times for 56°C for 30 min varied from 5.0 to 7.7 h depending on the log (Juzwik et al., 2021). Based on the temperature profiles reported in the study (Juzwik et al., 2021), even after 7.7 h, the temperature at the centre of the section did not exceed 45°C.

Both for *Q. rubra* and *J. nigra*, the temperature reached at the external surface and at the cambium layer was substantially higher than that measured 5 cm below the cambium (Juzwik et al., 2019, 2021).

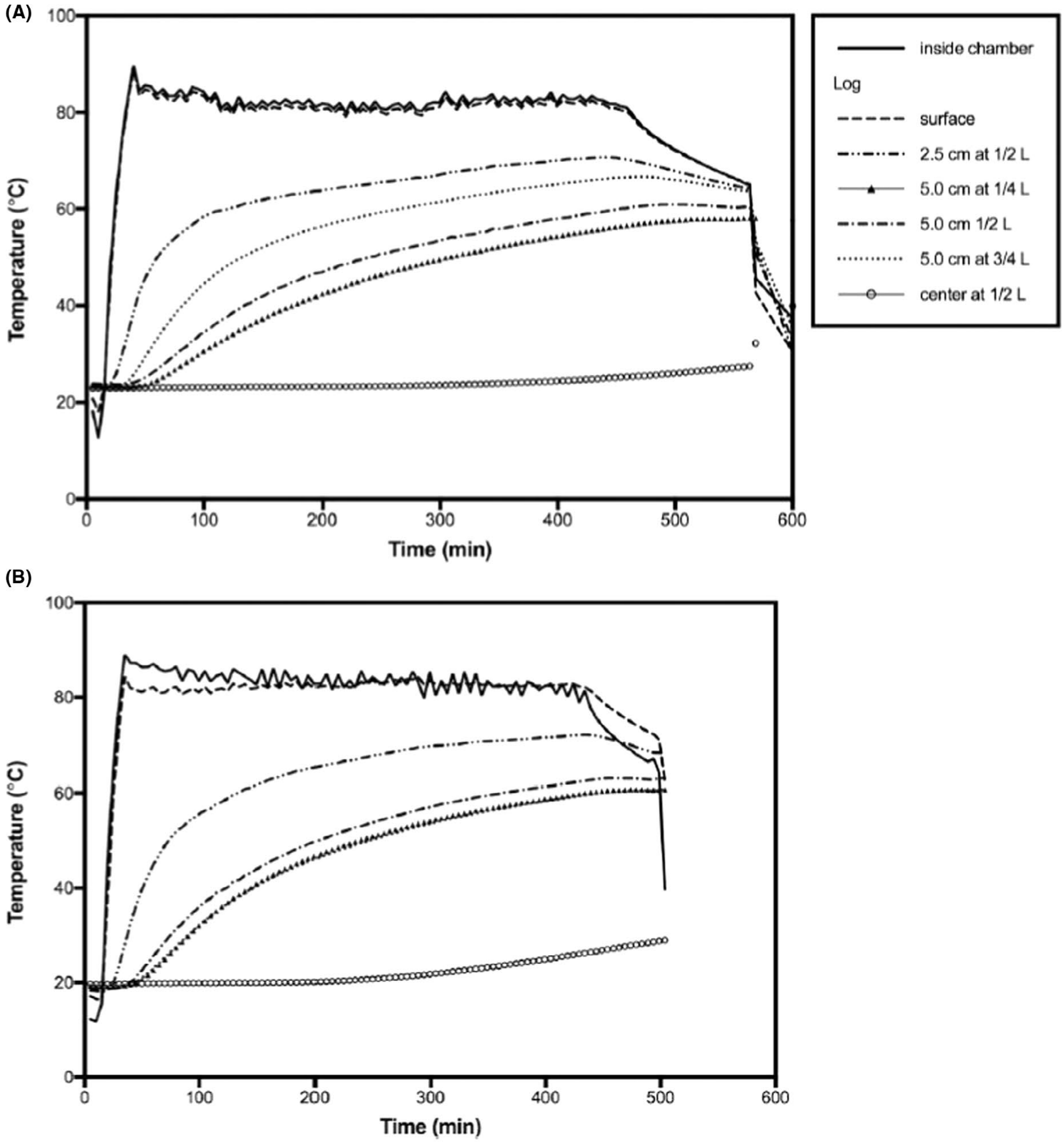


FIGURE 3 Temperature profiles of (A) 56°C for 30-min treatment of *Q. rubra* log and (B) 60°C for 60 min at an initial vacuum of 100 mmHg. The temperatures were measured at different depths of the wood and at different distances from the end of the log. Reproduced from J. Juzwik et al. (2019) Vacuum steam treatment eradicates viable *Bretziella fagacearum* from logs cut from wilted *Quercus rubra*. Plant Dis. 103(2):276-283. https://doi.org/10.1094/PDIS-07-18-1252-RE.

6.3 | General information on temperature limits of pests

A literature review on the temperature limits on a wide range of wood-dwelling insects, fungi and bacteria was conducted in a previous EFSA opinion (EFSA PLH Panel, 2024a). The information retrieved suggests that a temperature of 60°C for 30 min is sufficient to eliminate all wood-boring insects except powder post beetles where a lethal temperature of 82°C was reported. The lethal temperature of some fungal species was higher than that of insects. For example, Tansey (1971) and Schmidt (2007) reported lethal temperatures of > 82°C for short-term exposure for some fungal species. The eradication temperature (99.99% mortality) for 11 investigated wood-colonising fungal species (30 min exposure) ranged from 41.6°C to 69.6°C (Ramsfield et al., 2010).

6.4 | Specific information on temperature limits of survival of relevant pests

6.4.1 | Temperature limits of survival for *B. fagacearum*

The mycelium of *B. fagacearum* did not survive exposure to a temperature of 45°C for 4 h, but it survived 45°C when exposed for only 1 h (Lewis, 1985). The mycelium survived 46°C and died at 48°C when exposed to the heat for 30 mins (Noseworthy et al., 2024). Ascospores are more heat tolerant and survived exposure to 50°C for 2 h and were killed when exposed for 6 h to 50°C (Cole & Fergus, 1956).

Juzwik et al. (2019) investigated the survival of *B. fagacearum* in logs. Naturally and artificially infested red oak logs were vacuum–steam–heat treated at 56°C for 30 min and 60°C for 60 min held at a depth of 5 cm below the cambium. No living inoculum was found in the samples taken after the treatments.

However, in a second study with red oak logs (Juzwik, unpublished, information included in the Dossier), using the same methodology as described above, two samples (230 samples were positive out of 480 pretreatment samples and two samples were positive out of 480 post-treatment samples) in the 60°C treatment tested positive for surviving *B. fagacearum*: one sample from the inner sapwood and one from the outer sapwood. It should be noted that these two positive samples came from two different logs out of a total of 15 treated logs. No positive samples were found in the logs treated at 56°C (253 samples were positive out of 480 pretreatment samples and no samples were positive out of 480 post-treatment samples).

A similar study was conducted with artificially inoculated *Q. alba*. However, there was a very low number of positive samples found in logs before treatment (0.63% were positive out of 792 samples). Therefore, the result of zero positive samples after treatment cannot be used as strong evidence of the efficacy of the treatment.

Available information suggests that an exposure to a temperature of 56°C is generally sufficient to kill *B. fagacearum* mycelium. Ascospores are more heat tolerant and require 6 h of exposure to 50°C to ensure their inactivation. Ascospores are produced at the surface of the wood and hence will be exposed to higher temperatures than 56°C. Surviving *B. fagacearum* was found in an experiment with the suggested vacuum–steam–heat treatment of logs at a temperature of 60°C. Therefore, it seems that the proposed methodology is not always sufficient to kill all *B. fagacearum*.

6.4.2 | Temperature limits of survival for *Geosmithia morbida* and *Pityophthorus juglandis*

The LT_{99} of larvae and adults of *P. juglandis* was 48.1°C and 52.7°C, respectively, for an exposure duration of 30 mins in plastic tubes (Luna et al., 2013). No larvae survived exposure in logs at temperatures of 50.1°C for 30 min at 3.8 cm depth below the cambium (Mackes et al., 2016).

No viable mycelium of *G. morbida* was found in *J. nigra* logs exposed to 48°C for 40 mins at 1 cm below cambium and no viable larvae of *P. juglandis* were found after exposure to 52°C for 40 min at 1 cm below cambium (Mayfield et al., 2014). Juzwik et al. (2021) reported no viable mycelium of *G. morbida* and no viable larvae of *P. juglandis* in *J. nigra* logs after exposure to 56°C for 30 min measured at 5 cm depth below the cambium. Some surviving *G. morbida* inocula were detected when the above temperatures per time exposures were applied at 3.2 cm depth below the cambium instead of 5 cm depth below the cambium.

The available information suggests that *G. morbida* and *P. juglandis* would not survive exposure to 56°C for 30 min granted that the required temperature is reached in all areas of the log where the pests can be found.

6.4.3 | Temperature limits of survival for other relevant pests

Larvae of *Anoplophora glabripennis* did not survive exposure to a temperature of 57.8°C for 30 min, measured at the centre of heat-treated logs (Myers & Bailey, 2011). Eggs of *Lycorma delicatula* withstood 50°C for 30 min; however, no eggs survived 55°C for 15 min (Zandi-Sohani et al., 2025). For the two wood borer species, *Arhopalus ferus* and *Hylurgus ligniperda*, the lethal temperatures (LT 99.99) for a 30-min exposure ranged from 46.9°C (larvae of *H. ligniperda*) to 57.4°C (eggs of *A. ferus*). The lethal temperatures for other life stages fell between these extremes – for example, 52°C and 53.3°C for larvae, and 51°C and 55.8°C for adults of *A. ferus* and *H. ligniperda*, respectively (Pawson et al., 2019). Concerning ambrosia beetles, *Anisandrus dispar* is reported not to survive temperatures exceeding 50°C for 15 min in laboratory tests (Noseworthy et al., 2023) and *Xylosandrus germanus* is reported not to survive 58°C for 1 min (Suh, 2014).

Further information on the temperature limits of survival of other groups of pests can be found in Appendix A. For some relevant pests (i.e. *A. minutus, D. virescens, E. mammata, N. euwallaceae*), no information on the temperature of survival was found. However, there is no evidence in support of a higher temperature limit of survival for these pests.

6.5 | Depth of wood colonised

The depth of the wood which is colonised by the target organisms is crucial for estimating the efficacy of the proposed treatment. In case that the target organisms are found deeper than 5 cm below the cambium, they will not be exposed to the proposed temperature of 56°C for 30 min and hence may be able to survive the treatment.

According to the Dossier Section 2, *B. fagacearum* is not known to colonise heartwood because of the low moisture content of heartwood. *Bretziella fagacearum* colonises the whole circumference of sapwood and can colonise towards the sapwood–heartwood boundary in *Q. rubra*. *Quercus alba* has deeper sapwood than *Q. rubra* (see below) and *B. fagacearum* may grow deeper in the sapwood where the treatment will be less effective. In *Q. alba*, infections by *B. fagacearum* could remain asymptomatic for many years because the trees can produce new annual rings of sapwood and compartmentalise the fungus (Juzwik et al., 2011). Thus, the vascular staining associated with the fungus is observed deeper in the sapwood (EFSA, 2020b).

Data on the depth of sapwood in *Q. rubra* and *Q. alba* were submitted in the Dossier Sections 1 and 2. Measurements were conducted on 348 *Q. rubra* and 235 *Q. alba* logs. In total, 75% of the measurements resulted in a sapwood width of ≤ 2.11 cm in *Q. rubra* and ≤ 2.7 cm in *Q. alba*. However, sapwood wider than 5 cm was found in one *Q. rubra* and in four *Q. alba* logs. No data on sapwood depth were available for *J. nigra*.

While, in most cases, the heating of logs to a depth of 5 cm below the cambium is sufficient to cover the whole sapwood of the logs in few logs the sapwood was wider. Target organisms dwelling in wood deeper than 5 cm may not be exposed sufficiently long and not to a sufficiently high temperature to prevent their survival.

6.6 | Uncertainty analysis of literature data

The uncertainty of the different studies is mainly determined by the number of individuals or amount of isolates (proxy of inoculum) of a pest exposed to the heat treatment in each experiment. To quantify the remaining uncertainties for each survival estimator the 95% confidence interval (see below Table 8) was calculated. In case of zero survival, a one-sided interval was used; otherwise, the two-sided interval was calculated.

TABLE 8 Calculation of the 95% confidence intervals for Binomial(N,p) distributed rates with the Clopper–Pearson approximation. The exponential approximation for full presence/absence is less conservative than Clopper–Pearson (minimal change).

Observation k out of N	Lower bound	Upper bound
0 < k < N	BETA.INV(0.025, k, N-k + 1)	BETA.INV(0.975, k + 1, N-k)
k = 0 (full absence in the sample)	0%	1-EXP(LN(0.05/N) 'Upper 95% level'
k = N (full presence in the sample)	EXP(LN(0.05/N) 'Lower 95% level'	100%

In the following figures (Figures 4–6), the results are plotted against the temperature of each treatment.

Bretziella fagacearum

The analysis of the results of studies with *B. fagacearum* is presented in Table 9 and Figure 4.

TABLE 9 Summary of the calculated 95% confidence intervals for the estimate of survival of *B. fagacearum* for different temperatures in the studies of Noseworthy et al. (2024) and Juzwik et al. (2019). Results of Juzwik relate to measurements in inner sapwood. Juzwik 2nd pers refers to the unpublished study included in the Dossier. The letters indicate the specific study reported in the reference.

Reference & study	Temperature [°C]	Duration [min]	Sample size: N	Survivors: k	Estimate of survival [%]	95% CI lower	95% CI upper
48°C: Noseworthy 2024 (a)	48	30	18	0	0%	0%	15%
56°C: Juzwik 2019 (a)	56	30	20	0	0%	0%	14%
56°C: Juzwik 2019 (c)	56	30	24	0	0%	0%	12%
56°C: Juzwik 2nd pers (a)	56	30	159	0	0%	0%	1.9%
60°C: Juzwik 2019 (e)	60	60	20	0	0%	0%	14%
60°C: Juzwik 2019 (g)	60	60	24	0	0%	0%	12%
60°C: Juzwik 2nd pers (c)	60	60	155	1	0.62%	0.16%	3.5%

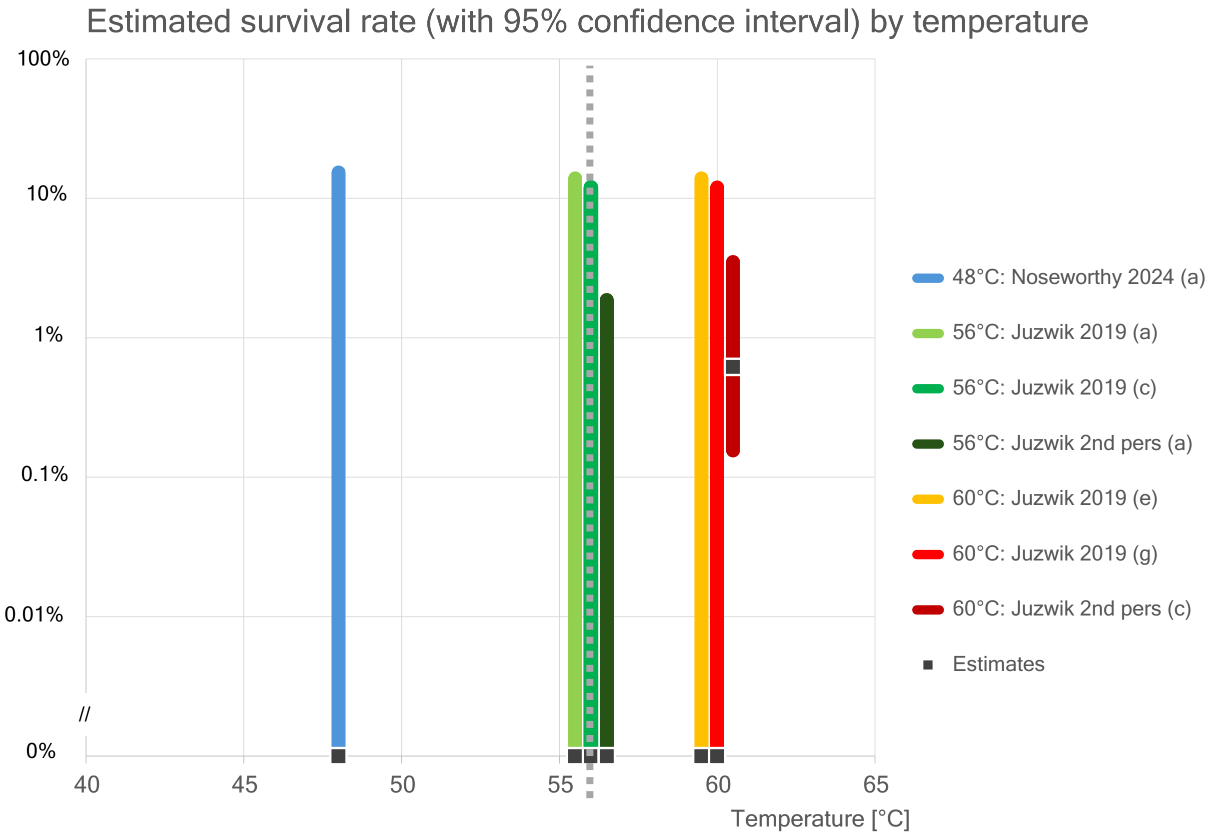


FIGURE 4 95% confidence intervals for the estimate of survival of *B. fagacearum* for different temperatures in different studies. The interval starts at 0% (one-sided) in case no pest survived in the experiment; otherwise, the two-sided interval was calculated. Results of Juzwik et al. (2019) relate to measurements in inner sapwood. Letters indicate the specific study reported in the reference.

Geosmithia morbida

The analysis of the results of studies with *G. morbida* is presented in Table 10 and Figure 5.

TABLE 10 Summary of the calculated 95% confidence intervals for the estimate of survival of *G. morbida* for different temperatures in the studies of Mayfield et al. (2014) and Juzwik et al. (2021). The letters indicate the specific study reported in the reference.

Reference & study	Temperature [°C]	Duration [min]	Sample size: N	Survivors: k	Estimate of survival [%]	95% CI lower	95% CI upper
48°C: Mayfield 2014 (a)	48	40	12	0	0%	0%	22%
56°C: Juzwik 2021 (a)	56	30	126	4	3.2%	0.20%	7.9%
56°C: Juzwik 2021 (d)	56	30	199	0	0%	0%	1.5%
60°C: Juzwik 2021 (c)	60	60	106	2	1.9%	0.23%	6.6%
60°C: Juzwik 2021 (f)	60	60	168	0	0%	0%	1.8%

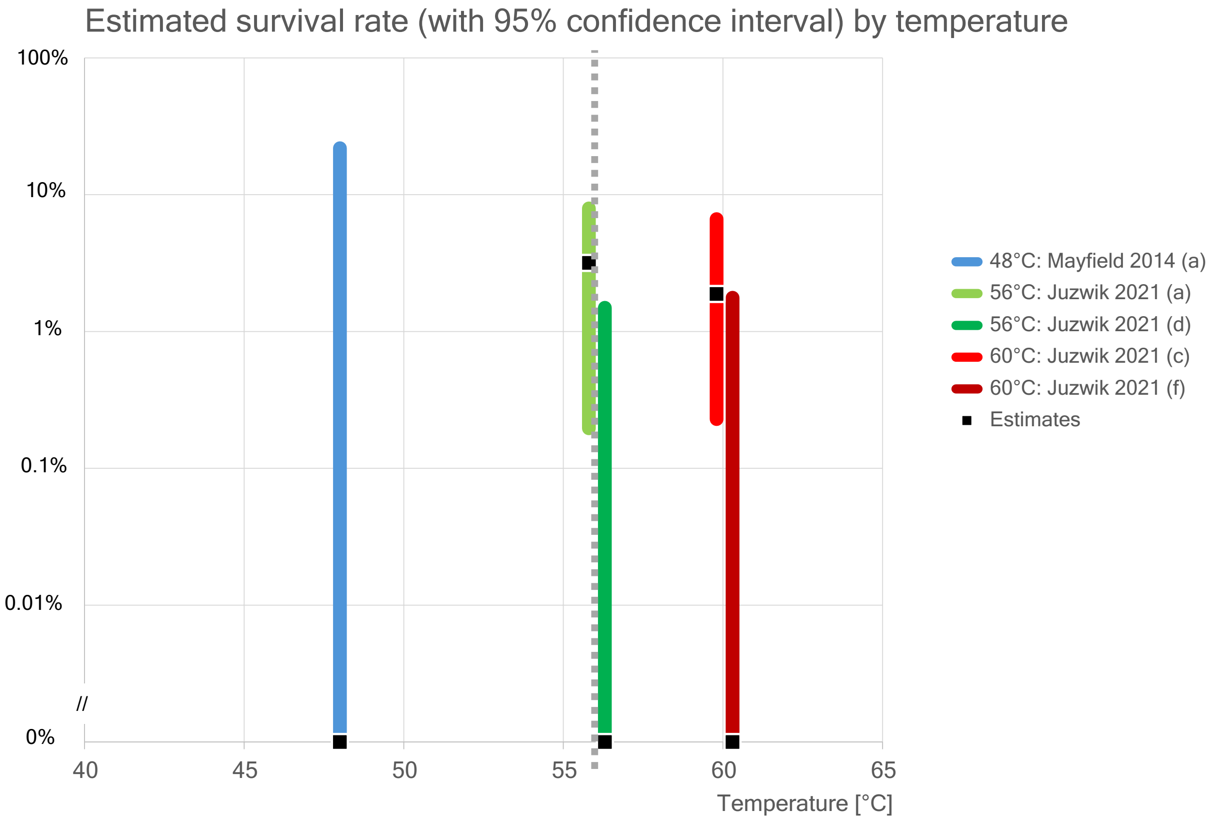


FIGURE 5 95% confidence intervals for the estimate of survival of *G. morbida* for different temperatures in different studies. The interval starts at 0% (one-sided) in case no pest survived in the experiment; otherwise, the two-sided interval was calculated. Letters indicate the specific study reported in the reference.

Pityophthorus juglandis

The analysis of the results of studies with *P. juglandis* is presented in Table 11 and Figure 6.

TABLE 11 Summary of the calculated 95% confidence intervals for the estimate of survival of *P. juglandis* for different temperatures in the studies of Costanzo et al. (2012), Luna et al. (2013), Mayfield et al. (2014) and Juzwik et al. (2021). The letters indicate the specific study reported in the reference.

Reference & study	Temperature [°C]	Duration [min]	Sample size: N	Survivors: k	Estimate of survival [%]	95% CI lower	95% CI upper
Luna et al., 2013 (b)	48.1	30	12	0	0%	0%	22%
Costanzo 2012 (a)	48.1	0	3	1	33%	6.8%	91%
Costanzo 2012 (b)	50.1	30	3	0	0%	0%	63%
Mayfield 2014 (d)	52	40	28	0	0%	0%	10%
Luna et al., 2013 (a)	52.7	30	15	0	0%	0%	18%
Juzwik 2021 (g)	56	30	216	0	0%	0%	1.4%
Juzwik 2021 (j)	56	30	1491	1	0.067%	0.016%	0.37%
Juzwik 2021 (i)	60	60	512	0	0%	0%	0.58%
Juzwik 2021 (l)	60	60	906	1	0.11%	0.027%	0.61%

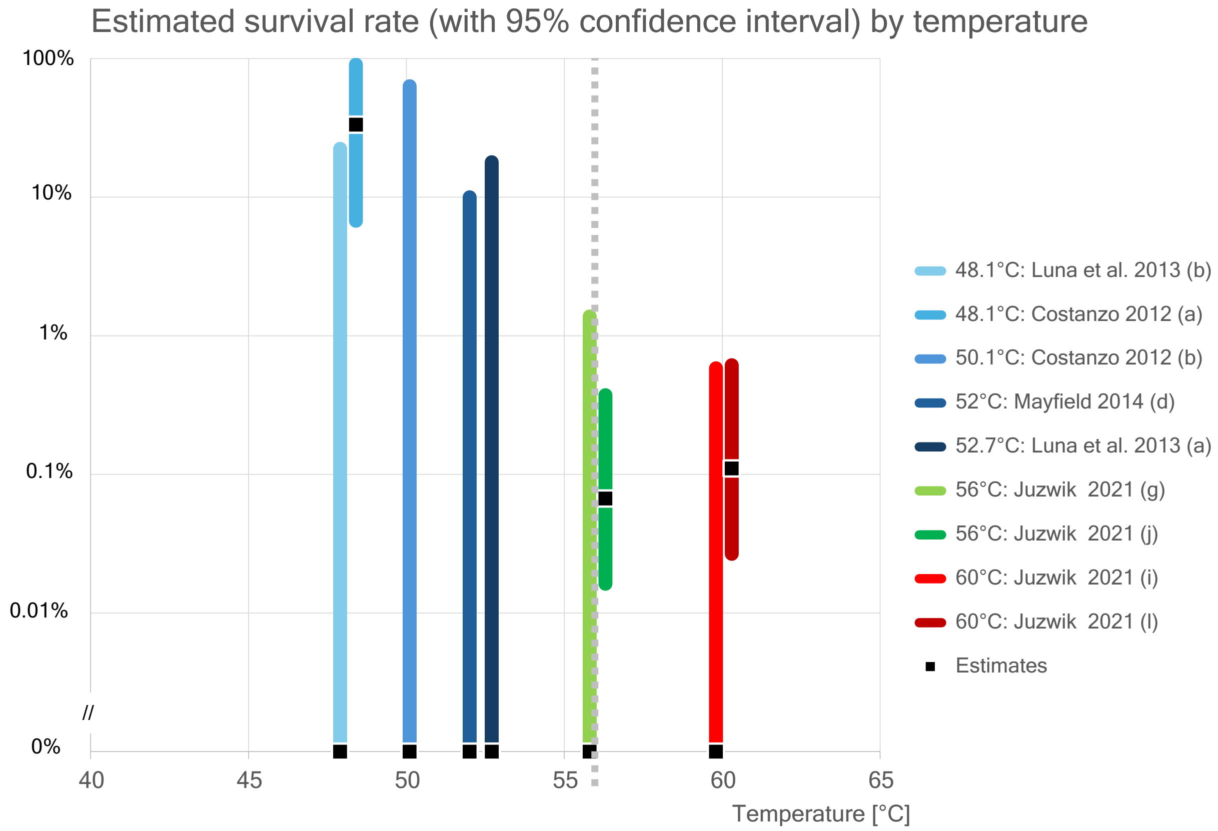


FIGURE 6 95% confidence intervals for the estimate of survival of *P. juglandis* for different temperatures in different studies. The interval starts at 0% (one-sided) in case no pest survived in the experiment; otherwise, the two-sided interval was calculated. Letters indicate the specific study reported in the reference.

7 | QUANTITATIVE ASSESSMENT OF THE PEST FREEDOM OF OAK AND WALNUT LOGS BASED ON THE EFFICACY OF THE TREATMENT

7.1 | EKE results

An EKE was performed for pest freedom of oak logs (*Q. alba* and *Q. rubra*) and walnut logs (*J. nigra*) treated as proposed by the applicant for *B. fagacearum*, *G. morbida* and *P. juglandis*. In addition, also other pest species potentially associated with the commodity were assessed with species representing groups of organisms colonising different depths of wood. An overview of the elicitations conducted for the different combinations of pests and commodity species and a description of the methodology followed are provided in Section 2.2.3.

Bark and sapwood-associated fungi and oomycetes (such as *C. parasitica*, *D. virescens*, *E. mammata*, *N. euwallaceae* and *P. ramorum*) are considered to be covered by the assessment of *B. fagacearum* and *G. morbida* and bark and sapwood-dwelling insects (such as *A. glabripennis*, *Pseudopityophthorus pruinosus*, *Pseudopityophthorus minutissimus*, *Euwallacea fornicatus sensu lato* and Scolytinae spp. (non-European)) are considered to be covered by *P. juglandis* and ambrosia beetles.

Insects which can inhabit the heartwood are represented by *A. minutus*.

Insects which are dwelling on the outer bark (such as *L. delicatula*, *L. japonica*) will not be able to survive the temperatures proposed in the treatment as they will be exposed to temperatures significantly higher than 56°C (see also Section 6.2). Therefore, this group of insects was not assessed further in the EKE.

The outcome of the EKE on pest freedom of oak logs (*Q. alba* and *Q. rubra*) and walnut logs (*J. nigra*) is presented in Table 12 and Figure 7.

Figure 8 provides an explanation of the descending distribution function describing the likelihood of pest freedom of *Quercus alba* logs produced in the US and treated with vacuum–steam–heat for *B. fagacearum*.

TABLE 12 Conclusion on the likelihood of pest freedom of logs of *Quercus rubra*, *Q. alba* and *Juglans nigra*.

Number	Group*	Pest species	Sometimes pest free	More often than not pest free	Frequently pest free	Very frequently pest free	Extremely frequently pest free	Pest free with some exceptional cases	Pest free with few exceptional cases	Almost always pest free
1		*Bretziella fagacearum*/*Q. rubra*			**L**	**M**				**U**
2		*Bretziella fagacearum*/*Q. alba*			**L**	**M**			**U**	
3		*Geosmithia morbida*/*J. nigra*				**L**		**M**		**U**
4		*Pityophthorus juglandis*/*J. nigra*					**L**		**M**	**U**
5		*Ambrosia beetles*/*all**				**L**	**M**	**U**		
6		*Arrhenodes minutus*/*Quercus*	**LMU**							
7		*Xylella fastidiosa*/all*					**L**	**M**		**U**

PANEL A
*Covers logs of all three tree species.

	Pest freedom category	Pest-free plants out of 10,000	Legend of marked pest freedom categories	
🟥	Sometimes pest free	< 5000	**L**	Pest freedom category includes the elicited lower bound of the 90% uncertainty range
🟧	More often than not pest free	5000–< 9000		
🟧	Frequently pest free	9000–< 9500	**M**	Pest freedom category includes the elicited median
🟨	Very frequently pest free	9500–< 9900		
🟨	Extremely frequently pest free	9900–< 9950	**U**	Pest freedom category includes the elicited upper bound of the 90% uncertainty range
🟩	Pest free with some exceptional cases	9950–< 9990		
🟩	Pest free with few exceptional cases	9990–< 9995		
🟩	Almost always pest free	9995–10,000		

PANEL B

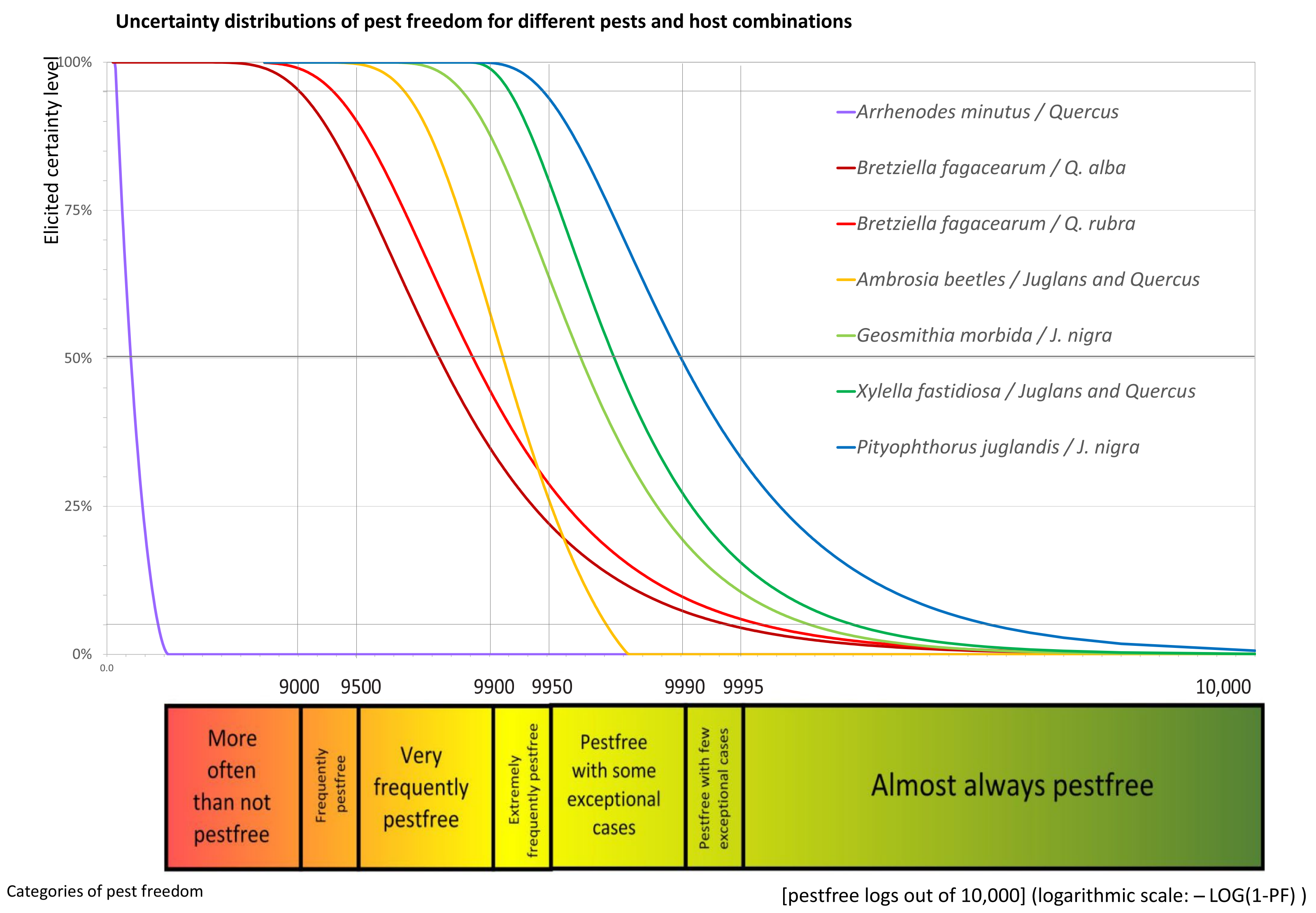


FIGURE 7 Elicited certainty (*y*-axis) of the number of pest-free oak and walnut logs (*x*-axis; log-scaled) out of 10,000 designated for export to the EU from the US for all evaluated pests visualised as descending distribution function. Horizontal lines indicate the reported certainty levels (starting from the bottom 5%, 25%, 50%, 75%, 95%) Please see the reading instructions below.

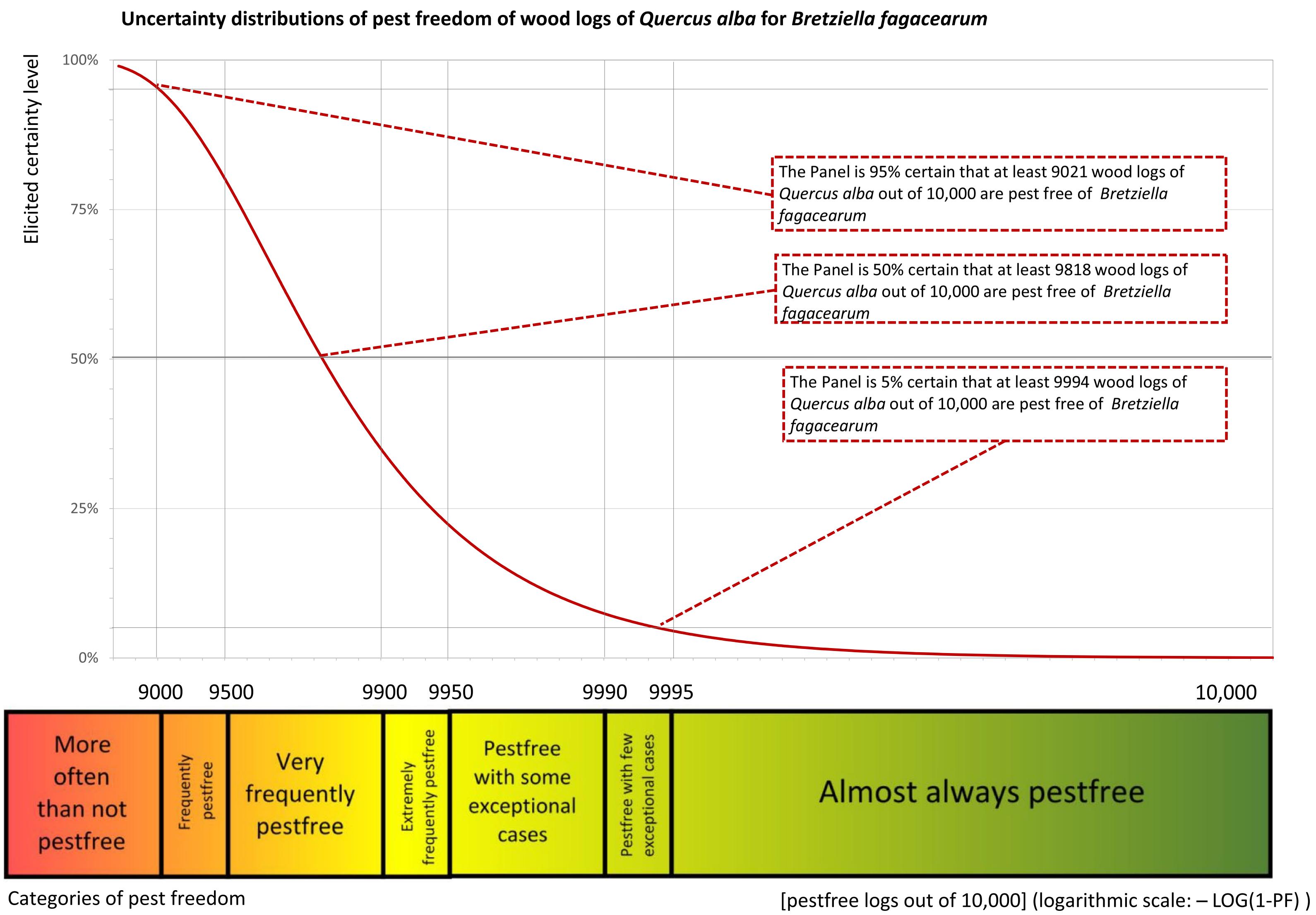


FIGURE 8 Explanation of the descending distribution function describing the likelihood of pest freedom of *Quercus alba* logs produced in the US and treated with vacuum-steam-heat for *Bretziella fagacearum*.

7.2 | Consideration of prevalence

Information on the prevalence of pests in the area of origin of the logs is important information for estimating the likelihood of pest freedom. However, this was not considered in the assessment because of the following reasons:

The applicant proposed the vacuum-steam-heat treatment as a stand-alone method without applying any other risk mitigation measures.

The information provided by the applicant country on the prevalence was not sufficient.

The information on prevalence provided by the applicant in Dosser Section 2 is included below for potential use by risk managers.

The maximum prevalence of *B. fagacearum* is 100% on *Q. rubra* and 15% on *Q. alba*.

The prevalence of *G. morbida* is low to very low, with an exception for plantations in Washington State where 80% of trees were affected. In natural forest stands in the eastern and southern US, the prevalence is considered very low or insignificant. Populations of *P. juglandis* collapsed in Ohio, Pennsylvania, Maryland and Virginia between 2013 and 2019, and no new detections were reported in southern states between 2012 and 2024.

Pityophthorus juglandis is currently occurring in 8% of the *J. nigra* range.

Quercus is a major host of *A. minutus*, but prevalence is not available for this species. In general, it is considered widespread but always at moderate or low density.

Maximum prevalence of *X. fastidiosa* in urban trees of *Q. rubra* was 15%; no information was available for *Q. alba*. *Juglans nigra* is not reported as a host.

8 | CONCLUSIONS

The efficacy of the vacuum steam treatment proposed by the US, to be used for *Q. alba* and *Q. rubra* against *B. fagacearum* and for *J. nigra* against *G. morbida* and *P. juglandis*, in mitigating the risk of introduction of Union quarantine pests was assessed. In addition to the above target pests, 14 other Union quarantine pests were identified as relevant for this opinion because they are present in the US and can potentially be associated with logs of *Q. alba* and/or *Q. rubra* and/or *J. nigra*. Some of these pests are regulated as groups of pests by Commission Implementing Regulation (EU) 2019/2072.

For the assessment of the treatment efficacy, the pests were grouped according to the depth of wood they can colonise. Insects which are dwelling on the outer bark (*L. japonica* and *L. delicatula*) will not be able to survive the temperatures proposed in the treatment as they will be significantly higher than 56°C. Therefore, this group of insects was not further assessed with an Expert Knowledge Elicitation (EKE).

The likelihood of pest freedom from *B. fagacearum* of infected and treated logs of *Q. alba* was estimated as 'very frequently pest free' with the 90% uncertainty range ranging from 'very frequently pest free' to 'pest free with some exceptional cases'. For infected and treated *Q. alba* logs, the EKE indicated with 95% certainty that between 9021 and 10,000 logs per 10,000 will be free from *B. fagacearum*. The likelihood of pest freedom from *B. fagacearum* of infected and treated logs of *Q. rubra* was estimated as 'very frequently pest free' with the 90% uncertainty range ranging from 'very frequently pest free' to 'pest free with some exceptional cases'. For infected and treated *Q. rubra* logs, the EKE indicated with 95% certainty that between 9347 and 10,000 logs per 10,000 will be free from *B. fagacearum*.

The likelihood of pest freedom from *G. morbida* of infected and treated logs of *J. nigra* was estimated as 'very frequently pest free' with the 90% uncertainty range ranging from 'very frequently pest free' to 'pest free with some exceptional cases'. For infected and treated *J. nigra* logs, the EKE indicated with 95% certainty that between 9862 and 10,000 logs per 10,000 will be free from *G. morbida*. The likelihood of pest freedom from *P. juglandis* of infested and treated logs of *J. nigra* was estimated as 'very frequently pest free' with the 90% uncertainty range ranging from 'very frequently pest free' to 'pest free with some exceptional cases'. For infested and treated *J. nigra* logs, the EKE indicated with 95% certainty that between 9948 and 10,000 will be free from *P. juglandis*.

The likelihood of pest freedom from ambrosia beetles of infested and treated logs of *Q. alba*, *Q. rubra* and *J. nigra* was estimated as 'very frequently pest free' with the 90% uncertainty range ranging from 'very frequently pest free' to 'pest free with some exceptional cases'. For infested and treated *Q. alba*, *Q. rubra* and *J. nigra* logs, the EKE indicated with 95% certainty that between 9723 and 10,000 logs per 10,000 will be free from ambrosia beetles.

The likelihood of pest freedom from *A. minutus* of infested and treated logs of *Q. alba* and *Q. rubra* was estimated as 'very frequently pest free' with the 90% uncertainty range ranging from 'very frequently pest free' to 'pest free with some exceptional cases'. For infested and treated *Q. alba* and *Q. rubra* logs, the EKE indicated with 95% certainty that between 1109 and 10,000 logs per 10,000 will be free from *A. minutus*.

The likelihood of pest freedom from *X. fastidiosa* of infected and treated logs of *Q. alba* and *Q. rubra* was estimated as 'very frequently pest free' with the 90% uncertainty range ranging from 'very frequently pest free' to 'pest free with some exceptional cases'. For infected and treated *Q. alba* and *Q. rubra* logs, the EKE indicated with 95% certainty that between 9921 and 10,000 logs per 10,000 will be free from *X. fastidiosa*. It should be noted that wood is considered a very unlikely pathway of entry of *X. fastidiosa* because xylem fluid-feeding insect vectors are not known to transfer the bacterium from detached wood to a host plant (EFSA PLH Panel, 2015).

Bark and sapwood-associated fungi or oomycetes such as *Cryphonectria parasitica, Davidsoniella virescens, Entoleuca mammata, Neocosmospora euwallacea* and *Phytophthora ramorum* were considered to be covered by the assessment of *B. fagacearum* and *G. morbida*.

Bark and sapwood-dwelling insects such as *Anoplophora glabripennis*, *Euwallacea fornicates sensu lato*, *Pseudopityophthorus minutissimus, Pseudopityophthorus pruinosus* and other Scolytinae species (non-European) were considered to be covered by the assessment conducted for *P. juglandis* and ambrosia beetles.

GLOSSARY

Control (of a pest)	Suppression, containment or eradication of a pest population (FAO, 2024a, 2024b).
Entry (of a pest)	Movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled (FAO, 2024b).
Establishment (of a pest)	Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO, 2024b).
Impact (of a pest)	The impact of the pest on the crop output and quality and on the environment in the occupied spatial units.
Introduction (of a pest)	The entry of a pest resulting in its establishment (FAO, 2024b).
Measures	Control (of a pest) is defined in ISPM 5 (FAO, 2024b) as 'Suppression, containment or eradication of a pest population' (FAO, 2024a). Control measures are measures that have a direct effect on pest abundance. Supporting measures are organisational measures or procedures supporting the choice of appropriate risk mitigation measures that do not directly affect pest abundance.
Pathway	Any means that allows the entry or spread of a pest (FAO, 2024b).
Phytosanitary measures	Any legislation, regulation or official procedure having the purpose to prevent the introduction or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests (FAO, 2024b).
Quarantine pest	A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled (FAO, 2024b).
Spread (of a pest)	Expansion of the geographical distribution of a pest within an area (FAO, 2024b).

ABBREVIATIONS

EKE	Expert Knowledge Elicitation
EPPO	European and Mediterranean Plant Protection Organization
FAO	Food and Agriculture Organisation
ISPM	International Standards for Phytosanitary Measures
PLH	Plant Health
TCD	Thousand Cankers Disease
USDA APHIS	Animal and Plant Health Inspection Service of United States Department of Agriculture
WTB	Walnut Twig Beetle

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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APPENDIX A

Pest data sheets

A.1 | AMBROSIA BEETLES

A.1.1 | Organism information

Taxonomic information	Order: Coleoptera Family: Curculionidae Common name: Ambrosia beetles Name used in the Dossier: – Note: 'Ambrosia beetles' is not a taxonomic designation; it refers to an ecological subgroup of fungus-farming beetles in the subfamilies Scolytinae and Platypodinae.
Group	Insects
EPPO code	1SCOLS (Scolytinae) 1PLATS (Platypodinae)
Regulated status	All the non-European species of ambrosia beetles are quarantine pests cumulatively included in the Annex II/A of the Commission Implementing Regulation (EU) 2019/2072 as Scolytinae spp. (non-European) [1SCOLF]), together with the non-European species of bark beetles. Scolytinae are also in the A1 list of Switzerland (EPPO, 2025h). Platypodinae are neither regulated in the EU, nor anywhere in the world.
Pest status in the US	Under the name 'ambrosia beetles', about 2100 species of Scolytinae and 1400 species of Platypodinae are listed; they are present worldwide but mostly in the tropics, living in the xylem of both conifer and deciduous trees and shrubs (Grousset et al., 2020). Ambrosia beetles are widespread in all the US with both native and non-native species, most of them belonging to the tribes Xyleborini, Corthylini and Xyloterini. According to Wood and Bright (1992), there are at least 60 species of Xyleborini, 7 of Xyloterini, 18 Corthylini in North America. Eight species of Platypodinae are known in the US, seven of them native (Jordal, 2014; Šenfeldová et al., 2024).
Pest status in the EU	Ambrosia beetles are currently present in the EU with nine species (5 Xyleborini and 4 Xyloterini) native and 19 species of non-native Scolytinae. Platypodinae include four species (3 introduced) (Barnouin et al., 2020; Colombari et al., 2022; EFSA PLH Panel, 2024b; Faccoli, 2015; Kirkendall & Faccoli, 2010; Knizek & Smith, 2024; Marchioro et al., 2022; Ruzzier et al., 2022). Native ambrosia beetles are widely distributed in all the EU MS, whereas the introduced species have generally a more limited distribution, often restricted at entry points or nearby regions.
Host status on *Quercus*/*Juglans*	Ambrosia beetles primarily feed on their fungal symbionts inside the wood of host plants and include a large number of polyphagous species mainly attacking broadleaf trees (Hulcr & Skelton, 2023), among these oaks and walnuts. According to Marchioro, Vallotto, et al. (2024); Marchioro, Besana, et al. (2024) and Ruzzier et al. (2023), *Quercus* is host for 162 and *Juglans* for 32 species of ambrosia beetles in the world.
Asymptomatic plants	The life cycle of ambrosia beetles takes place within the xylem of host plants, not only in the trunk but also in small branches or roots, so that external symptoms can be difficult to detect. Entry/exit holes are small and frass or sawdust may not be noticed or washed away by rain and wind. Only a few species produce a sort of small white 'noodles' protruding from the penetration hole. Since the xylem is colonised, plants may show delayed symptoms of decline and thus be asymptomatic.
Association with wood	Out of the dispersal phase, ambrosia beetles spend their life inside the sapwood of stressed/dying trees and logs, where they bore tunnels to feed and reproduce. Spores of symbiont fungi primarily from the genera *Ambrosiella, Fusarium, Raffaelea Meredithiella*, *Phialophoropsis* and *Dryadomyces* (Hulcr & Stelinski, 2017; Kirisits, 2004) are carried in the mycangia and the gut of adults; they germinate on the walls of galleries and the mycelium provides food for both adult beetles and developing larvae. Depending on the species, the length of the tunnels can vary from a few cm to 1.4 m (Smith & Hulcr, 2015), so that many ambrosia beetle species are known to cause relevant loss of value of round wood (Grousset et al., 2020). Given the life cycle and voltinism, ambrosia beetles can also be found on wood commodities, including wood packaging material and chips, with the exception of bark, sawdust and processed wood, such as furniture (EPPO, 2020b).
Temperature survival	Like in bark beetles, the development of ambrosia beetles generally occurs in a range from 5°C to 10°C and 25°C to 30°C (Sauvard, 2004). However, since they spend most of their life cycle inside trees, ambrosia beetles can benefit much more than bark beetles from the thermal buffering provided by wood, which depends on several factors such as diameter, side of the trunk, tissue moisture, depth of galleries and others (Formby et al., 2017; Umeda & Paine, 2019). Survival temperatures of ambrosia beetles have been investigated only for a few species and mostly under laboratory conditions. Cold tolerance varies from −10°C (lower lethal temperature) to −22°C (supercooling point); however, also at −5°C up to 100% larvae, 95.7% pupae and 69.2% adults can be killed (Dzurenko et al., 2022, citing Formby et al. (2013) and Cooperband et al. (2016)). As of survival at high temperatures, 32°C seems to be a critical threshold beyond which mortality in eggs-to-larvae and larvae-to-pupae transitions show a distinctive trend of declining survival, whereas a relevant increasing survival rate is observed in the transition from pupae-to-adults (Rojano et al., 2021). However, ambrosia beetle adults do not survive over 50–58°C in laboratory tests (Noseworthy et al., 2023; Suh, 2014).
Size at different life stages	Even more than bark beetles, ambrosia beetles are very small insects in all stages of development. Besides, the individual body size in the two groups is also more variable as a consequence of the more much variability of tree tissues than fungal food (Hulcr et al., 2015). The sizes of Xyleborini are well representative for the group. Eggs are approximately 0.5–1 mm long; larvae up to 2.0 mm in length; pupae 2.0–2.7 mm and adults 0.8–4.0 mm in length, with males usually much smaller than females and flightless or enable to fly.

A.2 | *ANOPLOPHORA GLABRIPENNIS*

A.2.1 | Organism information

Taxonomic information	Current valid scientific name: *Anoplophora glabripennis* Synonyms: – Name used in the EU legislation: *Anoplophora glabripennis* (Motschulsky) [ANOLGL] Order: Coleoptera Family: Cerambycidae Common name: Asian longhorn beetle, Asian long-horned beetle, ALB, basicosta white-spotted longicorn beetle starry sky beetle Name used in the Dossier: *Anoplophora glabripennis*
Group	Insects
EPPO code	ANOLGL
Regulated status	*Anoplophora glabripennis* is listed in the Annex II/B of the Commission Implementing Regulation (EU) 2019/2072 as *Anoplophora glabripennis* (Motschulsky) [ANOLGL] and as a priority pest by Commission Delegated Regulation (EU) 2019/1702. There are in place emergency measures in Implementing Decision 2015/893/EU. *Anoplophora glabripennis* is quarantine pest for Morocco, the US, Moldova and Norway (EPPO, 2025i). *Anoplophora glabripennis* is included in the EPPO A2 and in the A1 list of Iran, Kazakhstan, Azerbaijan Georgia, Russian Federation, Serbia, Switzerland, Türkiye, Ukraine, the UK and the EAEU (Armenia, Belarus, Kazakhstan, Kyrgyz Republic and the Russian federation) (EPPO, 2025i).
Pest status in the US	*Anoplophora glabripennis* is native to Asia and introduced in the eastern US, where after several successful eradication programs it is however still present with restricted distribution and few occurrences in Massachusetts, New York, Ohio and South Carolina (EPPO, 2025j).
Pest status in the EU	In the EU, *A. glabripennis* is present with restricted distribution in France (eradicated in Corse), Germany (transient under eradication) and Italy (Marche, Lombardia and Piemonte, under eradication) (EPPO, 2025j).
Host status on *Quercus*/*Juglans*	*Anoplophora glabripennis* is a highly polyphagous pest. However, in a recent exhaustive list of 66 tree host species of *A. glabripennis* (EFSA, 2025b) the genus *Quercus* is reported only with two Nearctic species: *Q. alba* and *Q. rubra*. In the same list *Juglans* is not included as host of *A. glabripennis*. No other data is available in the literature. One record of oviposition on *Quercus palustris* observed in New York has been considered incidental to heavy damage on nearby hosts (Wang, 2015). *Quercus alba* and *Q. rubra* are listed as occasional or potential hosts (EFSA, 2025b; Morewood et al., 2003) since there is no evidence they support the complete development of *A. glabripennis* in the field (Turgeon et al., 2022; van der Gaag & Loomans, 2014). Under laboratory conditions, Hoover et al. (2003) and Morewood et al. (2003) and Morewood et al. (2005) reported oviposition of viable eggs on both *Quercus alba* and *Q. rubra*, with survival of 1st instar larvae of 87% and 39% respectively. After manual insertion, larval survival of 67% for 90 days was recorded on *Q. rubra*. However, it was not possible to observe the development up to the adult stage.
Asymptomatic plants	No evidence that infested plants can be asymptomatic. However, early infestation on mature plants only shows little symptoms which may be undetected.
Association with wood	Depending on climate and host suitability, *A. glabripennis* has a 1- to 3-year life cycle with frequent overlapping generations and the presence of different developing stages from eggs to mature larvae in a same tree. Young larvae initially feed in the phloem of trunk and branches excavating short galleries in the cambium. Fully grown larvae bore oval-shaped tunnels first in the sapwood and then deeply in the heartwood. Pupation takes place in the external (i.e. terminal) part of a tunnel bored in the wood by mature larvae from which adults finally emerge through a circular exit holes 10–15 mm in diameter, with size smaller in males than females (EFSA, 2019, 2025b). Although the main damage caused by *A. glabripennis* is the decline and finally the death of infested trees, larval feeding also reduces wood quality. In urban parks and gardens where the species mainly infests ornamental trees, the economic impact of the infestation may be extremely relevant (Faccoli & Gatto, 2016) Besides, given the long duration of life cycle, the pest is frequently intercepted in wood packaging material at ports of entry (Haack et al., 2010; Krishnankutty et al., 2020).
Temperature survival	Studies on cold tolerance of overwintering stages of *A. glabripennis* showed supercooling points of −25.8°C for eggs and −25°C for larvae (Torson et al., 2021). Survival of *A. glabripennis* at different development stages and temperatures have been studied by Keena (2006) and Keena and Moore (2010). The range for optimal activity of adult beetles (feeding, mating, oviposition) is 15–25°C. The lower threshold for median longevity was −2°C for males and −3°C for females, the upper one 38°C and 39°C. As for the eggs, the lower and upper thresholds for hatching were 12°C and 34°C, respectively (Keena, 2006). The lower temperature for the development of larvae and pupae was 10°C. Over 30°C, the development of all instars progressively decreases and stops at 40°C (Keena & Moore, 2010). This threshold is consistent with the results of heat treatments of logs, which show that at 56°C for 30 min (ISPM 15 standard) all overwintering larvae of *A. glabripennis* are killed (Myers & Bailey, 2011).
Size at different life stages	Eggs are 5–7 mm in size. Young larvae are about 5 mm long; mature larvae are from 30 to 60 mm and pupa 30–37 mm (EFSA, 2019). Body length of adult's ranges from 17 to 40 mm (Haack et al., 2010).

A.3 | *ARRHENODES MINUTUS*

A.3.1 | Organism information

Taxonomic information	Current valid scientific name: *Arrhenodes minutus* Synonyms: *Arrhenodes minuta, Arrenodes minutus, Brentus brunneus, Brentus minutus, Brentus mucillosus, Brentus septentrionis, Curculio minutus, Eupsalis lecontei, Eupsalis minuta, Eupsalis sallei, Platysystrophus minutus* Name used in the EU legislation: *Arrhenodes minutus* Drury [ARRHMI] Order: Coleoptera Family: Brentidae Common name: oak timberworm Name used in the Dossier: *Arrhenodes minutus*
Group	Insects
EPPO code	ARRHMI
Regulated status	*Arrhenodes minutus* is listed as quarantine pest in the Annex II/A of the Commission Implementing Regulation (EU) 2019/2072 as *Arrhenodes minutus* Drury [ARRHMI]. *Arrhenodes minutus* is a quarantine pest in Moldova and included in the A1 list of Georgia, Serbia, Switzerland, Türkiye and the UK (EPPO, 2025k).
Pest status in the US	*Arrhenodes minutus* is native to North America; in the US, it is found in 26 eastern and central states: Arkansas, Florida, Illinois, Indiana, Kentucky, Louisiana, Maine, Manitoba, Maryland, Massachusetts. Michigan, Minnesota, Missouri, Nebraska, New Hampshire, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, Texas, Virginia, West Virginia, Wisconsin (EPPO, 2024a; Wrigley & Arendse, 2022).
Pest status in the EU	*Arrhenodes minutus* is absent from the EU territory (EPPO, 2022, 2024a). An individual *Arrhenodes minutus* was intercepted in France in 2005 in a shipment of oak wood (*Q. alba*) from the US, it has not established in Europe (EFSA PLH Panel, 2019b).
Host status on *Quercus/Juglans*	*Arrhenodes minutus* is known to feed and reproduce mostly on *Quercus* spp. Specifically, 9 species of *Quercus* are main hosts of the pest: *Quercus alba, Q. coccinea, Q. falcata, Q. michauxii, Q. muehlenbergii, Q. nigra, Q. rubra, Q. shumardii* and *Q. velutina* (EFSA, 2023b; EPPO, 2025l; Ulyshen & Hanula, 2009). *Quercus coccinea* and *Q. velutina* are the more susceptible species (EFSA, 2023b). *Fagus, Populus* and *Ulmus* are hosts too according to EFSA (2023b) and EPPO (2025l). Potential hosts (on which it is unknown whether the beetle can complete its life cycle) are *Acer* spp., *Acer negundo, A. rubrum, Betula papyrifera, Castanea* spp., *Gleditsia triacanthos, Liquidambar styraciflua, Pinus* sp. and *Tilia americana* (EFSA, 2023b; EFSA PLH Panel, 2019; EPPO, 2022). According to EFSA (2023b), potential hosts might be considered in surveys after a possible detection in the EU. No evidence was found to date that *Juglans* species are hosts of *A. minutus*.
Asymptomatic plants	Symptoms of larval feeding inside the wood are quite typical (see Section called: Association with wood) and mostly concern decaying or recently dead plants. No information on asymptomatic plants is available.
Association with wood	*Arrhenodes minutus* is the sole species in the genus *Arrhenodes* (EPPO, 2022). It is a primitive wood boring weevil falling in the category of saproxylic beetles (Ulyshen & Hanula, 2009). However, *A. minutus* is also known causing serious damage to timber, and it is suspected to be vector of Oak Wilt Disease caused by the fungus *Bretziella fagacearum* (Microascales, Ceratocystidaceae) (EFSA, 2023b). The adults of *A. minutus* feed on sap leaking from fresh wounds on healthy trees, logs and stumps, as well as snags and weakened trees. However, the beetles may be attracted also by freshly squared wood (EFSA, 2023b). Females lay eggs on both standing trees and fresh logs from 14 to 47 cm diameter. The growing larvae bore long tunnels into the xylem, progressively enlarging from 0.2 to 4.0 mm diameter. The larval galleries are transversal and have a typical U-shaped progress to the opposite side of trunk and then backwards to the entry point, where pupation occurs. Adults emerge from their entry holes. Intense tunnelling often makes the wood unmerchantable. 2–4 years are needed to complete the life cycle, so that adults may emerge from wooden furniture (EFSA, 2023b; Majka et al., 2007).
Temperature survival	No specific information on temperature survival of *A. minutus* was found. Since larvae develop deeper into the wood than other wood boring beetles, lethal temperatures observed for Cerambycidae, Buprestidae, Curculionidae or ambrosia beetles (Haack & Petrice, 2022; Noseworthy et al., 2023) might be not reliable.
Size at different life stages	Eggs: < 1 mm, spherical; mature larvae 12–24 mm long; pupa 10 mm; adults 4–35 mm, very elongate (EPPO, 2022).

A.4 | BARK BEETLES

A.4.1 | Organism information

Taxonomic information	Order: Coleoptera Family: Curculionidae Common name: Bark beetles Name used in the Dossier: –
Group	Insects
EPPO code	1SCOLS (Scolytinae)

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Regulated status	All the non-European species of bark beetles are cumulatively listed as quarantine pests in the Annex II/A of the Commission Implementing Regulation (EU) 2019/2072 under the designation Scolytinae spp. (non-European) [1SCOLF]), that also includes the non-European species of ambrosia beetles. Scolytinae are also in the A1 list of Switzerland (EPPO, 2025h).
Pest status in the US	Most members of the subfamily Scolytinae are bark beetles (about 3900 species) widely distributed in tropical, subtropical and temperate regions and reproducing under the bark of both conifer and broadleaf trees and shrubs. Considering that 578 species of bark and ambrosia beetles are found in the US (Atkinson, 2025), at least 53 of them are ambrosia beetles (Gomez et al., 2018) and 25 of the remaining species are known as important pests of conifers (Fettig & Audley, 2021), a number from 450 to 500 species of bark beetles reproducing on broadleaf trees in the US may be estimated.
Pest status in the EU	There are about 190 native species of bark beetles present in the EU (Pfeffer, 1995), 15 of them living on deciduous trees (Faccoli, 2015). Three other non-native species have recently been introduced, one of them feeding on a broadleaf host (EFSA PLH Panel, 2024b).
Host status on *Quercus/Juglans*	Bark beetles mostly include oligophagous species and only a few taxa depend on a single food source. According to Marchioro, Vallotto, et al. (2024); Marchioro, Besana, et al. (2024) *Quercus* is host for 118 and *Juglans* for 33 bark beetle species worldwide.
Asymptomatic plants	Bark beetles use the phloem tissues as a both food source and breeding substrate. Maternal and larval galleries form mating systems that often show specific patterns; the galleries spread over large parts of bark, destroying the phloem and cambium and causing disruption of water transport which rapidly leads to the death of trees. In many species of bark beetles, symbiotic fungi carried by adult beetles further accelerate the decline. Several typical symptoms, as entry holes, sawdust, resin and exudates emissions, may be observed on stems and branches of infested trees, whereas the onset of symptoms to the crown (discoloration, cast of leaves/needles, shoot wilting) is usually delayed. Asymptomatic plants are rarely observed only in the very early stages of attack.
Association with wood	Living in the inner bark of trees, bark beetles only slightly engrave the outer part of wood. However, they often carry symbiotic blue-staining fungi (mostly in the order Ophiostomatales) causing discoloration and significant loss of value of timber. This association is much more frequent in conifer than in broadleaf trees (Jankowiak et al., 2019; Kirisits, 2004) where blue-stain fungi rather cause vascular diseases also resulting in wood discoloration (Kirisits, 2004).
Temperature survival	The development of bark beetles generally occurs in a range from 5°C to 10°C and 25–30°C (Sauvard, 2004). Spending a large part of their life cycle beneath the bark of trees, bark beetles are generally more exposed to low temperatures than ambrosia beetles which live inside the wood making a better use of thermal buffering. However, cold tolerance may vary considerably according to species and their latitudinal distribution, as well as the life stage, the season and the overwintering microhabitats (the tree or the litter) (Lombardero et al., 2000; Sauvard, 2004). Cold hardiness has been studied most in conifer bark beetles, showing that lethal temperatures range from −12°C to −23°C for adult beetles and from −5°C to −12°C for immatures (Hefty et al., 2017; Koštál et al., 2011; Lombardero et al., 2000); however, adults of some species can survive at −26°C for 12 h (Koštál et al., 2014). Survival at low temperatures in larvae of some hardwood bark beetles seems to be higher, since they can survive at −19°C (Hansen & Somme, 1994) and this suggests that adult survival is likely at lower temperatures. Thermal tolerance to high temperatures is between 42.2°C and 47.6°C depending on life stage, with 100% mortality at 45.8, 47.6, 42.2 and 44.0°C for eggs, larvae, pupae and adults respectively (Pawson et al., 2019).
Size at different life stages	Like ambrosia beetles, bark beetles are small-sized insects; however, the body size of the latter is more variable as a consequence of the more much variability of tree tissues, mostly the bark thickness (Hulcr et al., 2015). According to Hulcr et al. (2015) most bark beetles vary in size from about 0.5 and 10 mm in length in all stages of development, with most species ranging from 1 to 4 mm long.

A.5 | *CRYPHONECTRIA PARASITICA*

A.5.1 | Organism information

Taxonomic information	Current valid scientific name: *Cryphonectria parasitica* Synonyms: *Diaporthe parasitica*, *Endothia gyrosa* var. *parasitica*, *Endothia parasitica*, *Valsonectria parasitica* (according to Index Fungorum, 2025) Name used in the EU legislation: *Cryphonectria parasitica* (Murrill) Barr [ENDOPA] Order: Diaporthales Family: Cryphonectriaceae Common name: blight of chestnut, blight of oak, canker of chestnut, chestnut blight, sweet chestnut blight Name used in the Dossier: *Cryphonectria parasitica*
Group	Fungi
EPPO code	ENDOPA

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Regulated status	The pathogen is listed in Annex III and in Annex VI of Commission Implementing Regulation (EU) 2019/2072 as *Cryphonectria parasitica* (Murrill) Barr. [ENDOPA]. It is EU protected zone quarantine pests of Ireland, Sweden and the UK (Northern Ireland) and also RNQP (Regulated non-quarantine pest) for plants for planting other than seeds of *Castanea*. *Cryphonectria parasitica* is a quarantine pest in Israel, Morocco, Norway, Serbia and the US (EPPO, 2025m). *Cryphonectria parasitica* is included in the EPPO A2 and in the A2 list of Jordan, Türkiye and COSAVE (Comite de Sanidad Vegetal del Cono Sur – Argentina, Brazil, Chile, Paraguay, Peru and Uruguay). It is also reported on A1 list of Argentina, Azerbaijan, Chile, Iran, the UK and IAPSC (Inter-African Phytosanitary Council) (EPPO, 2025m).
Pest status in the US	*Cryphonectria parasitica* is present in the US (Anagnostakis, 1987; Anagnostakis & Hillman, 1992; EPPO, 2025n; Farr & Rossman, 2025; Griffin, 1986; MyCoPortal, 2025). The pathogen is reported from these states: Alabama, Arkansas, California, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Mississippi, Nebraska, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Vermont, Virginia, Washington, West Virginia and Wisconsin (EPPO, 2025n; MyCoPortal, 2025). *Cryphonectria parasitica* was introduced into the US from East Asia at the end of 19th century. The pathogen was identified for the first time in New York City in 1904 on *Castanea dentata* and then rapidly spread throughout the US. It caused huge damage on chestnut trees (Anagnostakis, 1987; Anagnostakis & Hillman, 1992; Griffin, 1986). No prevalence data are available for *C. parasitica* on *Q. alba*. In forest stands with *Castanea dentata*, the prevalence can reach 100% (Dossier Section 2).
Pest status in the EU	*Cryphonectria parasitica* is present in the EU (EFSA PLH Panel, 2016; EPPO, 2025n; Farr & Rossman, 2025; MyCoPortal, 2025). It is present in Croatia, Italy, and Portugal. It has restricted distribution in Austria, Belgium, Bulgaria, France, Germany, Greece, Hungary, Romania, Slovakia, Slovenia and Spain. The pathogen is present with few occurrences in Czechia and the Netherlands. In Poland, the pathogen was eradicated (EPPO, 2025n). Different areas in the EU have different strains of *C. parasitica*, the ability of new strains to spread in areas already infected by other strains seems to be very limited (EFSA PLH Panel, 2016).
Host status on *Quercus/Juglans*	Among oaks the known hosts of *C. parasitica* are *Quercus alba, Q. coccinea, Q. frainetto, Q. ilex, Q. montana, Q. petraea, Q. prinus, Q. pubescens, Q. stellata, Q. suber, Q. velutina* and *Q. virginiana* (EPPO, 2025o; Farr & Rossman, 2025; Rigling & Prospero, 2018). In the US, these oak species were found infected by the pathogen: *Quercus alba, Q. coccinea, Q. prinus, Q. stellata, Q. velutina* and *Q. virginiana* (Farr & Rossman, 2025). Both field observations and inoculation experiments have shown that European oak species are less susceptible to *C. parasitica* compared to *Castanea sativa*, the main host in Europe (Dennert et al., 2020; Rigling & Prospero, 2018). There is no information on whether *C. parasitica* can also attack *Juglans*.
Asymptomatic plants	Endophytic behaviour of *C. parasitica* has been reported in young chestnut shoots (Bissegger & Sieber, 1994) and imported chestnut plants that developed symptoms after 16 months of post- entry quarantine (Cunnington & Pascoe, 2003).
Association with wood	*Cryphonectria parasitica* is a canker pathogen that infects the bark and cambium and partially also the sapwood underneath the bark and cambium infections (EFSA PLH Panel, 2016; EPPO, 2005).
Temperature survival	Jaynes and DePalma (1984) reported that mycelial growth of *C. parasitica* was impaired at temperature of 50°C or higher. Mycelium grown on agar medium was completely killed after exposure to a temperature of 56°C or higher for 20–30 min. Survival of conidia was affected at temperature of 50°C or higher, but some conidia survived after being incubated at 60°C for 30 min (Jaynes & DePalma, 1984).
Ability to create resting propagules/ chlamydospores	*Cryphonectria parasitica* does not create resting propagules or chlamydospores. *Cryphonectria parasitica* forms stromata in which asexual conidia are produced in pycnidia and sexual ascospores in perithecia (Rigling & Prospero, 2018).

A.6 | *DAVIDSONIELLA VIRESCENS*

A.6.1 | Organism information

Taxonomic information	Current valid scientific name: *Davidsoniella virescens* Synonyms: *Ceratocystis virescens*, *Endoconidiophora virescens*, *Ophiostoma virescens* (According to Index Fungorum, 2025) Name used in the EU legislation: *Davidsoniella virescens* (R.W. Davidson) Z.W. de Beer, T.A. Duong & M.J. Wingfield [CERAVI] Order: Microascales Family: Ceratocystidaceae Common name: sapstreak disease of maple, sapstreak disease of sugar maple Name used in the Dossier: *Davidsoniella virescens*
Group	Fungi
EPPO code	CERAVI
Regulated status	The pest is listed in Annex II of Regulation (EU) 2019/2072 as *Davidsoniella virescens* (R.W. Davidson) Z.W. de Beer, T.A. Duong & M.J. Wingfield [CERAVI]. The pathogen is quarantine pest in Israel and Tunisia. It is on the A1 list of Serbia, Switzerland, Türkiye and the UK (EPPO, 2025p).

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Pest status in the US	*Davidsoniella virescens* is native to North America and was reported for the first time in 1935 infecting *Acer saccharum* in North Carolina (Hepting, 1944; Kessler, 1972). The pathogen is present in the US (EPPO, 2025q; Farr & Rossman, 2025; MyCoPortal, 2025) and was reported in these states: Michigan (EPPO, 2025q; Kessler, 1972; Kessler Jr & Anderson, 1960; MyCoPortal, 2025; Richter, 2012), New York (Beil & Kessler, 1979; EPPO, 2025q; Houston, 1994), North Carolina (EPPO, 2025q; Hepting, 1944; Kessler, 1972; MyCoPortal, 2025; Roth et al., 1959), Vermont (EPPO, 2025q; Kessler, 1972), Tennessee (Kessler, 1972; Roth et al., 1959), and Wisconsin (EPPO, 2025q; Kessler, 1972).
Pest status in the EU	*Davidsoniella virescens* was recently detected in Poland on *Fagus sylvatica* (EPPO, 2025q; Kowalski & Bilański, 2024).
Host status on *Quercus/Juglans*	*Davidsoniella virescens* was reported to be pathogenic and saprophytic on different plant species. Harrington et al. (1998) detected that these two groups are different based on fingerprint nuclear markers. The pathogenicity was only confirmed for *Acer saccharum* (Hepting, 1944) and *Liriodendron tulipifera* (Kessler, 1972; Roth et al., 1959). According to Kessler (1972), the fungus often grows as saprophyte on cut logs and stumps. *Davidsoniella virescens* was found on green sapwood of hardwood logs and lumber of *Quercus* spp. (Davidson, 1944) and on *Quercus robur* (van Wyk et al., 2011). However, there is no evidence of damage on these plant species. There is no information on whether *D. virescens* can also attack *Juglans*.
Asymptomatic plants	No specific information on the presence of asymptomatic plants was found.
Association with wood	*Davidsoniella virescens* causes a vascular xylem disease (Houston, 1994). The fungus enters the tree mainly through wounds on the base of trunk or roots (Kessler, 1972), which could be caused by human activities such as logging, road building and sap hauling. The disease rarely occurs in nonwounded trees, by entering the tree through root-graft transmission. Moreover, there were no observed cases of infection through broken branches or other wounds of upper crowns or stems (Houston, 1994). The inoculum is believed to be brought to wounds by sap-feeding insects (Sinclair & Lyon, 2005). The fungus spreads rapidly in the sapwood, where it develops water-soaked lesions in the lower trunk and the roots (Hepting, 1944; Houston, 1994; Kessler, 1972). Sometimes, it also extends to the cambium (Hepting, 1944; Ohman & Spike, 1966). Experiments by Houston (1986) have shown that *D. virescens* can survive in infected wood for several months. The pathogen was infrequently isolated from air-dried felled wood (cut into boards) after 2 months (with moisture content of about 20%) from surface mycelium and after 5 months (with moisture content below 15%) from stained wood. Susceptible wood (EFSA PLH Panel, 2017a; Webber, 2008) and wood products (Webber, 2008) are possible pathways of entry of *D. virescens*.
Temperature survival	There is no information regarding lethal temperatures for this pathogen. According to EFSA PLH Panel (2024a), 'the extrapolation may be possible from information available for other fungal species. Given its biology and life-history traits, it is not expected that *D. virescens* is exceptionally thermotolerant. Temperatures of 56°C for 30 min (Juzwik et al., 2019) and 49°C (Jones, 1973) were lethal for phylogenetically related *Ceratocystis* species.'
Ability to create resting propagules/ chlamydospores	*Davidsoniella virescens* has two types of spores: (1) endoconidia (asexual) and (2) ascospores (sexual) (Davidson, 1944). There is no indication that the fungus can create resting propagules or chlamydospores.

A.7 | *ENTOLEUCA MAMMATA*

A.7.1 | Organism information

Taxonomic information	Current valid scientific name: *Entoleuca mammata* Synonyms: *Anthostoma blakei, Anthostoma morsei, Fuckelia morsei, Hypoxylon blakei, Hypoxylon holwayi, Hypoxylon mammatum, Hypoxylon morsei, Hypoxylon pauperatum, Hypoxylon pruinatum, Nemania mammata, Rosellinia pruinata, Sphaeria mammata, Sphaeria pruinata* (according to Index Fungorum, 2025) Name used in the EU legislation: *Entoleuca mammata* (Wahlenb.) Rogers and Ju Order: Xylariales Family: Xylariaceae Common name: canker of aspen, canker of poplar, hypoxylon canker of poplar Name used in the Dossier: *Entoleuca mammata*
Group	Fungi
EPPO code	HYPOMA
Regulated status	*Entoleuca mammata* is listed in Annex III of Commission Implementing Regulation (EU) 2019/2072 as protected zone quarantine pest for Ireland. The pathogen is quarantine pest in China and Israel. It is on the A1 list of Türkiye (EPPO, 2025r).
Pest status in the US	*Entoleuca mammata* is present in the US (Anonymous, 1960; EPPO, 2023c; Farr & Rossman, 2025; Farr & Rossman, 2025 citing Goos, 2010; Hawksworth, 1972; MyCoPortal, 2025). The pathogen is reported from these states: Alabama, Alaska, Arizona, California, Colorado, Connecticut, Idaho, Illinois, Indiana, Iowa, Maine, Massachusetts, Michigan, Minnesota, Missouri, Montana, New England, New Hampshire, New Mexico, New York, North Carolina, North Dakota, Ohio, Oregon, Pennsylvania, South Dakota, Vermont, Washington, Wisconsin, Wyoming (EPPO, 2023c; MyCoPortal, 2025). *Entoleuca mammata* is thought to be native to North America and was introduced into Europe several centuries ago (Kasanen et al., 2004).

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Pest status in the EU	*Entoleuca mammata* is currently present in the EU in 20 MS: Austria, Belgium, Croatia, Czechia, Finland, France, Germany, Greece, Italy, Lithuania, Netherlands, Slovakia, Slovenia, Sweden (EFSA PLH Panel, 2017b); Denmark (GBIF, 2025); Estonia (Lutter et al., 2019) Latvia (Zeps et al., 2016); Poland, Spain (Farr & Rossman, 2025) and Portugal (MyCoPortal, 2025).
Host status on *Quercus/Juglans*	*Entoleuca mammata* was reported on *Quercus alba*, *Quercus rubra* var. *borealis* (Anonymous, 1960; Farr & Rossman, 2025; Ginns, 1986) and *Quercus* sp. (EPPO, 2023c; Farr & Rossman, 2025; Farr & Rossman, 2025 citing Goos, 2010; Hawksworth, 1972). In the US, it was reported on *Quercus* sp. and *Quercus alba* (Anonymous, 1960; Farr & Rossman, 2025 citing Goos, 2010). There is no information on whether *E. mammata* can also attack *Juglans*.
Asymptomatic plants	The disease caused by *E. mammata* has a latent period and symptoms can appear 2 years after the ascospore infection (Ostry & Anderson, 2009; Sinclair & Lyon, 2005).
Association with wood	The pathogen is mostly found on trees 15–40 years old, but all ages can be infected (EFSA PLH Panel, 2017b; EPPO, 2023c). Infection usually starts from branches and twigs and then spreads to the main stem. *Entoleuca mammata* is most frequently found on stems about 1.5–2.5 m above the ground (Mathiassen, 1993). The cankers expand very rapidly (7–8 cm per month) in summer, and more slowly during winter; branches and stems can be girdled causing drying and breakage (EFSA PLH Panel, 2017b; Sinclair & Lyon, 2005). The ascospores of *E. mammata* infect a living wood penetrating in the periderm and invading tissues under the bark (sapwood) through mechanical wounds and injuries caused by woodpeckers and insects (Anderson et al., 1979; Ostry & Anderson, 1983). Only live wood is infected, and the fungus does not expand far into dead wood (Ostry, 2013). Infected wood, mostly with bark, may be a pathway for passive spread of *E. mammata* (EFSA PLH Panel, 2017b; EPPO, 2023c).
Temperature survival	There is no information regarding lethal temperatures for this pathogen. The only information available is as follows: optimum temperature for growth of mycelium is between 25°C and 28°C and for germination of ascospores is between 28°C and 30°C. Ascospores start to germinate when air is saturated, or plant surfaces are wet for 24–48 h and temperature is above 16°C (Sinclair & Lyon, 2005).
Ability to create resting propagules/ chlamydospores	*Entoleuca mammata* has two types of spores: (1) conidia in hyphal pegs (asexual) and, (2) ascospores in perithecium (sexual) (Ostry & Anderson, 2009). There is no indication that the fungus can produce resting propagules or chlamydospores.

A.8 | *LOPHOLEUCASPIS JAPONICA*

A.8.1 | Organism information

Taxonomic information	Current valid scientific name: *Lopholeucaspis japonica* Synonyms*: Euleucaspis japonica, Leucaspis hydrangeae, Leucaspis japonica, Leucaspis japonica darwiniensis, Leucaspis japonicus, Leucaspis menoni, Leucodiaspis hydrangeae, Leucodiaspis japonica, Leucodiaspis japonica, Leucodiaspis japonica darwiniensis, Lopholeucaspis darwiniensis, Lopholeucaspis japonica darwiniensis, Lopholeucaspis menoni* Order: Hemiptera Family: Diaspididae Common name: Japanese long scale, Japanese maple scale, Japanese pear white scale Name used in the Dossier: *Lopholeucaspis japonica*
Group	Insects
EPPO code	LOPLJA
Regulated status	*Lopholeucaspis japonica* is listed in Annex II/A of Commission Implementing Regulation (EU) 2019/2072 as *Lopholeucaspis japonica* Cockerell [LOPLJA] *Lopholeucaspis japonica* is quarantine pest in Belarus, Israel, Mexico, Morocco and Tunisia; it is regulated as non-quarantine pest in Ukraine (EPPO, 2025s). The pest is in the A1 list in Argentina, Chile, Bahrein, Kazakhstan, Uzbekistan, Serbia, Switzerland and United Kingdon; it is also in the A2 list in Azerbajizan, Georgia, Russian Federation, Türkiye, the EAEU (Armenia, Belarus, Kazakhstan, Kyrgyzstan, Russia) and EPPO A2 list (EPPO, 2025s).
Pest status in the US	*Lopholeucaspis japonica* is an armoured scale native to eastern Asia; it was introduced in the US where it is currently present in 17 states: Alabama, Connecticut, Delaware, District of Columbia, Georgia, Indiana, Kentucky, Louisiana, Maryland, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, Tennessee, Texas, Virginia (EPPO, 2023d).
Pest status in the EU	*Lopholeucaspis japonica* is absent from the EU. It was intercepted in Croatia, Greece, Italy and Slovak Republic, but never found acclimatised to date (EFSA PLH Panel, 2018e; EPPO, 2023d).
Host status on *Quercus/Juglans*	*Lopholeucaspis japonica* is a very polyphagous pest, known to feed on more than 63 tree and shrub species in 39 different families (EFSA PLH Panel, 2018e; EPPO, 2023e; García Morales et al., 2025). *Quercus* sp. and *Juglans regia* are hosts of *L. japonica* in the Republic of Georgia according to Batsankalashvili et al. (2017). No information was found about *Quercus* and *Juglans* as hosts of the pest in the US.
Asymptomatic plants	No asymptomatic plants are known. Scale colonies on trunk and branches are conspicuous when infestation is high, but small populations or overwintering stages may be difficult to detect (EFSA PLH Panel, 2018e).

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Association with wood	As a diaspidid scale, *Lopholeucaspis japonica* feeds on the phloem directly inserting the stylet on plant storage cells. Both adults and crawlers are mostly found in colonies in the bark crevices of the trunk and branches, less often on leaves and fruits (Fulcher et al., 2011). Branch dieback and plant death may be observed when severe infestations occur, but there is no direct association between the pest and the wood. However, immature stages and fertilised females have been found overwinter on the bark of branches and trunks in Tennessee, Maryland and Pennsylvania (Fulcher et al., 2011; Gill et al., 2012; Stimmel, 1995). Therefore, round wood with bark could be a potential pathway for *L. japonica* although this is not openly reported in the risk analyses, which mostly focus on plants for planting (bonsais included), cut branches and fruits (Biosecurity Australia, 2010; EFSA PLH Panel, 2018e, 2021, 2022).
Temperature survival	In the Far East, *L. japonica* can survive overwinter at temperatures from −20 to −25°C (EPPO, 2023e). As for lethal upper temperatures, no specific data was found in accordance with the poor information available on heat tolerance of scale insects in general. Some data for similar species of armoured scales may have only an indicative value. Mixed stages of *Quadraspidiotus perniciosus* show a 42% survival when exposed to 46°C for 5 h (Lurie et al., 1998). 50% survival of *Aonidiella aurantii* nymphs was observed under fluctuating temperatures with a maximum of 47–48°C (Wang, 2017 citing Abdelrahman, 1974).
Size at different life stages	Eggs are 0.25 mm; second-instar nymphs are 0.5–0.6 mm long in females and 0.8–1.0 mm in males; adult females are fixed under an elongate shield covered with white secretion, 1.0–1.8 mm in length (EPPO, 2023e).

A.9 | *LYCORMA DELICATULA*

A.9.1 | Organism information

Taxonomic information	Current valid scientific name: *Lycorma delicatula* Synonyms: *Aphaena delicatula, Lycorma delicatulum* Order: Hemiptera Family: Fulgoridae Common name: spotted lanternfly (SLF), spot clothing wax cicada, Chinese blistering cicada. Name used in the Dossier: *Lycorma delicatula*
Group	Insects
EPPO code	LYCMDE
Regulated status	*Lycorma delicatula* is quarantine pest listed in Annex II A of Commission Implementing Regulation (EU) 2019/2072 as *Lycorma delicatula* (White) [LYCMDE]. It is quarantine for Morocco and Canada and included in the EPPO A1 list; it is also in the A1 list for Chile, Switzerland and the UK (EPPO, 2025t).
Pest status in the US	*Lycorma delicatula* is native to Asia and was introduced in the US in 2014, where it is currently present in 16 states: Connecticut, Delaware, District of Columbia, Illinois, Indiana, Iowa, Kentucky, Maryland, Massachusetts, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia. The pest was only intercepted in Kansas, Maine, New York, Oregon and Rhode Island; it was eradicated in Vermont (EPPO, 2024b).
Pest status in the EU	*Lycorma delicatula* is absent from the EU territory (EPPO, 2024b).
Host status on *Quercus/Juglans*	*Lycorma delicatula* is a highly polyphagous pest (more than 100 host species according to Barringer and Ciafré (2020)). *Quercus* hosts are *Quercus acutissima, Q. aliena, Q. montana, Q. prinus, Q, rubra, Quercus* sp. (Barringer & Ciafré, 2020; EPPO, 2025u). *Quercus* spp. are not considered primary hosts of *L. delicatula* and are attacked when preferential hosts are unavailable (Stump et al., 2024). *Juglans* hosts include *Juglans cinerea, J. hindsii, J. major, J. mandshurica, J. microcarpa, J. nigra, J. regia* var. *orientis, J. x sinensis* and *Juglans* sp. (Barringer & Ciafré, 2020; EPPO, 2025u). According to EPPO (2021b), *Juglans* species are among the preferred hosts of *L. delicatula*, despite they produce juglone and other compounds known to be toxic to many insects (Barringer & Ciafré, 2020). *Juglans nigra* is considered by Madalinska and Nielsen (2024) to be a suitable host for *L. delicatula* like the key host plant *Ailanthus altissima*.
Asymptomatic plants	No asymptomatic plants are known. However, eggs and early instar nymphs on leaves/shoots and on the bark of branches/trunks may be barely visible.
Association with wood	*Lycorma delicatula* is a sap sucker insect, feeding on the phloem of host plants so causing foliage withering, branch wilting and occasionally plant death (Dara et al., 2015; Kim et al., 2011). No direct feeding association with wood is known by *Lycorma delicatula*. However, nymphs and adults are usually found on the bark of branches and trunks, where females lay eggs after mating. Oviposition usually occurs on the upper part of the trunk and the branches, and trees larger than 15 cm in diameter are preferred (EPPO, 2016). Therefore, many wood products, logs included, may carry the pest and particularly its eggs the key factor in the spread which can be also laid on wood packaging and other inert material.
Temperature survival	Cold tolerance of overwintering eggs may vary considerably in different insect populations and over time; according to Park (2015), lethal temperature causing 100% mortality of eggs is −20°C. However, recent studies carried out in Canada (Turbelin et al., 2024) seem to show that *L. delicatula* eggs are able to survive at low temperatures near the supercooling point of −27.7°C, a threshold that could be estimated as a lethal temperature for this stage. The survival of active life stages of *L. delicatula* was studied by Keena (2024) on individuals kept without food to simulate human-assisted movement conditions on various pathways via cargo or vehicles. In general, the survival time for all active stages decreases exponentially with increasing temperature. At a temperature of 30°C, first- to third instar nymphs are predicted to die in 1.69 to 1.63 days and adults in 2 days, respectively. However, at 10°C, the same stages can survive 14 days (1st instar nymphs), 8 days (3rd instar nymphs), and 4–5 days (adults), so the 1st instar movement is apparently the riskiest. As for upper lethal temperatures of eggs, recent heat treatment tests (Zandi-Sohani et al., 2025) have shown that no hatching of *L. delicatula* is observed when eggs are exposed for more than 15 min at 55°C, thus confirming also for this pest the effectiveness of the ISPM 15 protocol required in the treatment of wood packaging material to prevent the introduction of wood-boring insects.

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Size at different life stages	Eggs are oval 1 mm long, laid in masses of 30–50 eggs; 1st instar nymphs are 3.5–4.5 mm long; 2nd instar 5–6.5 mm; 3rd instar 7–9.5 mm; 4th instar 11–15 mm. Adult males are 21–22 mm long; the larger females 24–27 mm (EPPO, 2021b).

A.10 | *NEOCOSMOSPORA EUWALLACEAE*

A.10.1 | Organism information

Taxonomic information	Current valid scientific name: *Neocosmospora euwallaceae* Synonyms: *Fusarium euwallaceae* (according to Index Fungorum, 2025) Order: Hypocreales Family: Nectriaceae Common name: Fusarium dieback, Fusarium wilt Name used in the Dossier: *Neocosmospora euwallaceae* *Neocosmospora euwallaceae* is a symbiotic fungus of ambrosia beetle in *Euwallacea fornicatus* species complex (Paap et al., 2018). *Euwallacea fornicatus* species complex = *Euwallacea fornicatus sensu lato* which includes these species *E. fornicatus* sensu stricto, *E. fornicatior*, *E. perbrevis* and *E. kuroshio* (, 2025v; EPPO, 2020b; Smith et al., 2019).
Group	Fungi
EPPO code	FUSAEW
Regulated status	The pathogen is listed in Annex II/A of Commission Implementing Regulation (EU) 2019/2072 as *Neocosmospora euwallaceae* (S. Freeman, Z. Mendel, T. Aoki & O'Donnell) Sandoval-Denis, L. Lombard & Crous [FUSAEW]. *Neocosmospora euwallaceae* is included in the EPPO A2 (EPPO, 2024c) and in the A1 list of Iran, Switzerland and the UK (EPPO, 2025w).
Pest status in the US	*Neocosmospora euwallaceae* can spread only through the ambrosia beetle *Euwallacea fornicatus sensu lato* and it occurs everywhere the beetle has been introduced or spread. *Neocosmospora euwallaceae* is present in the US (Aoki et al., 2018; EPPO, 2025x; Farr & Rossman, 2025; Freeman et al., 2013; Lynch et al., 2016; Moreno et al., 2018; Rugman-Jones et al., 2020; Sandoval-Denis et al., 2019). The pathogen is reported from states of California (EPPO, 2025x; Freeman et al., 2013) and Hawaii (EPPO, 2025x; Rugman-Jones et al., 2020). *Neocosmospora euwallaceae* was isolated from galleries of *E. fornicatus* from *Persea americana* and *Quercus robur* in Los Angeles County in southern California (Freeman et al., 2013). *Neocosmospora euwallaceae* was isolated from heads of *E. fornicatus* from the Big Island of Hawaii (Rugman-Jones et al., 2020). The pathogen can be more widespread since there is a strong association between the insect pest and the fungal pathogen (Paap et al., 2018). In the US, *E. fornicatus sensu lato* was additionally reported from Florida (Carrillo et al., 2016; DAFNAE, 2025; EPPO, 2025y).
Pest status in the EU	*Neocosmospora euwallaceae* is reported as present, few occurrences in Germany. The fungus was detected in 2023, in greenhouses of Brandenburg and it is under eradication (EPPO, 2023f).
Host status on *Quercus*/*Juglans*	*Neocosmospora euwallaceae* was reported from the galleries of *E. fornicatus* of *Quercus agrifolia, Q. chrysolepis, Q. engelmannii, Q. ilex, Q. lobata, Q. macrocarpa, Q. mexicana, Q. robur, Q. suber* and *Q. virginiana* (EPPO, 2025z; Eskalen et al., 2013). There is no information on whether *N. euwallaceae* can also attack *Juglans*. However, *E. fornicatus sensu lato* was reported to attack *Juglans mandshurica* in Taiwan and *J. nigra* in North America (Eskalen et al., 2013). These trees could act as non-reproductive hosts (in which the beetles can drill and infect the associated fungi without being able to reproduce) (EPPO, 2020b).
Asymptomatic plants	*Neocosmospora euwallaceae* infections can be associated with brownish staining of the xylem, gumming, necrosis and abundant production of blue to brownish macroconidia (Freeman et al., 2013; Grosman et al., 2019; Mendel et al., 2012). In general, there is a correlation between severity of the beetle attack which therefore increases severity of infection by *N. euwallceae* and the observed dieback (Eskalen et al., 2013). Main symptoms caused by the beetle and the fungus are wilting of branches, discoloration of the leaves and death of young and mature trees (Mendel et al., 2012). Initial phases of infestation are associated with few external symptoms. While there is hardly visible injury in the bark at early stage of colonisation, later frass is produced, and the attack becomes obvious. Examination of the wood under the infested spot bored by the beetle reveals the brownish staining of the xylem and necrosis caused by the fungus (Mendel et al., 2012).
Association with wood	*Euwallacea fornicatus sensu lato* creates galleries in the trees (penetrating through cambium into xylem), where it introduces the symbiotic fungus, which colonises gallery walls and becomes a food source for developing larvae and callow adult beetles (Eskalen et al., 2013; Paap et al., 2018). After the attack of the beetle, *N. euwallaceae* invades the vascular tissue of the tree (Eskalen et al., 2013) causing brownish staining of the xylem (Freeman et al., 2013; Grosman et al., 2019; Mendel et al., 2012).
Temperature survival	There is no information regarding lethal temperatures for this pathogen. Another species, *N. solani*, was observed to be growing in a range of temperatures between 10°C and 35°C during laboratory experiments on Petri plates. No growth was observed at 5°C and 40°C during incubation period of 20 days. The growth of fungus was also affected by the water availability (Ezrari et al., 2021).
Ability to create resting propagules/ chlamydospores	*Neocosmospora euwallceae* creates (1) mycelium; (2) aerial conidiophores and conidia; (3) sporodochia; (4) sporodochial phialides, conidiophores and conidia; and (5) chlamydospores (Freeman et al., 2013).

A.11 | *PHYTOPHTHORA RAMORUM* (NON-EU ISOLATES)

A.11.1 | Organism information

Taxonomic information	Current valid scientific name: *Phytophthora ramorum* Synonyms: – Name used in the EU legislation: *Phytophthora ramorum* (non-EU isolates) Werres, De Cock & Man in 't Veld [PHYTRA] Order: Peronosporales Family: Peronosporaceae Common name: Sudden Oak Death (SOD), ramorum bleeding canker, ramorum blight, ramorum leaf blight, twig and leaf blight Name used in the Dossier: *Phytophthora ramorum*
Group	Oomycetes
EPPO code	PHYTRA
Regulated status	The pathogen is listed in Annex II of Commission Implementing Regulation (EU) 2019/2072 as *Phytophthora ramorum* (non-EU isolates) Werres, De Cock & Man in 't Veld [PHYTRA]. The EU isolates of *P. ramorum* are listed as regulated non-quarantine pest (RNQP). The pathogen is included in the EPPO A2 list (EPPO, 2025aa). *Phytophthora ramorum* is quarantine in Canada, China, Israel, Mexico, Morocco, South Korea and the UK. It is on A1 list of Brazil, Chile, Egypt, Kazakhstan, Serbia, Switzerland, Türkiye and EAEU (=Eurasian Economic Union: Armenia, Belarus, Kazakhstan, Kyrgyzstan and Russia) (EPPO, 2025aa).
Pest status in the US	*Phytophthora ramorum* is an introduced pathogen in the US. It is present in the natural environment in California and Oregon with restricted distribution (EPPO, 2025ab). Due to the movement of nursery stocks from California and Oregon, it has been detected in nurseries, residential/commercial landscaping or streams in many other states between 2003 and 2021 (USDA, 2023). The pathogen, however, is not considered to be established in the US outside of California and Oregon (USDA, 2023). According to EPPO (2025ab), *P. ramorum* is present, with few occurrences in Alabama, Colorado, Florida, Georgia, Illinois, Indiana, Iowa, Louisiana, Nebraska, New Mexico, North Carolina, Oklahoma, South Carolina, Tennessee and Texas. It is reported as absent or eradicated in Arizona, Arkansas, Connecticut, Kansas, Maryland, Mississippi, Missouri, New Jersey, New York state, Pennsylvania, Virginia and Washington state (EPPO, 2025ab). Lineages of *P. ramorum* present in the North America are: NA1, NA2 and EU1 (Grünwald et al., 2009).
Pest status in the EU	*Phytophthora ramorum* is present in the EU and it is currently reported in the following EU MS: Belgium, Croatia, Denmark, Finland (transient), France, Germany, Ireland, Luxembourg, the Netherlands, Poland and Slovenia (EPPO, 2025ab).
Host status on *Quercus*/*Juglans*	Proven oak hosts of *P. ramorum* confirmed by Koch's postulates are *Quercus agrifolia* (APHIS USDA, 2022; Rizzo et al., 2002), *Q. cerris* (APHIS USDA, 2022; COMTF, 2006), *Q. chrysolepis* (APHIS USDA, 2022; Murphy & Rizzo, 2003), *Q. falcata* (APHIS USDA, 2022; Brasier et al., 2004), *Q. ilex* (APHIS USDA, 2022; Denman et al., 2005), *Q. kelloggii* (APHIS USDA, 2022; Garbelotto et al., 2003), and *Q. parvula* var. *shrevei* (APHIS USDA, 2022; Rizzo et al., 2002). Other oak species found associated with *P. ramorum* are *Quercus acuta* (APHIS USDA, 2022; EPPO, 2013), *Q. petraea* (APHIS USDA, 2022; COMTF, 2005), *Q. phillyraeoides* (APHIS USDA, 2022; O'Hanlon et al., 2016), *Q. robur* (APHIS USDA, 2022; DEFRA, 2015) and *Q. rubra* (APHIS USDA, 2022; EPPO, 2013). *Quercus* species are mainly bark hosts (Davidson et al., 2003; Sansford et al., 2009). *Quercus agrifolia*, *Q. cerris*, *Q. chrysolepis*, *Q. ilex*, *Q. kelloggii*, *Q. petraea*, *Q. robur* and *Q. rubra* are reported as both bark and foliar hosts (Sansford et al., 2009). There is no information on whether *P. ramorum* can also attack *Juglans*.
Asymptomatic plants	If roots are infected by *P. ramorum*, the plants can be without aboveground symptoms for months until developmental or environmental factors trigger disease expression (Roubtsova & Bostock, 2009; Thompson et al., 2021). Application of some fungicides may reduce symptoms and therefore mask infection, making it more difficult to determine whether the plant is pathogen-free (DEFRA, 2008).
Association with wood	*Phytophthora ramorum* produces sporangia on the surfaces of infected leaves and twigs of host plants. These sporangia are splash-dispersed to new hosts, where they germinate to produce zoospores that penetrate and initiate an infection. In infected plant material, the chlamydospores are produced and can serve as resting structures (Davidson et al., 2005; Grünwald et al., 2008). Trunk cankers (e.g. on *Quercus*) are not known to support sporulation and therefore do not transmit the pathogen (DEFRA, 2008). *Phytophthora ramorum* is mainly a foliar pathogen; however, it is also associated with shoots, stems and occasionally roots (Grünwald et al., 2008; Parke & Lewis, 2007). The pathogen can penetrate bark and colonise phloem and xylem. It can remain viable within xylem for 2 or more years after the overlying phloem had been excised (Brown & Brasier, 2007). *Phytophthora ramorum* was found in discoloured sapwood of *Lithocarpus densiflorus*. Chlamydospores and hyphae were observed in xylem vessels, the latter also in ray parenchyma and fibre tracheids (Parke et al., 2007). Susceptible wood (including the debarked wood) is one possible pathway of entry for *P. ramorum* according to Sundheim et al. (2009), EFSA PLH Panel (2011) and Thomsen et al. (2023).

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Temperature survival	According to EFSA PLH Panel (2024a), 'the data collected in the literature review suggest that the temperature limit of survival of *P. ramorum* is between 50°C and 60°C for short exposure times (30–60 min) to dry heat in soil (Schweigkofler et al., 2014). Similar or lower lethal temperatures were observed in other studies (Funahashi & Parke, 2018; Linderman & Davis, 2008; Noble et al., 2009; Swain et al., 2006). In some studies, even short-term exposure to temperatures below 50°C was lethal (Browning et al., 2008). Differences in thermotolerance were observed in *P. ramorum* mating types European A1 and North American A2 with lethal temperatures (30 min exposure) of 45°C and 50°C, respectively. For longer exposure times of 3–14 days, the temperature limit of survival was observed to be between 30 and 55°C (Browning et al., 2008; Harnik et al., 2004; Tooley et al., 2008; Yakabe & MacDonald, 2010). However, there were two exceptions where higher temperature limits were observed. One active *P. ramorum* isolate was recovered from wood after treatment with 56°C for 30 min in a preliminary study conducted by Tubajika et al. (2007) and *P. ramorum* mycelium was not killed by exposure to a temperature of 60°C for 1 h (Chimento et al., 2012). The heat treatment in this study has led only to a delay in growth by 1 week. This observation adds some uncertainty on whether the reported lethal temperatures in other studies have indeed always caused mortality or have only inactivated the microbe without being lethal. However, it is noted that the study was not performed to investigate the thermotolerance of *P. ramorum* and it was rather an observation in an attempt to obtain dead mycelium.'
Ability to create resting propagules/ chlamydospores	*Phytophthora* species generally reproduce through (a) dormant (resting) spores which can be either sexual (oospores) or asexual (chlamydospores); and (b) fruiting structures (sporangia) which contain zoospores (Erwin & Ribeiro, 1996). Oospores and chlamydospores can serve as resting spores (Davidson et al., 2005). However, oospores of *P. ramorum* were only observed under laboratory conditions (Brasier & Kirk, 2004).

A.12 | *XYLELLA FASTIDIOSA*

A.12.1 | Organism information

Taxonomic information	Current valid scientific name: *Xylella fastidiosa* Synonyms: Grapevine Pierce's disease agent, *Xylella fastidiosa* subsp. *piercei* Order: Lysobacterales Family: Lysobacteraceae Common name: Anaheim disease, California vine disease, citrus variegated chlorosis, leaf scorch of almond, leaf scorch of American sycamore, leaf scorch of coffee, leaf scorch of elm, leaf scorch of maple, leaf scorch of mulberry, leaf scorch of oleander, olive quick decline syndrome, peach phony disease, Pierce's disease of grapevine, plum leaf scald, dwarf disease of lucerne, dwarf disease of alfalfa Name used in the Dossier: *Xylella fastidiosa* subsp. *multiplex* Subspecies: – *Xylella fastidiosa* subsp. *fastidiosa* – *Xylella fastidiosa* subsp. *morus* – *Xylella fastidiosa* subsp. *multiplex* – *Xylella fastidiosa* subsp. *pauca* – *Xylella fastidiosa* subsp. *sandyi* – *Xylella fastidiosa* subsp. *Tashke*
Group	Bacteria
EPPO code	XYLEFA Subspecies: XYLEFF, XYLEFO, XYLEFM, XYLEFP, XYLEFS, XYLEFT
Regulated status	The pathogen is listed in Annex II of Commission Implementing Regulation (EU) 2019/2072 as *Xylella fastidiosa* (Wells et al.) [XYLEFA] and as a priority pest by Commission Delegated Regulation (EU) 2019/1702. Moreover, there are in place emergency measures. *Xylella fastidiosa* is a quarantine pathogen in Canada, China, Israel, Moldova, Morocco, New Zealand and Tunisia (EPPO, 2025ac). *Xylella fastidiosa* is included in the EPPO A2 and in the A2 list of COSAVE (Comite de Sanidad Vegetal del Cono Sur – Argentina, Brazil, Chile, Paraguay, Peru and Uruguay). It is also reported on A1 list of Azerbaijan, Bahrain, Chile, Egypt, Georgia, Jordan, Paraguay, Russia, Serbia, Switzerland, Türkiye, Ukraine, the UK and IAPSC (Inter-African Phytosanitary Council) (EPPO, 2025ac).
Pest status in the US	*Xylella fastidiosa* is present in the US (EPPO, 2025ad), in Alabama, Arizona, Arkansas, California, Delaware, District of Columbia, Florida, Georgia, Indiana, Kentucky, Louisiana, Maryland, Massachusetts, Mississippi, Missouri, Nebraska, New Jersey, New Mexico, New York, North Carolina, Oklahoma, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Utah, Virginia and Washington (EFSA, 2025a). The subspecies present in the US are *X. fastidiosa* subsp. *fastidiosa, X. fastidiosa* subsp. *morus, X. fastidiosa* subsp. *multiplex, X. fastidiosa* subsp. *sandyi* and *X. fastidiosa* subsp. *tashke* (EFSA, 2025a). Dossier Section 2 states that: '*Xylella fastidiosa* subsp. *multiplex* is very rare in *Q. rubra* forest stands. Maximum prevalence in one IN plantation: 15%; pathogen is common in urban trees of several eastern states. *Xylella fastidiosa* subsp. *multiplex* is not reported in *Q. alba* forest stands.'
Pest status in the EU	*Xylella fastidiosa* is present in the EU – in France, Italy, Portugal and Spain (EPPO, 2025ad; EFSA, 2025a). The subspecies present in the EU are *X. fastidiosa* subsp. *fastidiosa*, *X. fastidiosa* subsp. *multiplex*, *X. fastidiosa* subsp. *pauca* and *X. fastidiosa* subsp. *sandyi* (EFSA, 2025a).

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Host status on *Quercus/Juglans*	Oak species naturally infected by *X. fastidiosa* (*X. fastidiosa*, *X. fastidiosa* subsp. *fastidiosa*, *X. fastidiosa* subsp. *multiplex*, *X. fastidiosa* subsp. *pauca*) are *Quercus agrifolia*, *Q. alba*, *Q. cerris*, *Q. coccinea*, *Q. falcata*, *Q. ilex*, *Q. imbricaria*, *Q. incana*, *Q. laevis*, *Q. laurifolia*, *Q. macrocarpa*, *Q. nigra*, *Q. orocantabrica*, *Q. palustris*, *Q. phellos*, *Q. prinus*, *Q. pubescens*, *Q. pyrenaica*, *Q. robur*, *Q. rubra*, *Q. shumardii*, *Q. suber*, *Q. velutina* and *Q. virginiana* (EFSA, 2025a). Artificially infected oak species of *X. fastidiosa* are *Q. lobata* and *Q. petraea* (EFSA, 2025a). Known walnut species naturally infected by *X. fastidiosa* (*X. fastidiosa*, *X. fastidiosa* subsp. *fastidiosa*) is only *Juglans regia* (EFSA, 2025a).
Asymptomatic plants	*Xylella fastidiosa* typically causes symptoms in host plants, however, some infected plants can remain asymptomatic and serve as a source of inoculum for vectors (Hopkins & Purcell, 2002).
Association with wood	*Xylella fastidiosa* colonises the vessels of the plant xylem, the network responsible for water transport, where it can move both up- and downstream (Almeida et al., 2001; Meng et al., 2005). This colonisation restricts water movement within the xylem, leading to blocked vessels, a phenomenon associated with the development of disease symptoms (Newman et al., 2003). The movement of plants for planting and infected vectors is the major pathway of entry for *X. fastidiosa*. Movement of seeds, fruits, cut flowers, ornamental foliage and wood (when not intended for propagation) are considered as unlikely pathway of entry for *X. fastidiosa* (EFSA PLH Panel, 2015; EPPO, 2020c). EFSA PLH Panel (2015) states that: 'the probability that a xylem fluid-feeding insect would transfer the bacterium from detached wood to a host plant is considered very unlikely. There is no record of acquisition of *X. fastidiosa* from detached wood and, therefore, this pathway is not considered further. Uncertainty is high because of lack of studies.'
Temperature survival	In vitro, the optimum growth temperature for *X. fastidiosa* was 28°C, and no growth was observed at 12°C (Feil & Purcell, 2001). Two studies have demonstrated that lethal temperatures for *X. fastidiosa* are 42°C for 3 h (Martins et al., 2007) and 37°C for 3 days (Feil & Purcell, 2001).

APPENDIX B

Overview literature search on temperature survival limits

Searches for temperature limits of survival of *Bretziella fagacearum*, *Geosmithia morbida* and *Pityophthorus juglandis* were conducted in September 2025 in Scopus and Web of Science.

The total number of records after de-duplication was 27. References were excluded if they did not contain information on the temperature limits of survival of the pests.

The search string was the following:

TOPIC: ("Bretziella fagacearum" or "Ceratocystis fagacearum" or "Chalara quercina" or "Endoconidiophora fagacearum" or "Thielaviopsis quercina" or "oak wilt" or "Geosmithia morbida" or "thousand cankers disease" or "Pityophthorus juglandis" or "walnut twig beetle")

AND

TOPIC: (heat* OR temperature* OR thermal OR thermic) AND (death* OR disinfect* OR disinfest* OR kill* OR inactivat* OR surviv* OR decontaminat* OR extreme OR limit OR limits OR resistan* OR stress OR tolerance OR tolerant OR treatment* OR trial*)

In addition, the literature retrieved on pests relevant for this opinion was screened for information on temperature limits for survival. The final number of relevant articles retrieved was 11.

B.1 | OVERVIEW ON THE TEMPERATURE LIMITS OF SURVIVAL FROM STUDIES RETRIEVED IN THE LITERATURE SEARCH AND FROM STUDIES SUBMITTED BY THE APPLICANT

Lethal temperature [°C]	Non-lethal temperature [°C]	Duration of exposure	Life stage	Species	Reference
Bretziella fagacearum, Geosmithia morbida, Pitiophthorus juglandis					
Studies found in literature review					
50°C 50°C	50°C	2 h 6 h 2 h	Conidia Ascospores Ascospores	*Ceratocystis fagacearum*	Cole and Fergus (1956)
45°C North Carolina Strain	45°C Texas Strain	3 h	Mycelium growing on Agar plates Both strains survived 45°C for 1 h and were both killed by exposure to 45°C for 4 h	*Ceratocystis fagacearum*	Lewis (1985)
48	46	30 min	Mycelium in water bath	*Bretziella fagacearum*	Noseworthy et al. (2024)
48°C 52°C		40 min 40 min at 1 cm depth below cambium	Mycelium in logs Larvae in logs	*Geosmithia morbida* *Pityophthorus juglandis*	Mayfield et al. (2014)
56°C		30 min at 5 cm depth from the bottom of the bark	Mycelium in logs Larvae in logs	*Geosmithia morbida* *Pityophthorus juglandis*	Juzwik et al. (2021) (also reported in Dossier)
52.7°C (LT$_{99}$) 48.1°C (LT$_{99}$)		30 min	Adults Larvae	*Pityophthorus juglandis*	Luna et al. (2013)
50.1°C	48.1°C	30 min Log core temperature (= temperature at 3.8 cm below cambium)	Larvae in logs	*Pityophthorus juglandis*	Mackes et al. (2016)
48°C 53°C (LT 99)		Not described	Larvae Adults	*Pityophthorus juglandis*	Peachey (2012)
Studies reported in Dossier					
56°C (5 cm in sapwood)		30 min	Mycelium in logs of *Q. rubra*	*B. fagacearum*	Juzwik et al. (2019) (Dossier)
56°C (5 cm in sapwood)	60°C (5 cm in sapwood)[1]	30 min	Mycelium in logs of *Q. rubra*	*B. fagacearum*	Unpublished, Juzwik pers. comm. (Dossier)

(Continues)

(Continued)

Lethal temperature [°C]	Non-lethal temperature [°C]	Duration of exposure	Life stage	Species	Reference
No viable fungus retrieved, study inconclusive due to low recovery rate			Mycelium in logs of *Q. rubra alba?*	*B. fagacearum*	Unpublished, Juzwik pers. comm. (Dossier)
57.8°C		30 min measured at the centre of the log, 12.5 cm from the cut end	Larvae in logs	*Anoplophora glabripennis*	Myers and Bailey (2011)
Other actionable pests					
55°C	50°C	15 min 30 min	Eggs	*Lycorma delicatula*	Zandi-Sohani et al. (2025)
57.4°C 52°C 51°C (LT 99.99)		30 min	Eggs Larvae Adult	*Arhopalus ferus* (Scolytinae)	Pawson et al. (2019)
50.1°C 53.3°C 46.9°C 55.8°C (LT 99.99)			Eggs Larvae Pupae Adults	*Hylurgus ligniperda* (Scolytinae)	

APPENDIX C

Elicited values for pest freedom

C.1 | OVERALL LIKELIHOOD OF PEST FREEDOM OF *BRETZIELLA FAGACEARUM* FOR *QUERCUS RUBRA* LOGS

C.1.1 | Reasoning for a scenario which would lead to a reasonably low number of infected *Quercus rubra* logs

The scenario assumes that the proposed vacuum–steam treatment (56°C for 30 min) is fully effective in killing all the inoculum in infected logs. The entire sapwood, where the pathogen is located is exposed to lethal temperatures. The scenario is based on the first study conducted by Juzwik et al. (2019), in which no surviving fungi were observed after *Q. rubra* logs were vacuum steam treated at 56°C for 30 min.

C.1.2 | Reasoning for a scenario which would lead to a reasonably high number of infected *Quercus rubra* logs

The scenario assumes that the proposed vacuum–steam treatment (56°C for 30 min) is only partially effective in killing all the inoculum in infected logs, as some areas deeper in the sapwood are not exposed to lethal temperatures. The scenario also assumes that some logs have a sapwood deeper than 5 cm. The scenario is based on a second study conducted by Juzwik et al. unpublished (Dossier Section 1), in which surviving fungi were observed after *Q. rubra* logs were vacuum steam treated at 60°C for 60 min.

C.1.3 | Reasoning for a central scenario equally likely to over- or underestimate the number of infected *Quercus rubra* logs (Median)

The scenario assumes that the proposed vacuum–steam treatment (56°C for 30 min) is not fully effective in killing all the inoculum in infected logs. In the studies of Juzwik et al. unpublished (Dossier Section 1), vacuum–steam treatment achieved a considerable reduction in pathogen inoculum, but live cultures of the pathogen were still isolated from a few treated logs.

C.1.4. | Reasoning for the precision of the judgement describing the remaining uncertainties (1st and 3rd quartile/interquartile range)

The first quartile describes the highest uncertainty, reflecting the variation in the results of the experimental studies. There are less uncertainties towards higher values as the proposed vacuum–steam treatment considerably reduced the pathogen inoculum in infected logs.

C.1.5 | Elicitation outcomes of the assessment of the pest freedom for *Bretziella fagacearum* on *Quercus rubra* logs

The following tables show the elicited and fitted values for pest infection (Table C.1) and pest freedom (Table C.2).

TABLE C.1 Elicited and fitted values of the uncertainty distribution of pest infection by *Bretziella fagacearum* per 10,000 logs.

Percentile	1%	2.5%	5%	10%	17%	25%	33%	50%	67%	75%	83%	90%	95%	97.5%	99%
Elicited values	0					50		100		300					1000
EKE	0.383	1.41	3.78	10.2	21.6	39.5	61.6	122	213	280	374	494	653	807	1001

Note: The EKE results are the BetaGeneral (0.70535, 12.478, 0, 3700) distribution fitted with @Risk version 7.6.

Based on the numbers of estimated infected logs, the pest freedom was calculated (i.e. = 10,000 – number of infected logs per 10,000). The fitted values of the uncertainty distribution of the pest freedom are shown in Table C.2.

TABLE C.2 The uncertainty distribution of logs free of *Bretziella fagacearum* per 10,000 logs calculated in Table C.1.

Percentile	1%	2.5%	5%	10%	17%	25%	33%	50%	67%	75%	83%	90%	95%	97.5%	99%
Values	9000					9700		9900		9950					10,000
EKE results	8999	9193	9347	9506	9626	9720	9787	9878	9938	9961	9978	9990	9996	9999	10,000

Note: The EKE results are the fitted values.

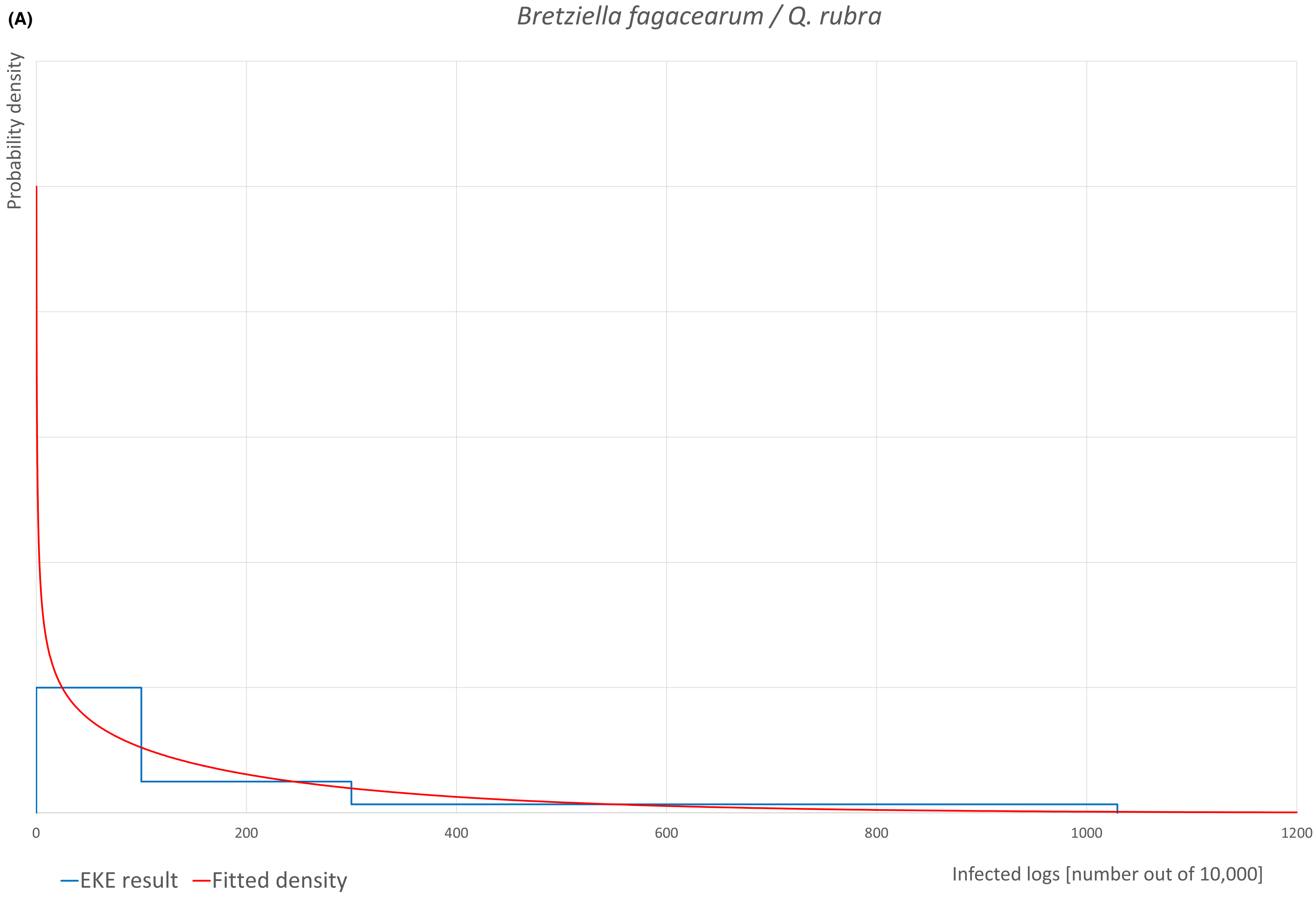

FIGURE C.1 (Continued)

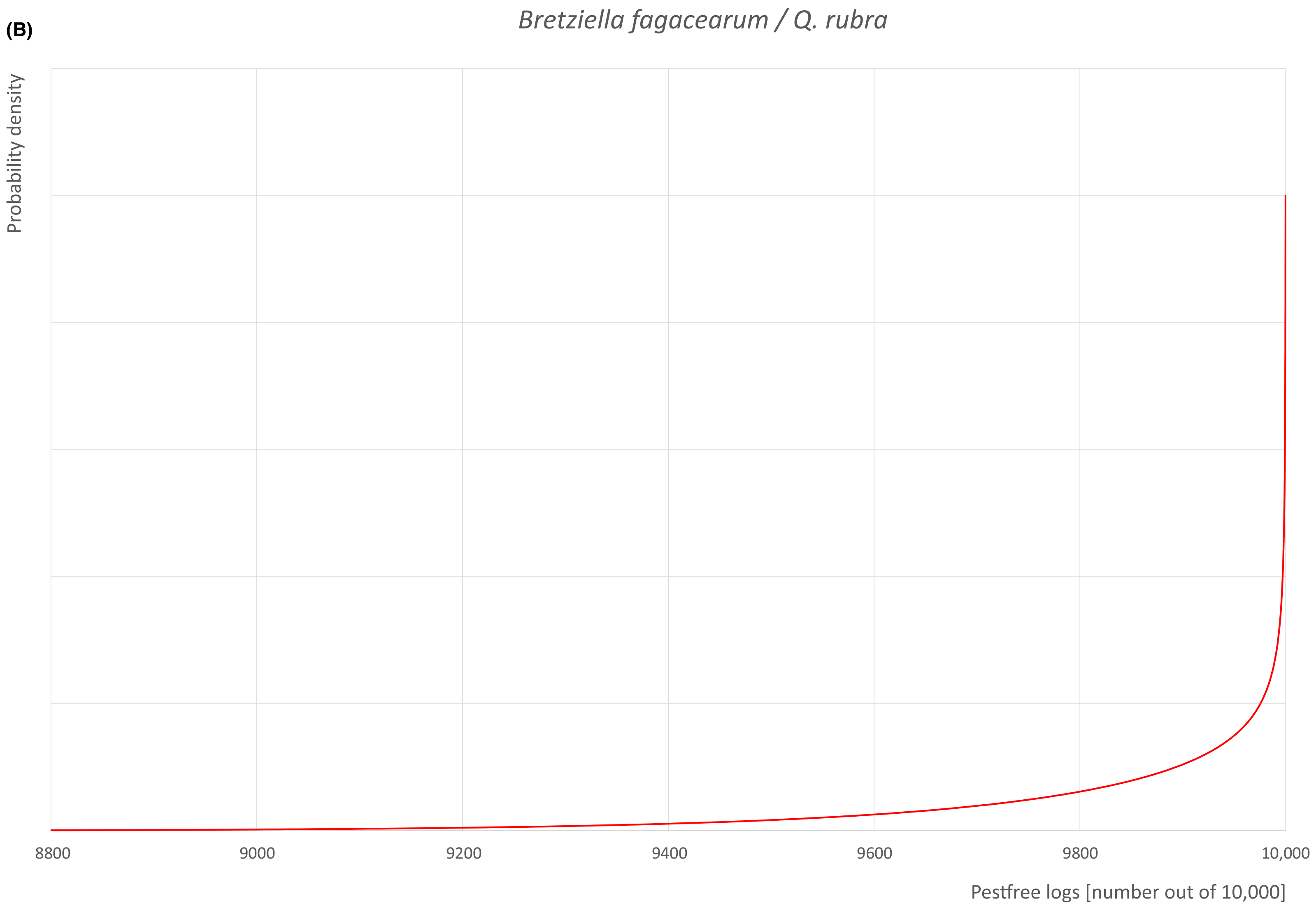

FIGURE C.1 (Continued)

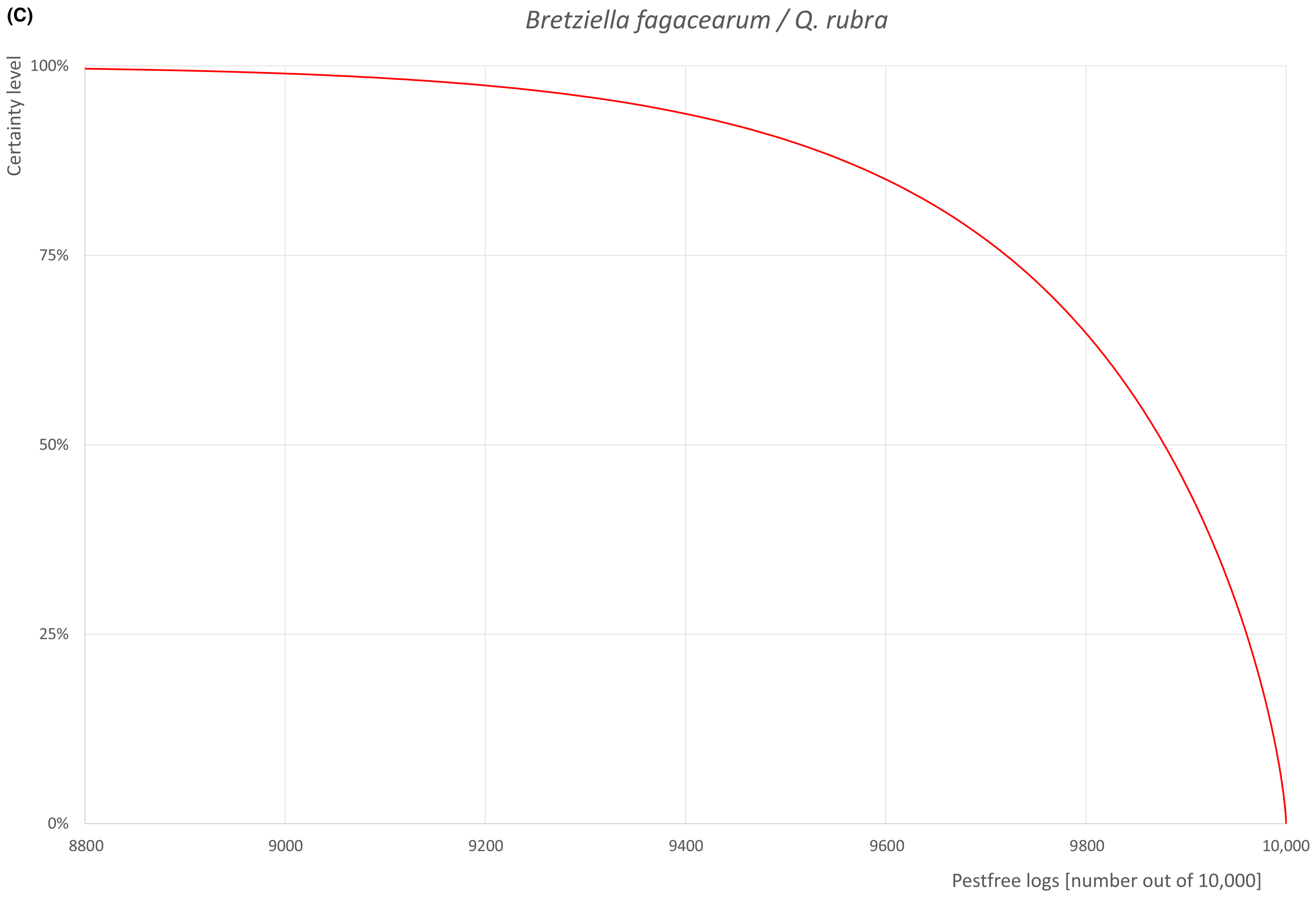

FIGURE C.1 (A) Elicited uncertainty of pest infection per 10,000 logs (histogram in blue–vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty of the proportion of pest free bare root logs per 10,000 (i.e. = 1 – pest infection proportion expressed as percentage); (C) descending uncertainty distribution function of pest infection per 10,000 logs.

C.2 | OVERALL LIKELIHOOD OF PEST FREEDOM OF *BRETZIELLA FAGACEARUM* FOR *QUERCUS ALBA* LOGS

Quercus alba has deeper sapwood and *B. fagacearum* may grow deeper in the sapwood (see Section 6.5) where the treatment will be less effective. Therefore, higher values were elicited for *Q. alba* in comparison to *Q. rubra*. All the other reasonings for the scenarios are identical with those above for *Q. rubra* in Section C.1.

C.2.1 | Elicitation outcomes of the assessment of the pest freedom for *Bretziella fagacearum* on *Quercus alba* logs

The following tables show the elicited and fitted values for pest infection (Table C.3) and pest freedom (Table C.4).

TABLE C.3 Elicited and fitted values of the uncertainty distribution of pest infection by *Bretziella fagacearum* per 10,000 logs.

Percentile	1%	2.5%	5%	10%	17%	25%	33%	50%	67%	75%	83%	90%	95%	97.5%	99%
Elicited values	0					75		150		450					1500
EKE	0.573	2.11	5.65	15.3	32.3	59.1	92.4	182	320	419	561	741	979	1209	1500

Note: The EKE results are the BetaGeneral (0.70482, 12.353, 0, 5500) distribution fitted with @Risk version 7.6.

Based on the numbers of estimated infected logs, the pest freedom was calculated (i.e. = 10,000 – number of infected logs per 10,000). The fitted values of the uncertainty distribution of the pest freedom are shown in Table C.4.

TABLE C.4 The uncertainty distribution of logs free of *Bretziella fagacearum* per 10,000 logs calculated in Table C.3.

Percentile	1%	2.5%	5%	10%	17%	25%	33%	50%	67%	75%	83%	90%	95%	97.5%	99%
Values	8500					9550		9850		9925					10,000
EKE results	8500	8791	9021	9259	9439	9581	9680	9818	9908	9941	9968	9985	9994	9998	9999

Note: The EKE results are the fitted values.

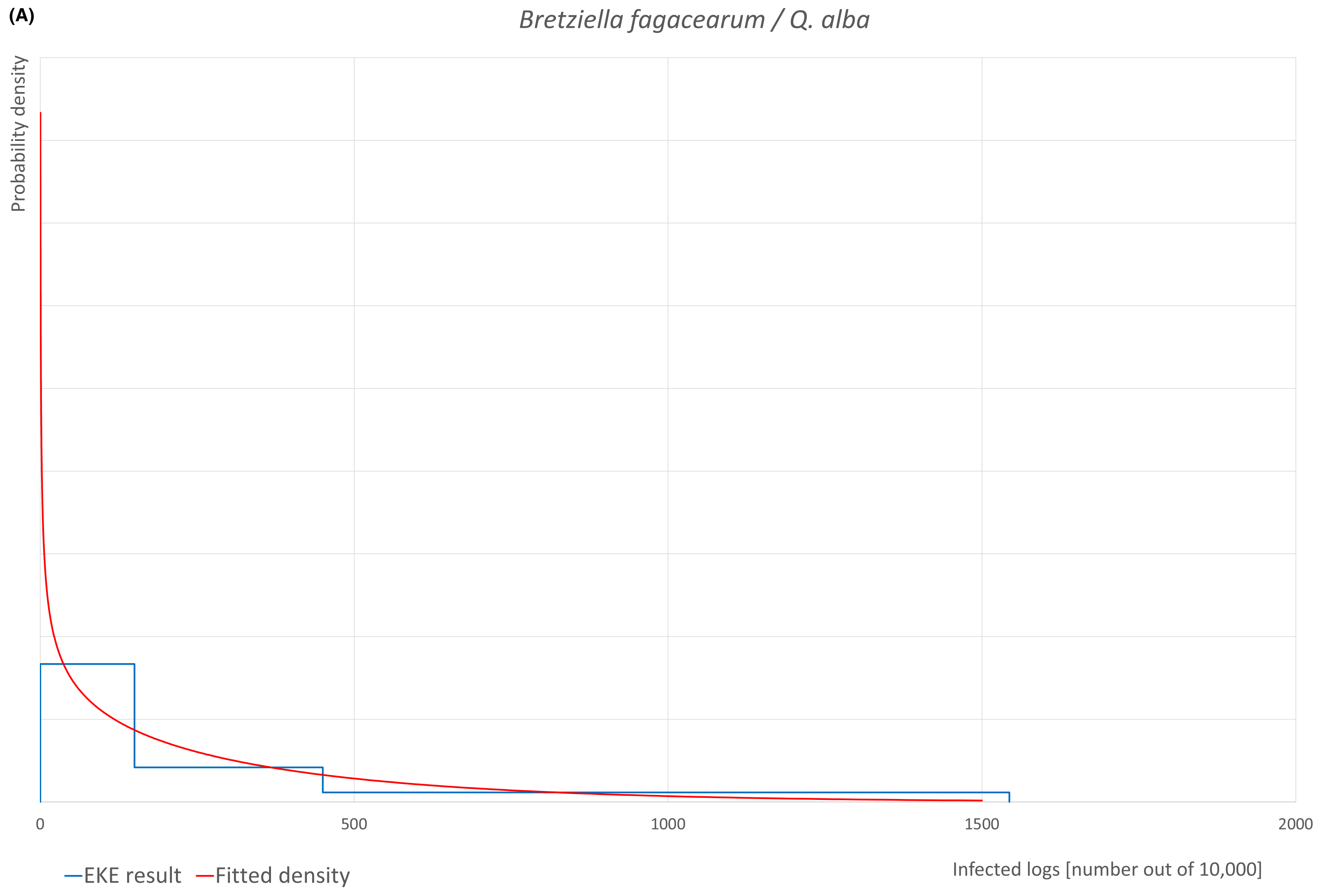

FIGURE C.2 (Continued)

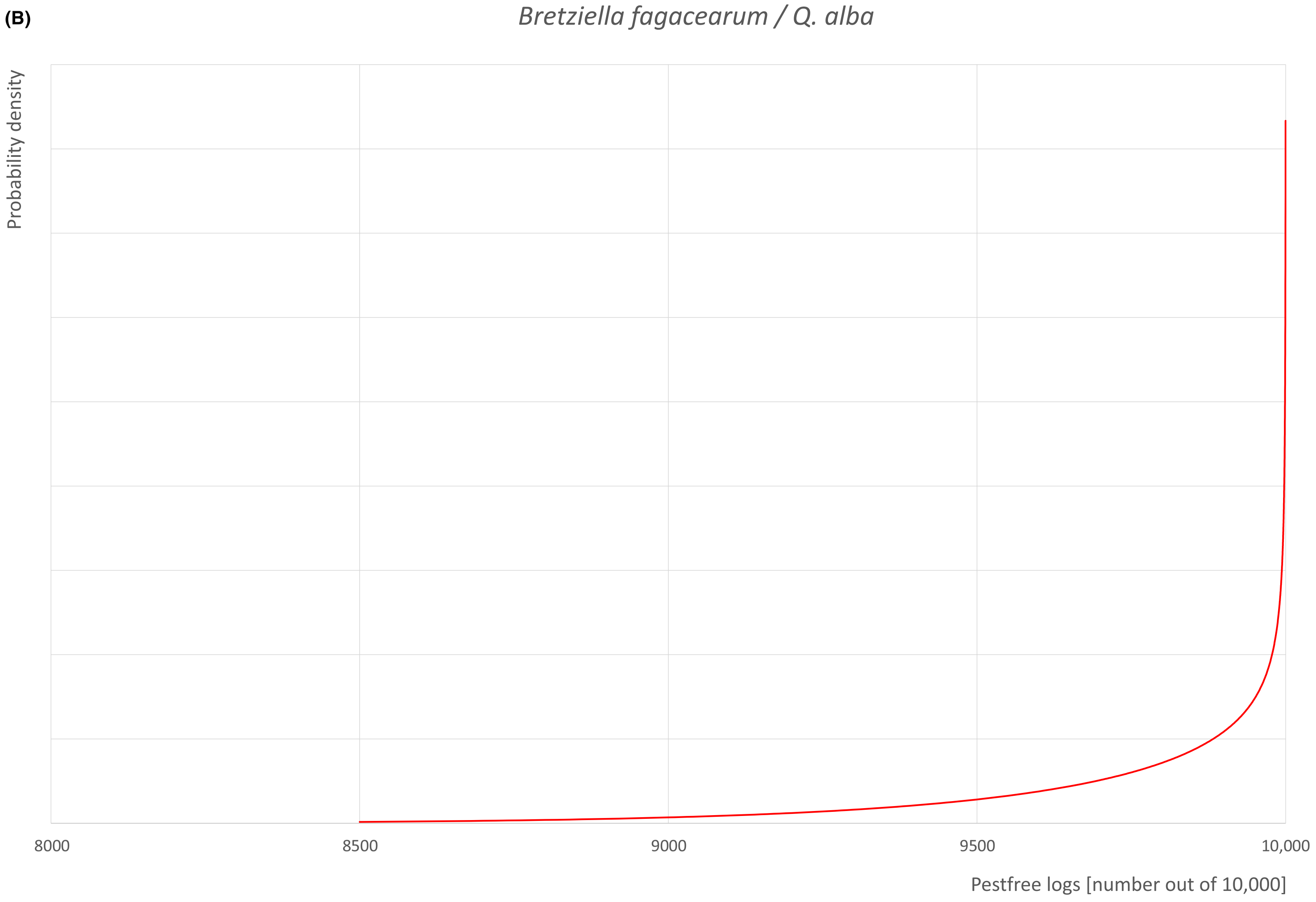

FIGURE C.2 (Continued)

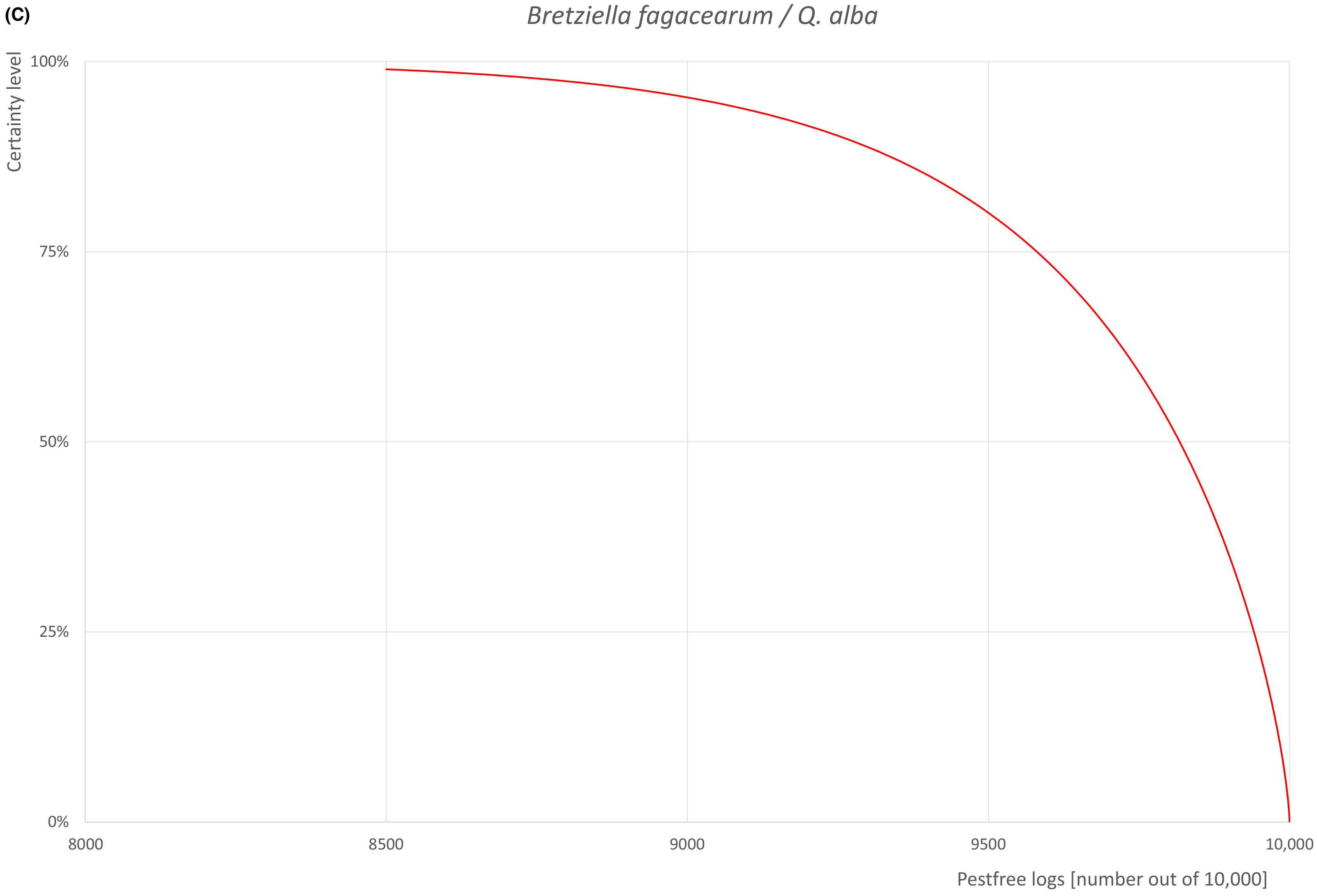

FIGURE C.2 (A) Elicited uncertainty of pest infection per 10,000 logs (histogram in blue–vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty of the proportion of pest-free bare root logs per 10,000 (i.e. = 1 – pest infection proportion expressed as percentage); (c) Descending uncertainty distribution function of pest infection per 10,000 logs.

C.3 | OVERALL LIKELIHOOD OF PEST FREEDOM OF *GEOSMITHIA MORBIDA* FOR *JUGLANS NIGRA* LOGS

C.3.1 | Reasoning for a scenario which would lead to a reasonably low number of infected *Juglans nigra* logs

The scenario assumes that the pathogen is present exclusively in the outer sapwood (phloem and cambium), and therefore, it is exposed to temperatures higher than 56°C (over 60°C) for a period of time exceeding 30 min. These conditions result in a complete eradication of the fungal inoculum.

C.3.2 | Reasoning for a scenario which would lead to a reasonably high number of infected *Juglans nigra* logs

The scenario assumes that the pathogen is present, although with a relatively low frequency, deeper in the sapwood, where it is exposed to temperatures closer to 56°C for 30 min. These conditions may not be sufficient to kill all the viable inoculum.

C.3.3 | Reasoning for a central scenario equally likely to over- or underestimate the number of infected *Juglans nigra* logs (Median)

The scenario assumes that the pathogen is almost exclusively present in the outer sapwood (phloem and cambium) where it is exposed to temperatures sufficient to kill the large majority of the fungal inoculum.

C.3.4 | Reasoning for the precision of the judgement describing the remaining uncertainties (1st and 3rd quartile/interquartile range)

The limited information on the biology of the pest, with special emphasis on histopathology, results in a high level of uncertainties below the median. Otherwise, the efficacy against the pest of the vacuum–steam treatment is expected to be high giving less uncertainty for rates above the median.

C.3.5 | Elicitation outcomes of the assessment of the pest freedom for *Geosmithia morbida* on *Juglans nigra* logs

The following tables show the elicited and fitted values for pest infection (Table C.5) and pest freedom (Table C.6).

TABLE C.5 Elicited and fitted values of the uncertainty distribution of pest infection by *Geosmithia morbida* per 10,000 logs.

Percentile	**1%**	**2.5%**	**5%**	**10%**	**17%**	**25%**	**33%**	**50%**	**67%**	**75%**	**83%**	**90%**	**95%**	**97.5%**	**99%**
Elicited values	0					15		30		70					200
EKE	0.362	0.984	2.11	4.58	8.24	13.3	19.1	33.3	53.1	66.8	85.6	109	138	166	200

Note: The EKE results are the BetaGeneral (0.92037, 10.47, 0, 580) distribution fitted with @Risk version 7.6.

Based on the numbers of estimated infected logs the pest freedom was calculated (i.e. = 10,000 – number of infected logs per 10,000). The fitted values of the uncertainty distribution of the pest freedom are shown in Table C.6.

TABLE C.6 The uncertainty distribution of logs free of *Geosmithia morbida* per 10,000 logs calculated in Table C.5.

Percentile	**1%**	**2.5%**	**5%**	**10%**	**17%**	**25%**	**33%**	**50%**	**67%**	**75%**	**83%**	**90%**	**95%**	**97.5%**	**99%**
Values	9800					9930		9970		9985					10,000
EKE results	9800	9834	9862	9891	9914	9933	9947	9967	9981	9987	9992	9995	9998	9999	10,000

Note: The EKE results are the fitted values.

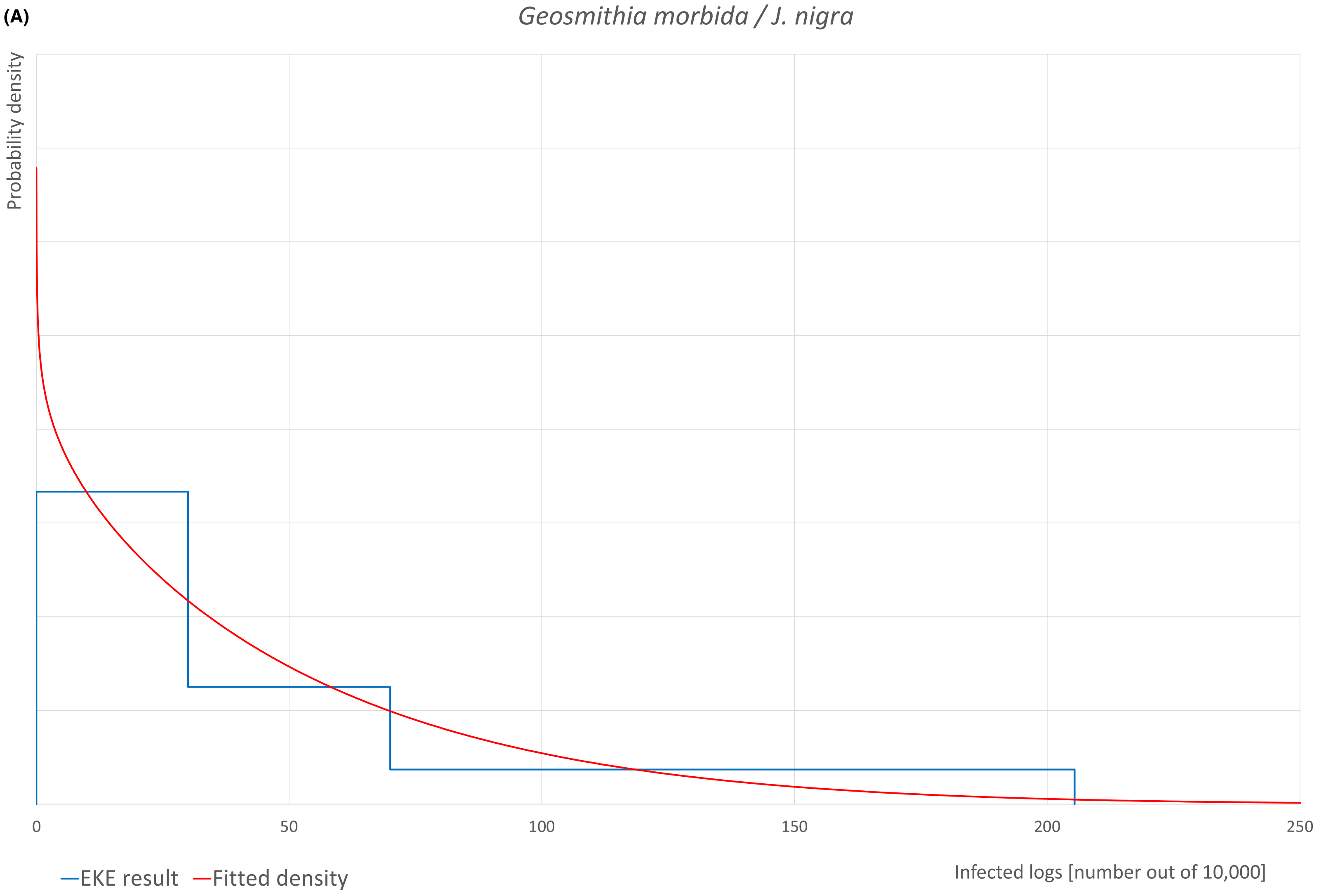

FIGURE C.3 (Continued)

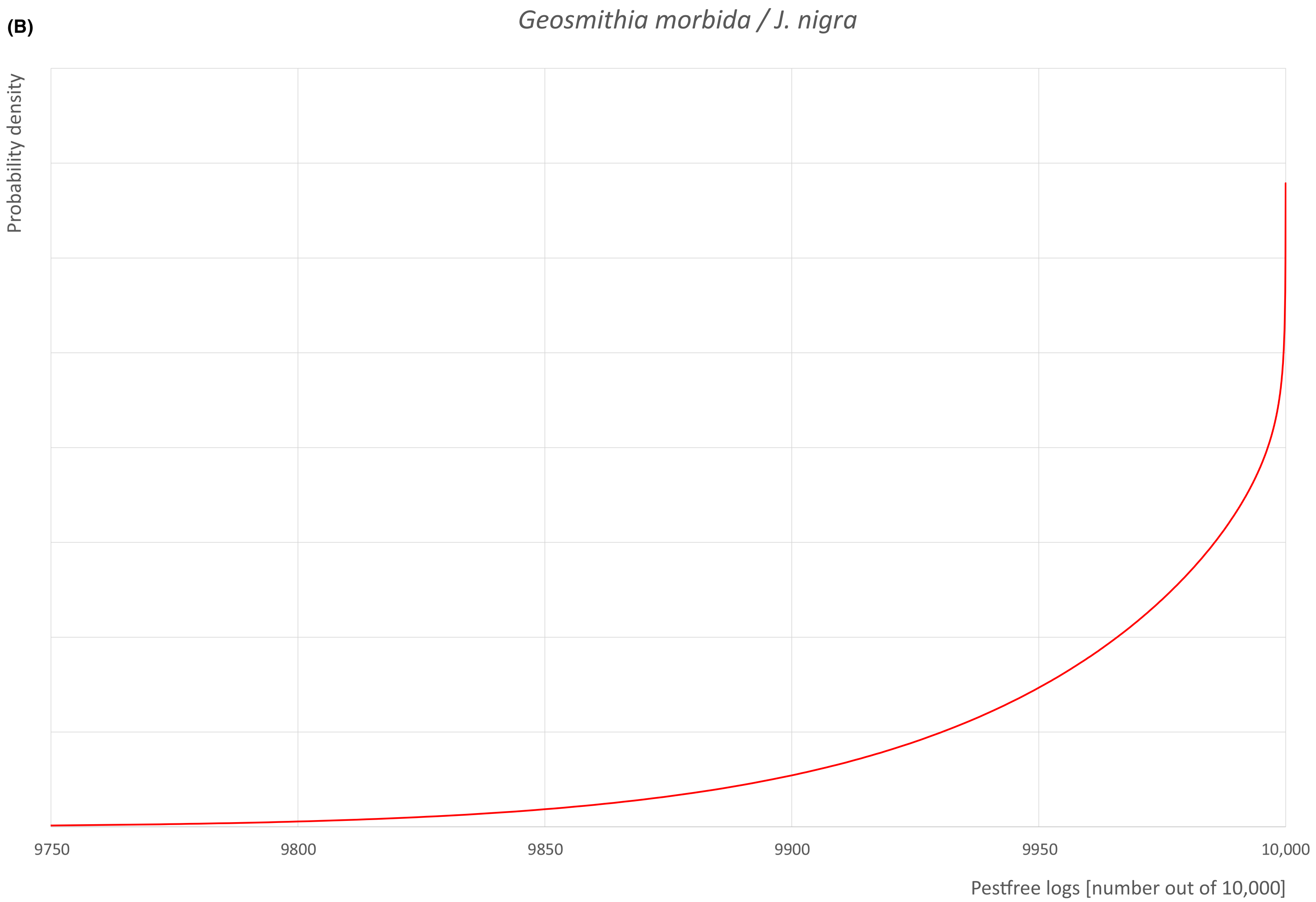

FIGURE C.3 (Continued)

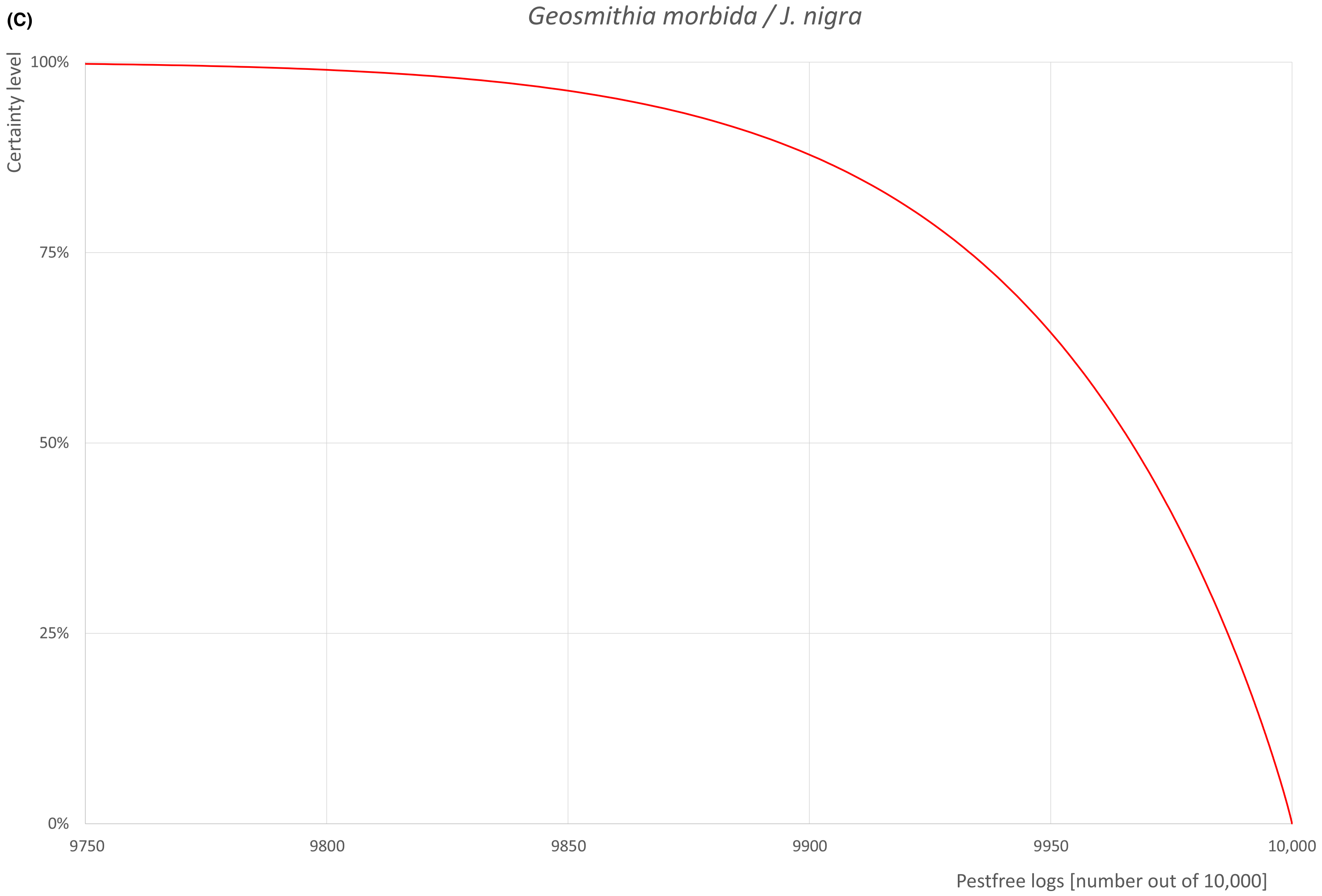

FIGURE C.3 (A) Elicited uncertainty of pest infection per 10,000 logs (histogram in blue–vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty of the proportion of pest-free bare root logs per 10,000 (i.e. = 1 – pest infection proportion expressed as percentage); (C) descending uncertainty distribution function of pest infection per 10,000 logs.

C.4 | OVERALL LIKELIHOOD OF PEST FREEDOM OF *PITYOPHTHORUS JUGLANDIS* FOR *JUGLANS NIGRA* LOGS

C.4.1 | Reasoning for a scenario which would lead to a reasonably low number of infested *Juglans nigra* logs

The scenario assumes that the proposed vacuum-steam treatment (56°C for 30 min) is fully effective in killing all the specimens of the pest in infested logs. The entire inner bark (maximum depth 2–3 cm from the surface), where the pest is located, is exposed to lethal temperatures of more than 60°C for more than 60 min.

C.4.2 | Reasoning for a scenario which would lead to a reasonably high number of infested *Juglans nigra* logs

The scenario assumes that the proposed vacuum–steam treatment (56°C for 30 min) is only partially effective in killing all the insects in infested logs, as the application of the treatment may not be uniform on the whole log and, in the case of a high colonisation density of the log, there may be some surviving insects at 56°C.

C.4.3 | Reasoning for a central scenario equally likely to over- or underestimate the number of infested *Juglans nigra* logs (Median)

The scenario assumes that the proposed vacuum–steam treatment (56°C for 30 min) is effective in killing the insects in logs, as the temperature reached in the bark is sufficient to kill the beetle. However, the scenario also assumes that there may be minimal insect survival due to non-uniform application of the treatment and high colonisation of the logs.

C.4.4 | Reasoning for the precision of the judgement describing the remaining uncertainties (1st and 3rd quartile/interquartile range)

The first quartile describes the highest uncertainty, reflecting the variation in the results of the experimental studies. There are less uncertainties towards higher values as the proposed vacuum–steam treatment considerably reduced the presence of the pest in the infested logs.

C.4.5 | Elicitation outcomes of the assessment of the pest freedom for *Pityophthorus juglandis* on *Juglans nigra* logs

The following tables show the elicited and fitted values for pest infestation (Table C.7) and pest freedom (Table C.8).

TABLE C.7 Elicited and fitted values of the uncertainty distribution of pest infestation by *Pityophthorus juglandis* per 10,000 logs.

Percentile	1%	2.5%	5%	10%	17%	25%	33%	50%	67%	75%	83%	90%	95%	97.5%	99%
Elicited values	0					4		8		25					75
EKE	0.0202	0.0830	0.242	0.711	1.59	3.04	4.88	9.97	17.7	23.3	31.0	40.4	52.2	62.8	75.1

Note: The EKE results are the BetaGeneral (0.6488, 5.0782, 0, 141) distribution fitted with @Risk version 7.6.

Based on the numbers of estimated infested logs, the pest freedom was calculated (i.e. = 10,000 – number of infested logs per 10,000). The fitted values of the uncertainty distribution of the pest freedom are shown in Table C.8.

TABLE C.8 The uncertainty distribution of logs free of *Pityophthorus juglandis* per 10,000 logs calculated in Table C.7.

Percentile	1%	2.5%	5%	10%	17%	25%	33%	50%	67%	75%	83%	90%	95%	97.5%	99%
Values	9925					9975		9992		9996					10,000
EKE results	9925	9937	9948	9960	9969	9977	9982	9990	9995	9997	9998	9999.3	9999.8	9999.9	10,000

Note: The EKE results are the fitted values.

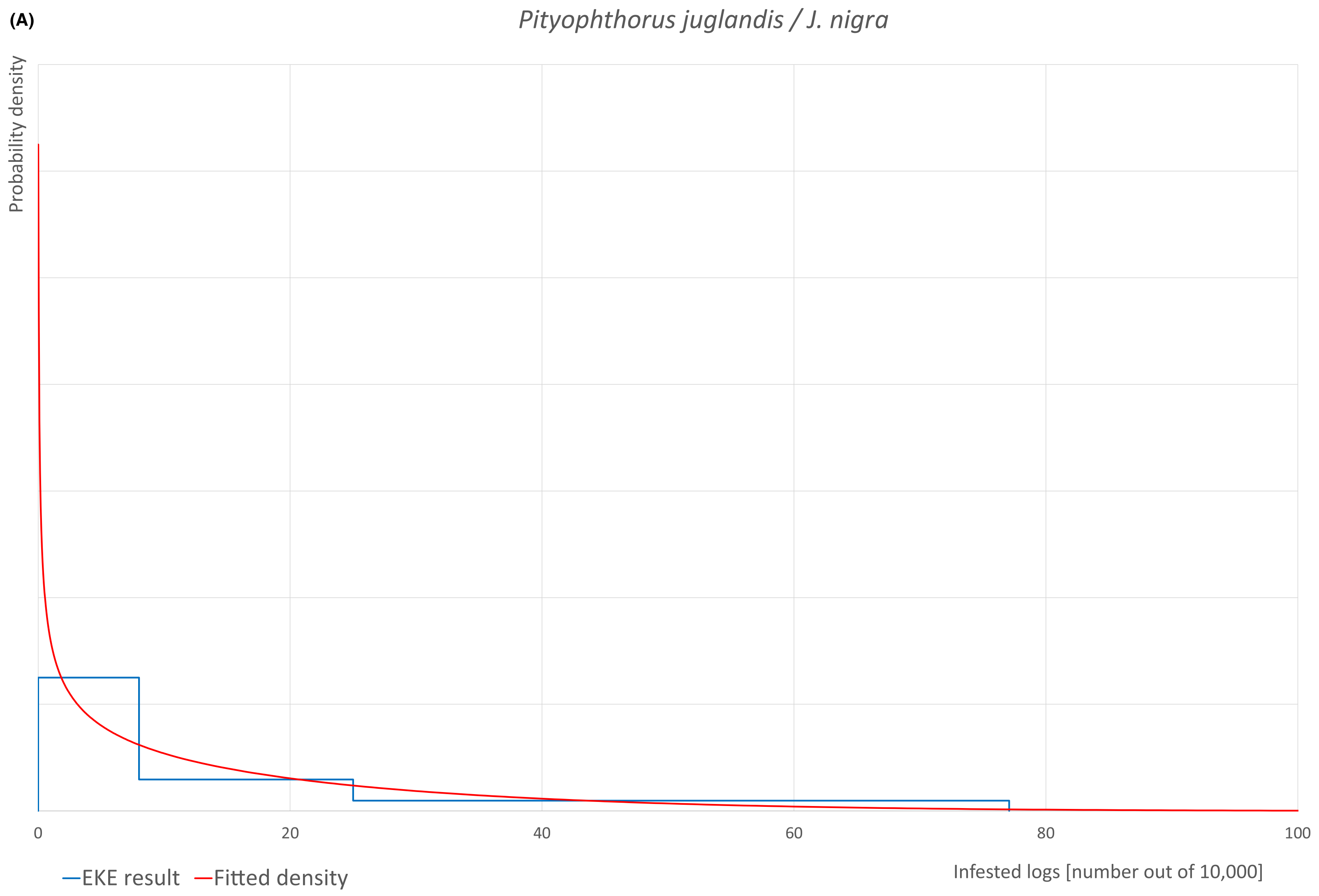

FIGURE C.4 (Continued)

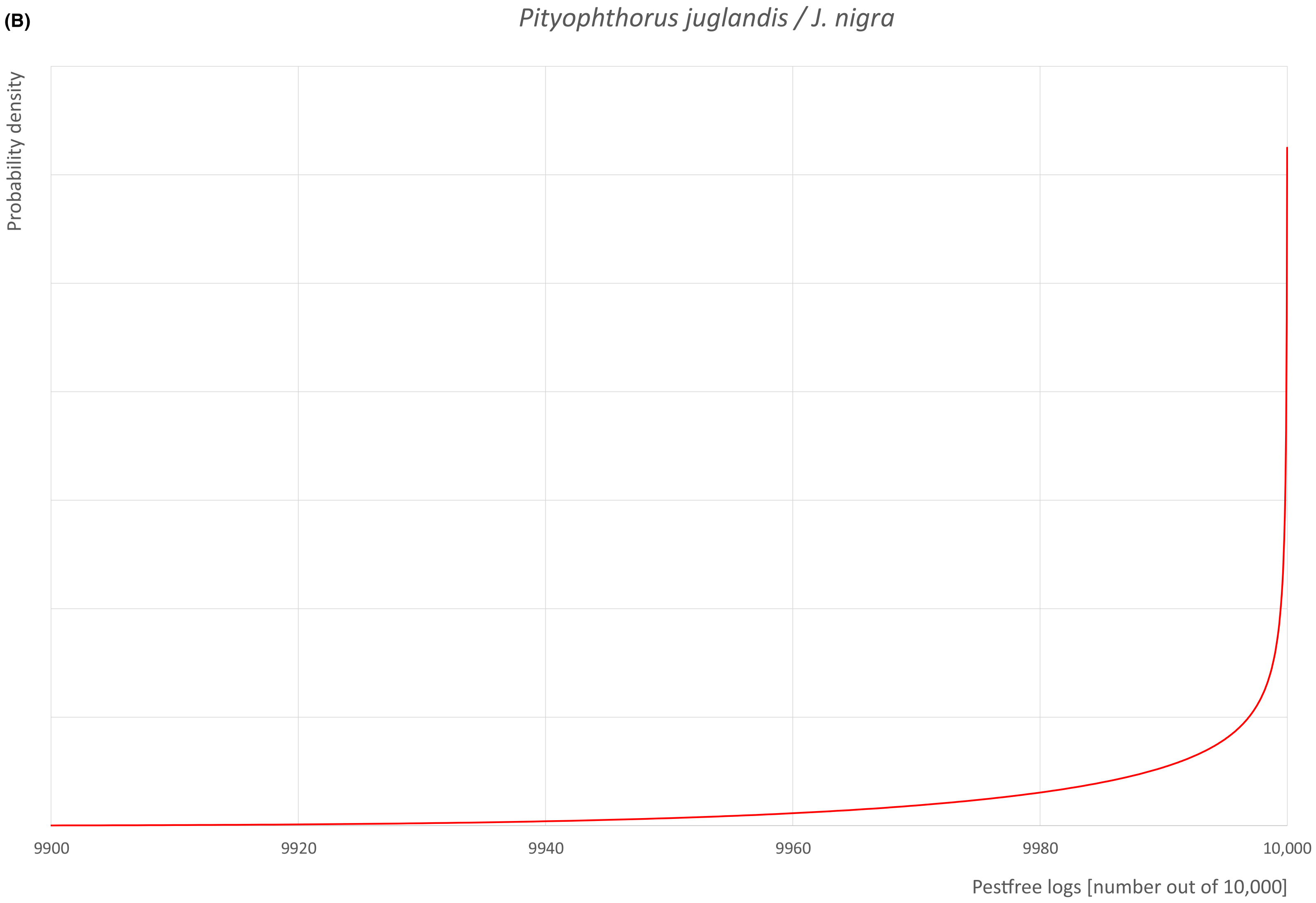

FIGURE C.4 (Continued)

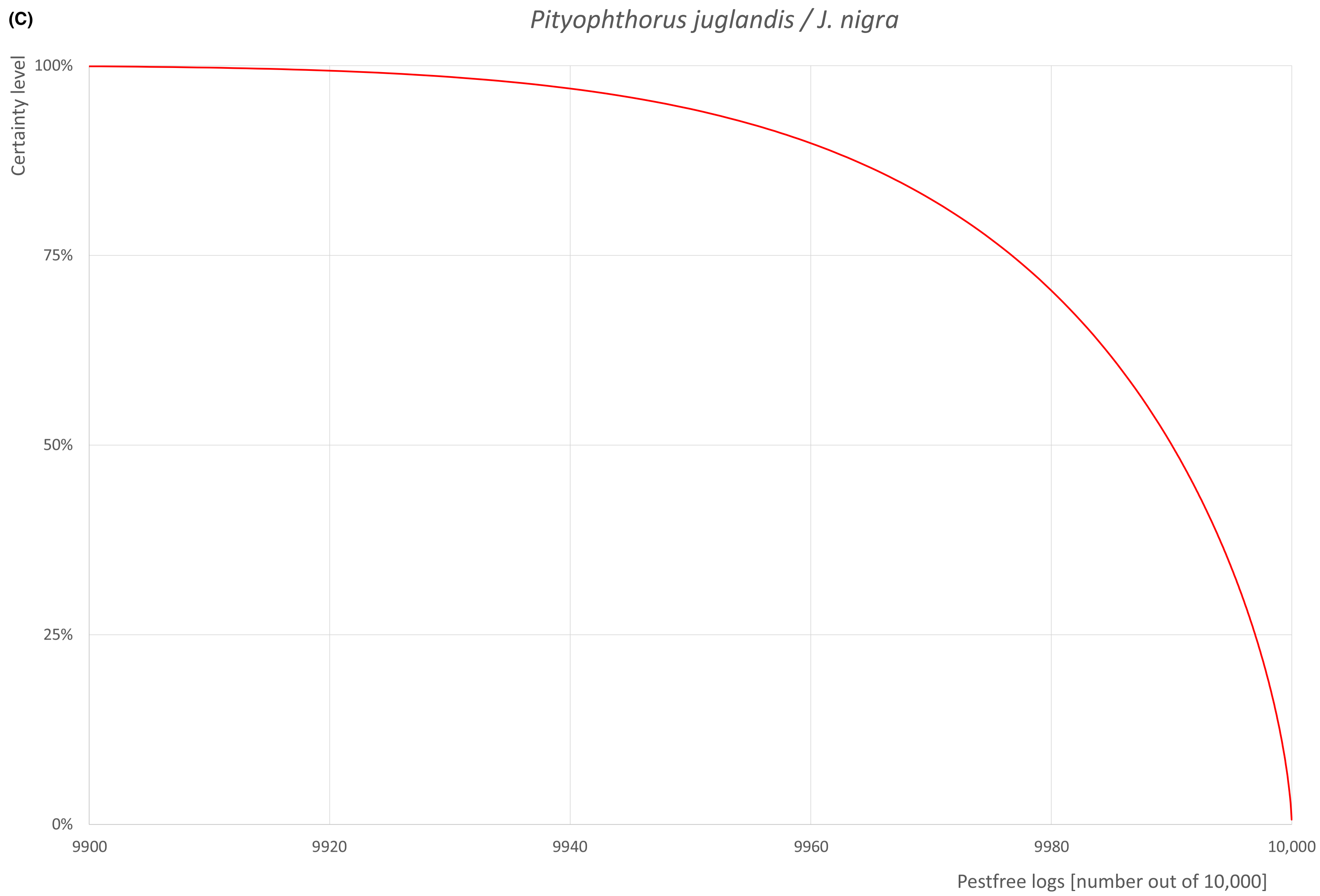

FIGURE C.4 (A) Elicited uncertainty of pest infestation per 10,000 logs (histogram in blue–vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty of the proportion of pest-free bare root logs per 10,000 (i.e. = 1 – pest infestation proportion expressed as percentage); (C) descending uncertainty distribution function of pest infestation per 10,000 logs.

C.5 | OVERALL LIKELIHOOD OF PEST FREEDOM OF AMBROSIA BEETLES FOR *JUGLANS* AND *QUERCUS* LOGS

C.5.1 | Reasoning for a scenario which would lead to a reasonably low number of infested *Juglans* and *Quercus* logs

This scenario assumes that insects are killed at temperatures below 56°C and that most are located within 5 cm of the sapwood surface. However, a small number of insects may still be found deeper than 5 cm in the sapwood.

C.5.2 | Reasoning for a scenario which would lead to a reasonably high number of infested *Juglans* and *Quercus* logs

This scenario assumes a high infestation level and an increased thermal tolerance of the insects. It also assumes that the treatment is not fully effective in eliminating all insects. Additionally, it assumes that some insects are located in regions deeper than 5 cm below the cambium where temperatures remain below 56°C.

C.5.3 | Reasoning for a central scenario equally likely to over- or underestimate the number of infested *Juglans* and *Quercus* logs (median)

The scenario assumes that the proposed vacuum–steam treatment (56°C for 30 min) is not fully effective in killing all the insects in infested logs.

C.5.4 | Reasoning for the precision of the judgement describing the remaining uncertainties (1st and 3rd quartile/interquartile range)

The limited information on all the biology of ambrosia beetles and the effectiveness of vacuum steam treatment relative to the depth of their galleries results in a lower uncertainty for scenarios above the median.

C.5.5 | Elicitation outcomes of the assessment of the pest freedom for ambrosia beetles on *Juglans* and *Quercus* logs

The following tables show the elicited and fitted values for pest infestation (Table C.9) and pest freedom (Table C.10).

TABLE C.9 Elicited and fitted values of the uncertainty distribution of pest infestation by ambrosia beetles per 10,000 logs.

Percentile	1%	2.5%	5%	10%	17%	25%	33%	50%	67%	75%	83%	90%	95%	97.5%	99%
Elicited values	20					50		80		150					400
EKE	20.0	21.7	24.5	30.0	37.6	47.6	58.5	84.7	120	145	179	222	277	331	400

Note: The EKE results are the BetaGeneral (1.0737, 26.058, 18.8, 2300) distribution fitted with @Risk version 7.6.

Based on the numbers of estimated infested logs, the pest freedom was calculated (i.e. = 10,000 – number of infested logs per 10,000). The fitted values of the uncertainty distribution of the pest freedom are shown in Table C.10.

TABLE C.10 The uncertainty distribution of logs free of ambrosia beetles per 10,000 logs calculated in Table C.9.

Percentile	1%	2.5%	5%	10%	17%	25%	33%	50%	67%	75%	83%	90%	95%	97.5%	99%
Values	9600					9850		9920		9950					9980
EKE results	9600	9669	9723	9778	9821	9855	9880	9915	9941	9952	9962	9970	9975	9978	9980

Note: The EKE results are the fitted values.

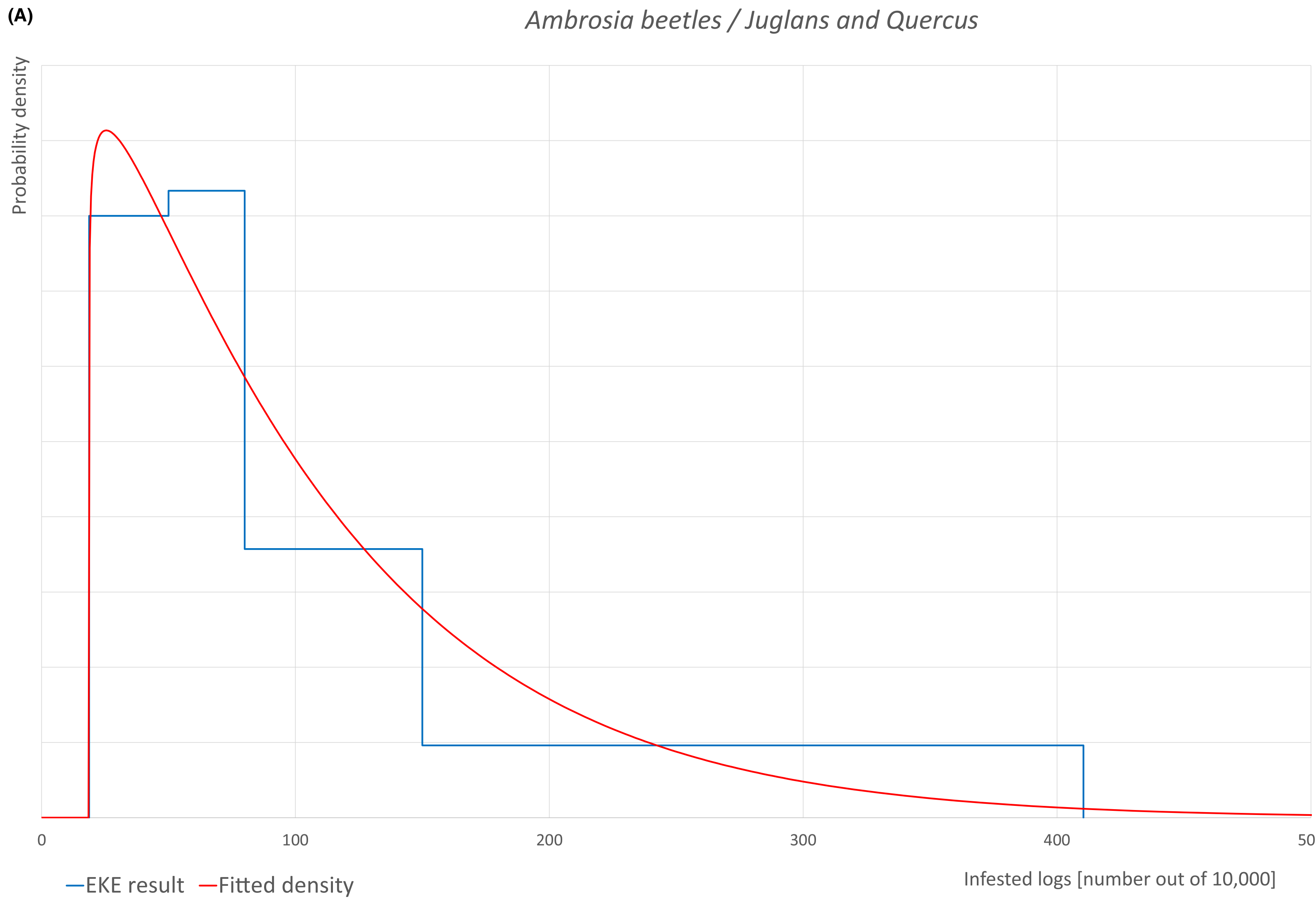

FIGURE C.5 (Continued)

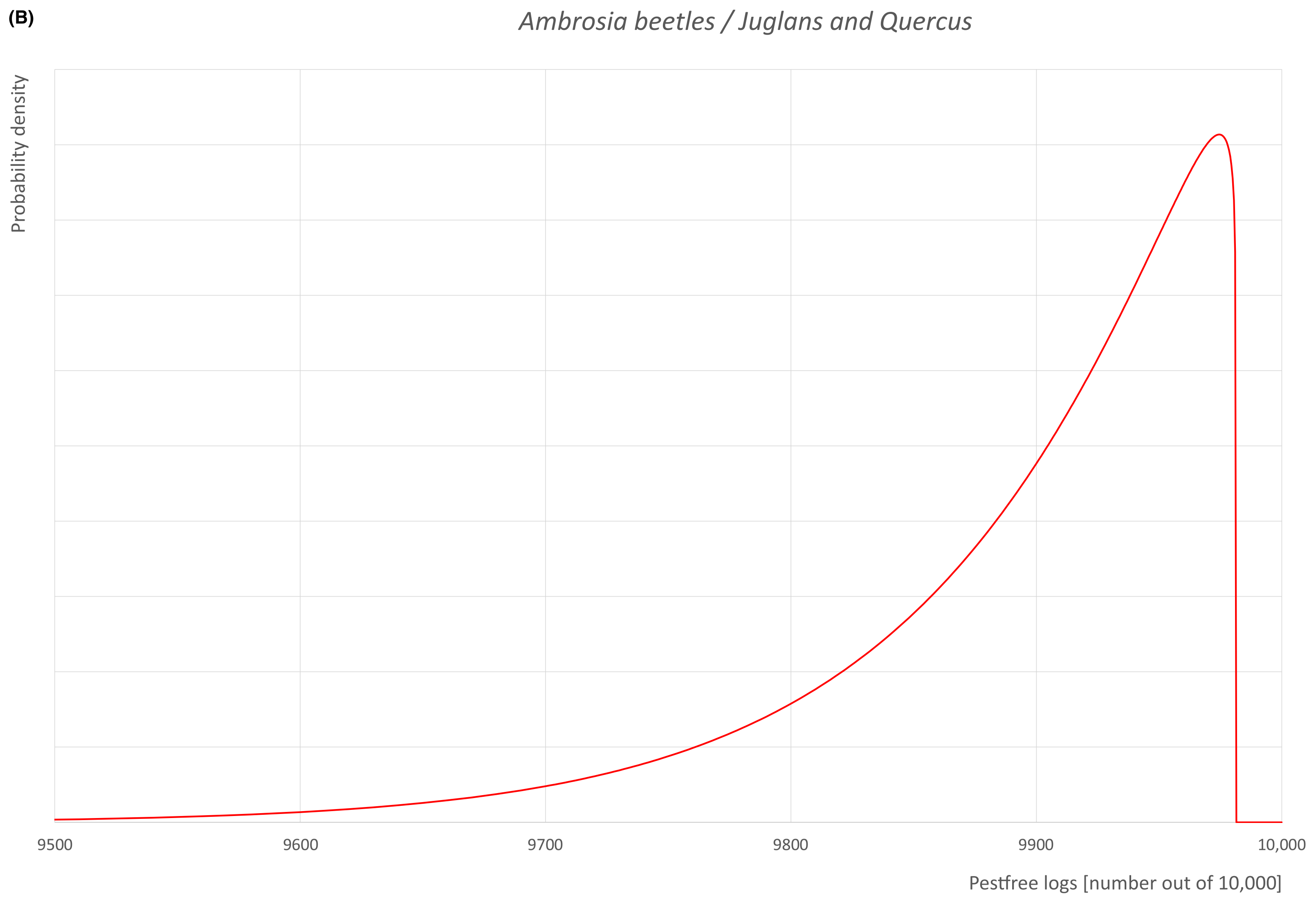

FIGURE C.5 (Continued)

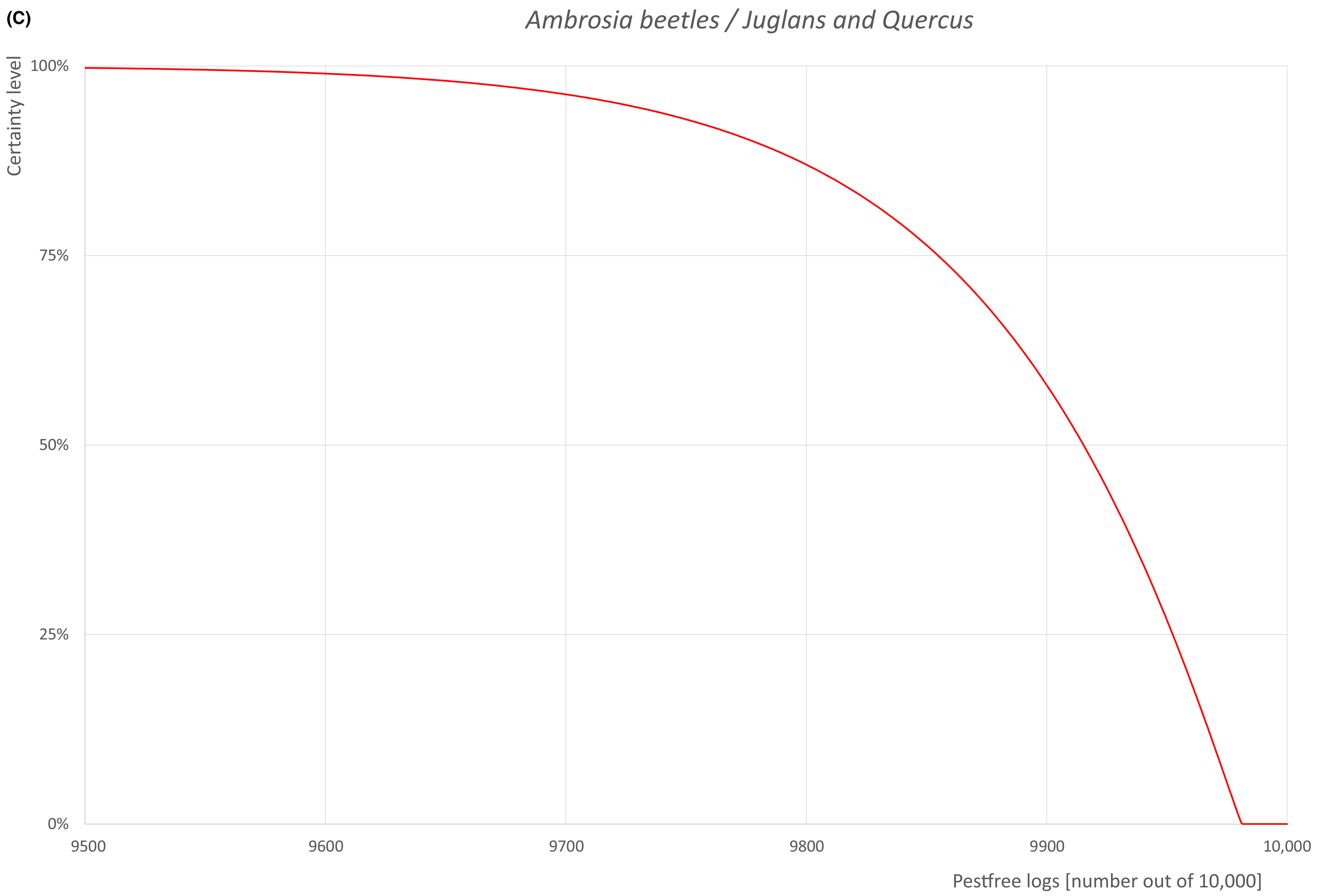

FIGURE C.5 (A) Elicited uncertainty of pest infestation per 10,000 logs (histogram in blue–vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty of the proportion of pest-free bare root logs per 10,000 (i.e. = 1 – pest infestation proportion expressed as percentage); (C) descending uncertainty distribution function of pest infestation per 10,000 logs.

C.6 | OVERALL LIKELIHOOD OF PEST FREEDOM OF *ARRHENODES MINUTUS* FOR *QUERCUS* LOGS

C.6.1 | Reasoning for a scenario which would lead to a reasonably low number of infested *Quercus* logs

The scenario assumes that some insects are located beyond 5 cm from the surface, where temperatures below 56°C may still be sufficient to cause mortality. However, it also assumes that most insects are present in areas where temperatures remain below 40°C and thus are unlikely to be killed.

C.6.2 | Reasoning for a scenario which would lead to a reasonably high number of infested *Quercus* logs

This scenario assumes that the species have a higher tolerance to temperature. It also assumes that most of the insects are in areas where the temperature does not reach 56°C, and therefore, they will survive.

C.6.3 | Reasoning for a central scenario equally likely to over- or underestimate the number of infested *Quercus* logs (median)

This scenario also assumes that most logs are in the thicker range, which reduces heat penetration and slows internal temperature rise. As a result, large portions of the log interior remain below 56°C, with some areas even staying below 40°C, well below the insect-killing threshold.

C.6.4 | Reasoning for the precision of the judgement describing the remaining uncertainties (1st and 3rd quartile/interquartile range)

The scenario assumes a high degree of uncertainty in both directions, primarily due to variability in stem thickness.

C.6.5 | Elicitation outcomes of the assessment of the pest freedom for *Arrhenodes minutus* on *Quercus* logs

The following tables show the elicited and fitted values for pest infestation (Table C.11) and pest freedom (Table C.12).

TABLE C.11 Elicited and fitted values of the uncertainty distribution of pest infestation by *Arrhenodes minutus* per 10,000 logs.

Percentile	**1%**	**2.5%**	**5%**	**10%**	**17%**	**25%**	**33%**	**50%**	**67%**	**75%**	**83%**	**90%**	**95%**	**97.5%**	**99%**
Elicited values	5000					6500		7500		8300					9000
EKE	5001	5173	5392	5736	6111	6508	6861	7489	8047	8305	8554	8749	8891	8961	9002

Note: The EKE results are the BetaGeneral (1.5349, 0.99995, 4790, 9030) distribution fitted with @Risk version 7.6.

Based on the numbers of estimated infested logs the pest freedom was calculated (i.e. = 10,000 – number of infested logs per 10,000). The fitted values of the uncertainty distribution of the pest freedom are shown in Table C.12.

TABLE C.12 The uncertainty distribution of logs free of *Arrhenodes minutus* per 10,000 logs calculated in Table C.11.

Percentile	**1%**	**2.5%**	**5%**	**10%**	**17%**	**25%**	**33%**	**50%**	**67%**	**75%**	**83%**	**90%**	**95%**	**97.5%**	**99%**
Values	1000					1700		2500		3500					5000
EKE results	998	1039	1109	1251	1446	1695	1953	2511	3139	3492	3889	4264	4608	4827	4999

Note: The EKE results are the fitted values.

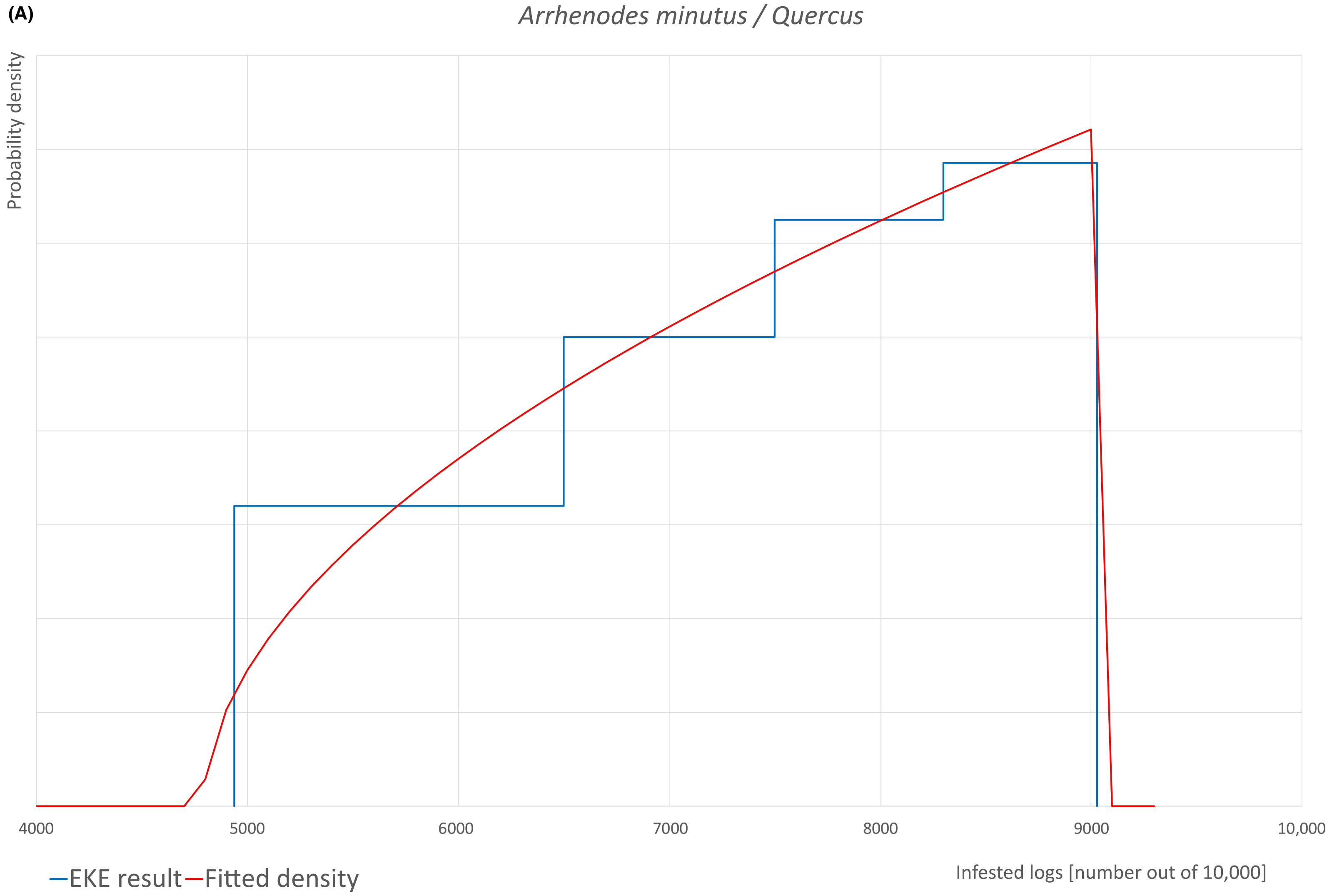

FIGURE C.6 (Continued)

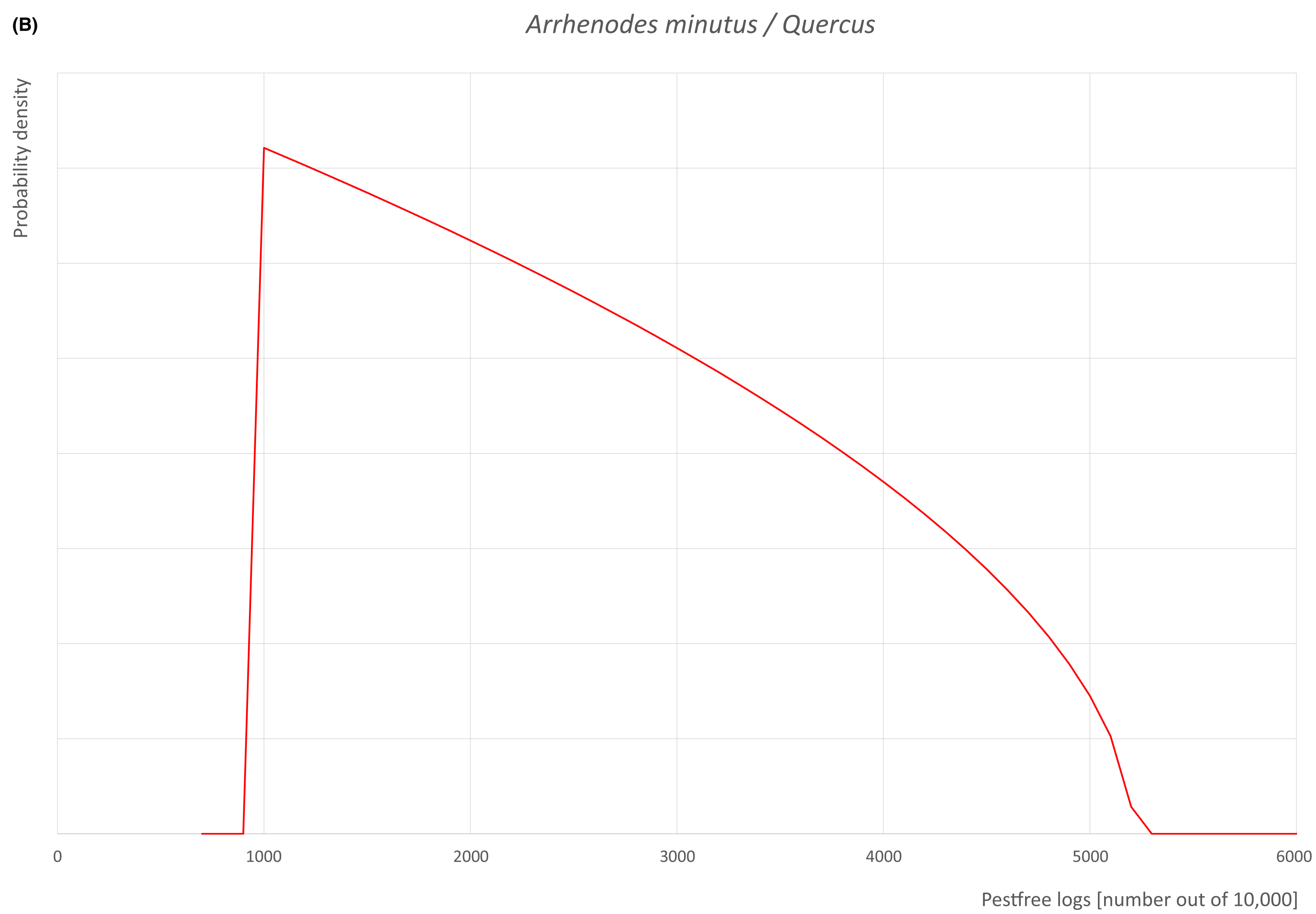

FIGURE C.6 (Continued)

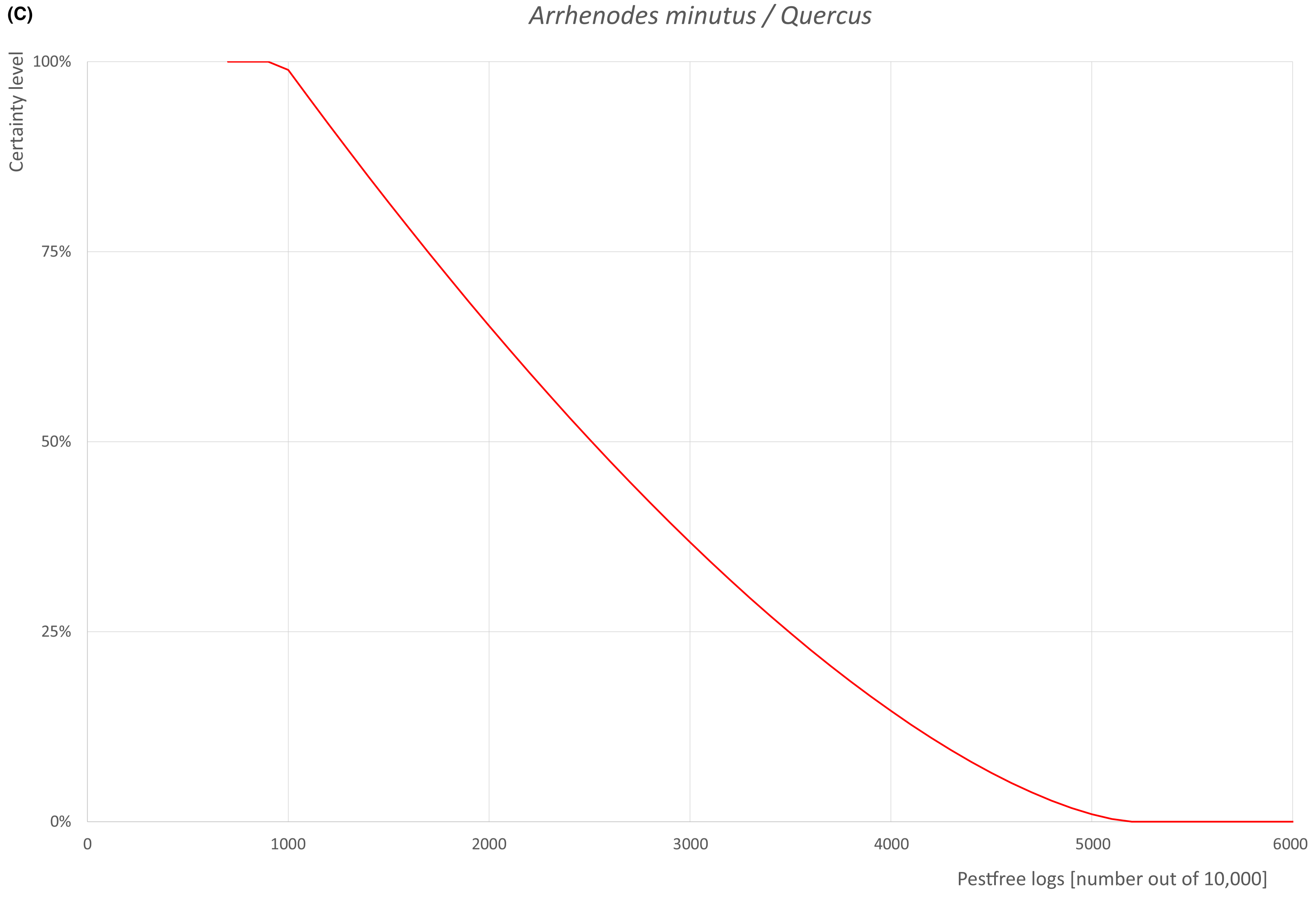

FIGURE C.6 (A) Elicited uncertainty of pest infestation per 10,000 logs (histogram in blue–vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty of the proportion of pest free bare root logs per 10,000 (i.e. = 1 – pest infestation proportion expressed as percentage); (C) descending uncertainty distribution function of pest infestation per 10,000 logs.

C.7 | OVERALL LIKELIHOOD OF PEST FREEDOM OF *XYLELLA FASTIDIOSA* FOR *JUGLANS* AND *QUERCUS* LOGS

C.7.1. | Reasoning for a scenario which would lead to a reasonably low number of infected *Juglans* and *Quercus* logs

This scenario assumes that the proposed heat treatment is effective against *X. fastidiosa* and that the pest is exposed to 56°C; i.e. it does not grow deeper than 5 cm in the sapwood.

C.7.2. | Reasoning for a scenario which would lead to a reasonably high number of infected *Juglans* and *Quercus* logs

The heat treatment is only partly effective and that the functional sapwood is deeper than 5 cm i.e. the pathogen is not exposed to 56°C for 30 min.

C.7.3. | Reasoning for a central scenario equally likely to over- or underestimate the number of infected *Juglans* and *Quercus* logs (median)

The evidence points to low heat tolerance of *X. fastidiosa* suggesting that *X. fastidiosa* does not survive 56°C for 30 min. However, some inoculum may survive if it is not sufficiently exposed to the heat i.e. if the functional sapwood is wider than 5 cm.

C.7.4. | Reasoning for the precision of the judgement describing the remaining uncertainties (1st and 3rd quartile/interquartile range)

The available information points at low heat tolerance of *X. fastidiosa* and hence less uncertainty regarding low percentages of surviving inoculum. The uncertainty is greater towards higher percentages of survival.

C.7.5. | Elicitation outcomes of the assessment of the pest freedom for *Xylella fastidiosa* on *Juglans* and *Quercus* logs

The following tables show the elicited and fitted values for pest infection (Table C.13) and pest freedom (Table C.14).

TABLE C.13 Elicited and fitted values of the uncertainty distribution of pest infection by *Xylella fastidiosa* per 10,000 logs.

Percentile	**1%**	**2.5%**	**5%**	**10%**	**17%**	**25%**	**33%**	**50%**	**67%**	**75%**	**83%**	**90%**	**95%**	**97.5%**	**99%**
Elicited values	0					10		20		45					100
EKE	0.188	0.553	1.25	2.86	5.32	8.80	12.7	22.3	34.9	43.1	53.6	65.3	78.5	89.2	100

Note: The EKE results are the BetaGeneral (0.85376, 3.0594, 0, 132) distribution fitted with @Risk version 7.6.

Based on the numbers of estimated infected logs, the pest freedom was calculated (i.e. = 10,000 – number of infected logs per 10,000). The fitted values of the uncertainty distribution of the pest freedom are shown in Table C.14.

TABLE C.14 The uncertainty distribution of logs free of *Xylella fastidiosa* per 10,000 logs calculated in Table C.13.

Percentile	**1%**	**2.5%**	**5%**	**10%**	**17%**	**25%**	**33%**	**50%**	**67%**	**75%**	**83%**	**90%**	**95%**	**97.5%**	**99%**
Values	9900					9955		9980		9990					10,000
EKE results	9900	9911	9921	9935	9946	9957	9965	9978	9987	9991	9995	9997	9998.7	9999.4	9999.8

Note: The EKE results are the fitted values.

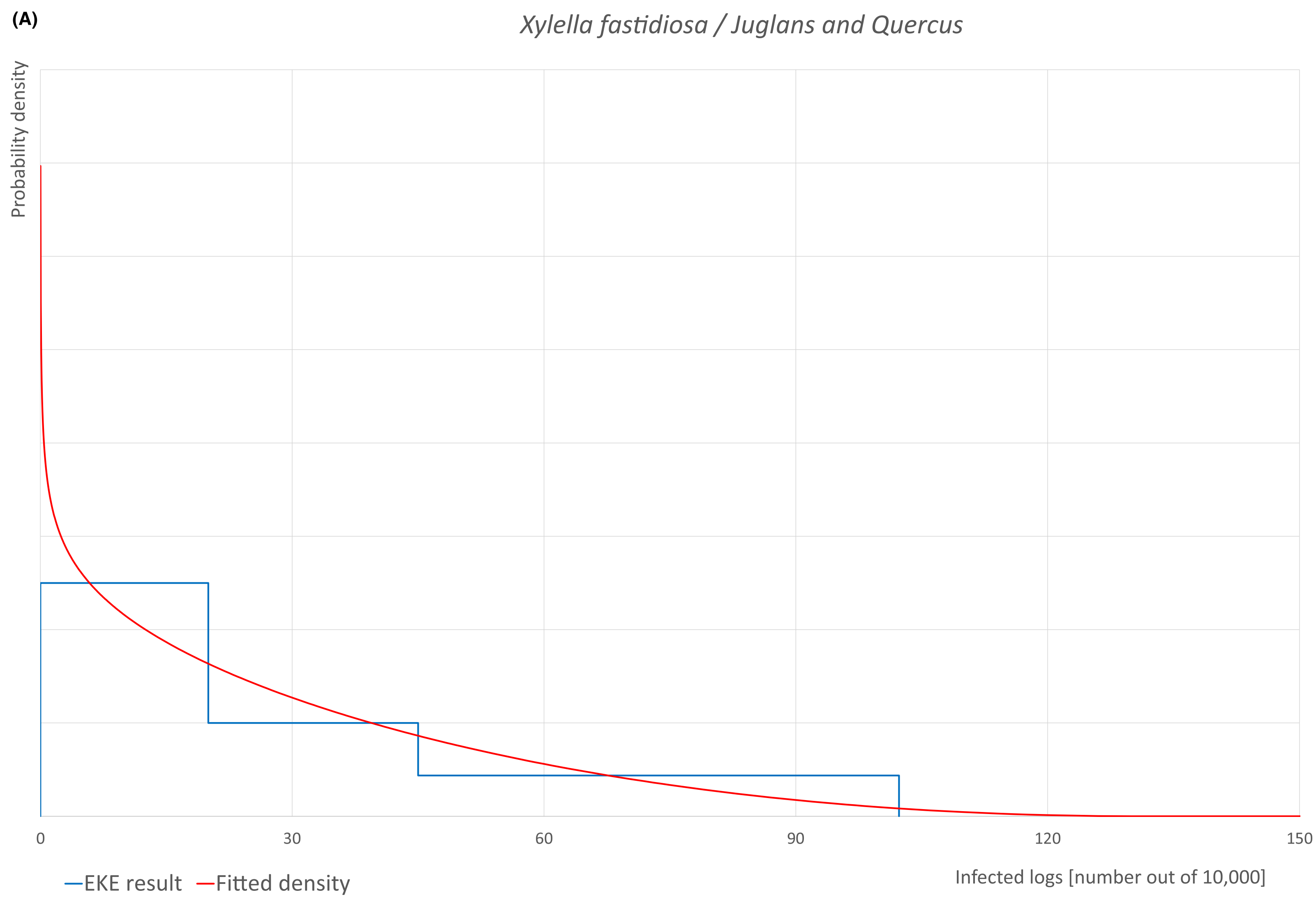

FIGURE C.7 (Continued)

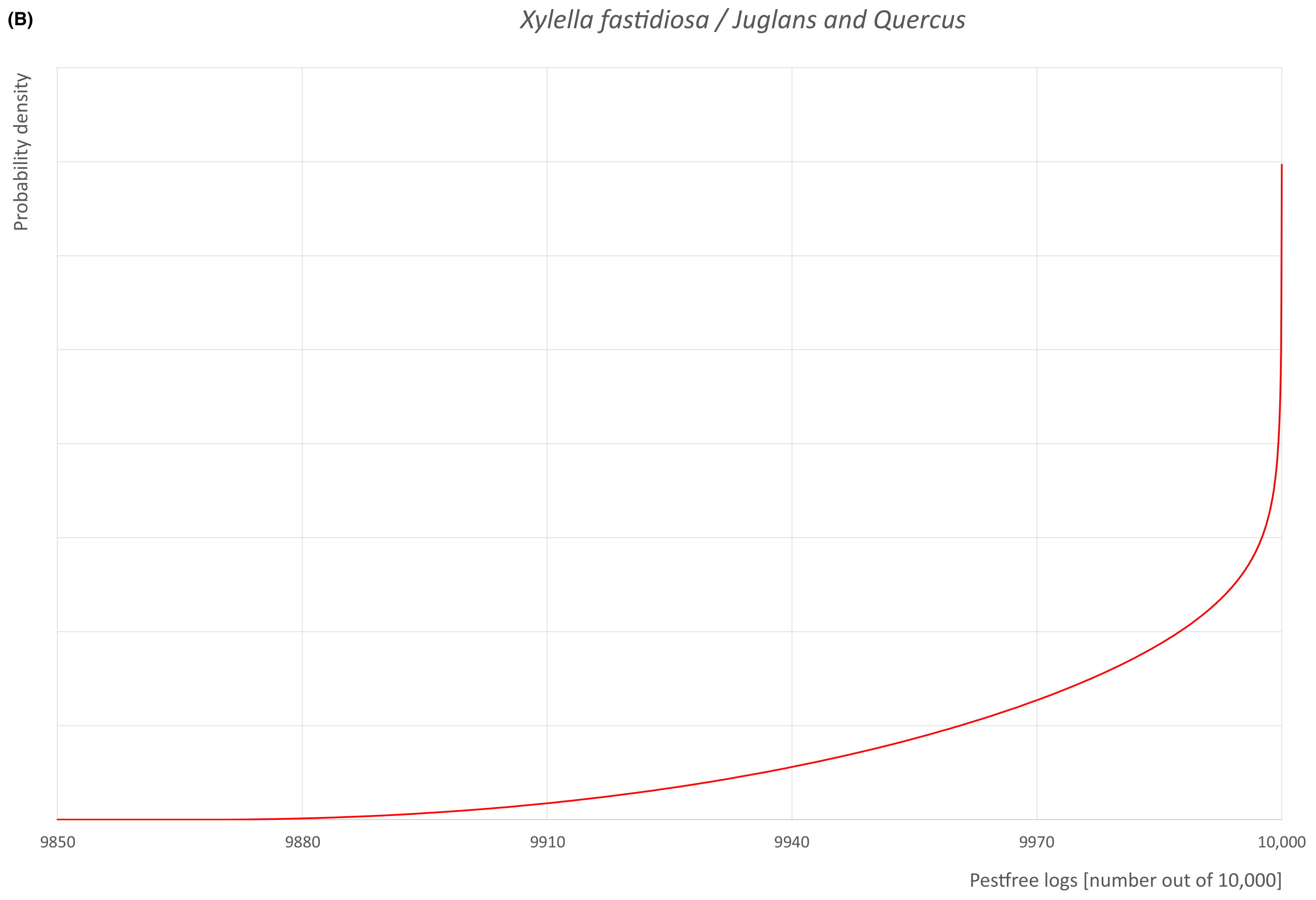

FIGURE C.7 (Continued)

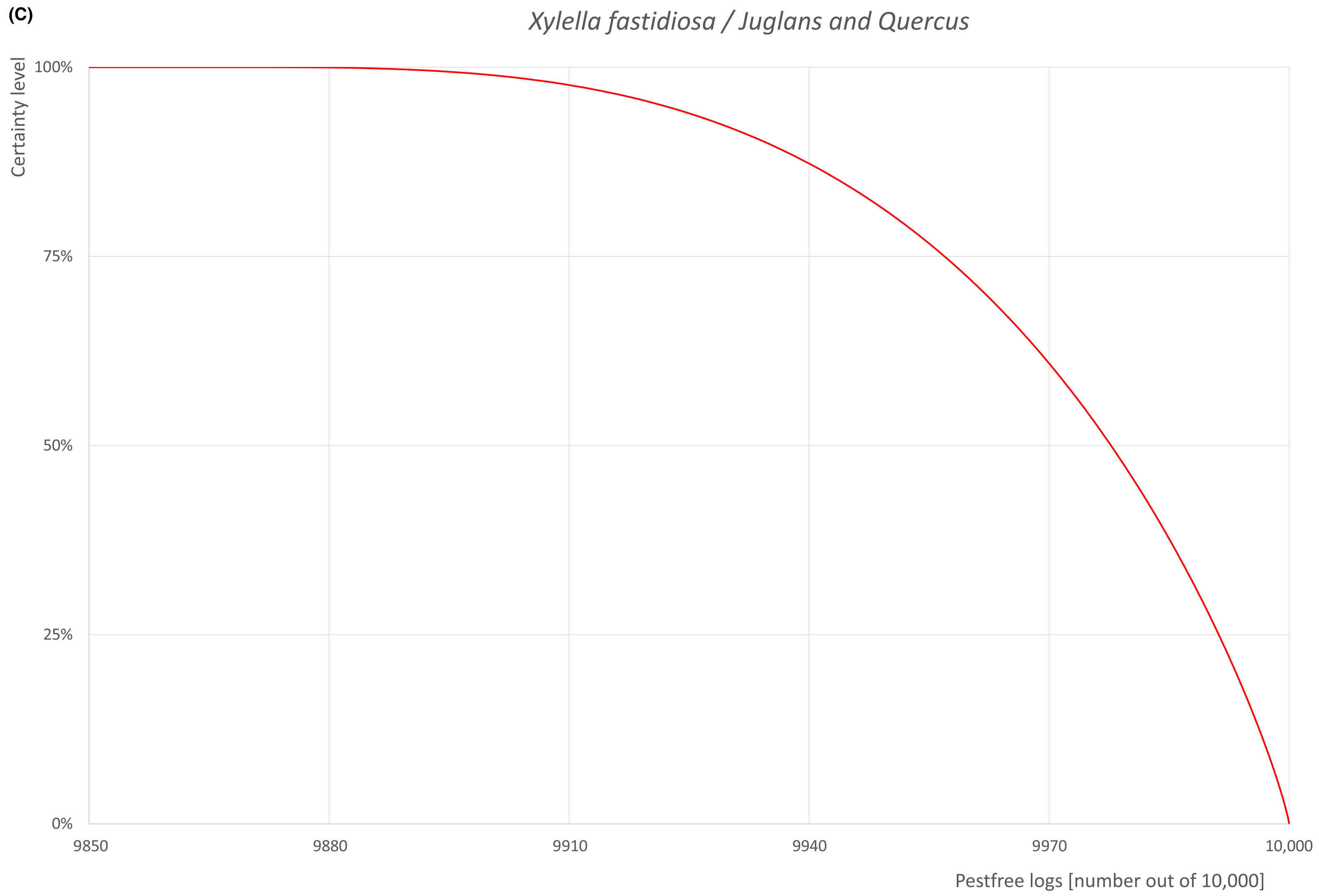

FIGURE C.7 (A) Elicited uncertainty of pest infection per 10,000 logs (histogram in blue–vertical blue line indicates the elicited percentile in the following order: 1%, 25%, 50%, 75%, 99%) and distributional fit (red line); (B) uncertainty of the proportion of pest free bare root logs per 10,000 (i.e. = 1 – pest infection proportion expressed as percentage); (C) descending uncertainty distribution function of pest infection.

APPENDIX D

Excel file with the EU quarantine pest list of oak and walnut species

Appendix D is available under the Supporting Information section on the online version of the scientific output.