EUROPEAN AND MEDITERRANEAN PLANT PROTECTION ORGANIZATION
ЕВРОПЕЙСКАЯ И СРЕДИЗЕМНОМОРСКАЯ ОРГАНИЗАЦИЯ ПО КАРАНТИНУ И ЗАЩИТЕ РАСТЕНИЙ
ORGANIZATION EUROPEENNE ET MEDITERRANEENNE POUR LA PROTECTION DES PLANTES

04-10804
PPM 8.8

PEST RISK ASSESSMENT SCHEME

Organism:	*Phytophthora quercina*
Assessor(s):	Dr. Thomas Jung
Date:	25/08/2003
Approximate time spent on the assessment	41 hours

PEST RISK ASSESSMENT

STAGE 1: INITIATION **Identify pest** *This section examines the identity of the pest to ensure that the assessment is being performed on a real identifiable organism and that the biological and other information used in the assessment is relevant to the organism in question.*		
1. Is the organism clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank? *if yes go to 3* *if no go to 2*	Yes	*Phytophthora quercina* (Jung) Chromista: Oomycota: Pythiales: Pythiaceae
2. Attempt to redefine the taxonomic entity so that the criteria under 1 are satisfied. Is this possible? *if yes go to 3* *if no go to 22*		
The PRA area *The PRA area can be a complete country, several countries or part(s) of one or several countries*		
3. Clearly define the PRA area. *go to 4*		Germany (EU/EPPO region)
Earlier analysis *The pest, or a very similar pest, may have been subjected to the PRA process before, nationally or internationally. This may partly or entirely replace the need for a new PRA.*		
4. Does a relevant earlier PRA exist? *if yes go to 5* *if no go to 7*	No	
5. Is the earlier PRA still entirely valid, or only partly valid (out of date, applied in different circumstances, for a similar but distinct pest)? if entirely valid End if partly valid go to 6 if not valid go to 7		
6. Proceed with the assessment, but compare as much as possible with the earlier assessment. *go to 7*		

STAGE 2: PEST RISK ASSESSMENT **Section A: Pest categorization (qualitative criteria of a quarantine pest)**		
Geographical criteria *This section considers the geographic distribution of the pest in the PRA area.*		
7. Does the pest occur in the PRA area? *if yes go to 8* *if no go to 9*	Yes	*P. quercina* is present in Germany, Sweden, United Kingdom, France, Italy, Austria, Belgium, Luxembourg, Hungary, Serbia and Turkey.
8. Is the pest of limited distribution in the PRA area? *Note: "of limited distribution" means that the pest has not reached the limits of its potential range either in the field or in protected conditions; it is not limited to its present distribution by climatic conditions or host-plant distribution. There should be evidence that, without phytosanitary measures, the pest would be capable of additional spread.* *if yes go to 18* *if no go to 22*	Yes	Most probably *P. quercina* is present in oak stands on suitable sites throughout the PRA area. Since it was not found in western and southwestern parts of France (Delatour *et al.* 2001a), and there are no records from some EU and many EPPO regions, it cannot be excluded that it has not reached the limits of its potential range in the EU/EPPO region. Furthermore, oak species are of major importance for afforestations on former agricultural sites, for amenity plantings, and for the conversion of pure conifer forests into mixed forests and hardwood forests that are better adapted to site conditions and less vulnerable to storm damages. These sites are presently not infested by *P. quercina*, and newly established oak plantings at these sites as well as yet uninfested nurseries are at serious risk that without phytosanitary measures the pathogen would be introduced via infested nursery stock.
Potential for establishment *For the pest to establish, it must find a widely distributed host plant in the PRA area (do not consider plants which are accidental/very occasional hosts or recorded only under experimental conditions). If it requires a vector, a suitable species must be present or its native vector must be introduced. The pest must also find environmental conditions suitable for survival, multiplication and spread, either in the field or in protected conditions.*		
9. Does at least one host plant grow to a substantial extent in the PRA area, in the open, in protected conditions or both? *if yes go to 10* *if no go to 22*		
10. Does the pest have to pass part of its life cycle on a host plant other than its major host (i.e. obligate alternate host plant)? *if yes go to 11* *if no go to 12*		
11. Does the alternate host plant also occur in the same part of the		

PRA area as the major host plant ? *if yes go to 12* *if no go to 22*		

12. Does the pest require a vector (i.e. is vector transmission the only means of dispersal)? *if yes go to 13* *if no go to 14*		
13. Is the vector (or a similar species which is known or suspected to be a vector) present in the PRA area or likely to be introduced. If in doubt, a separate assessment of the probability of introduction of the vector (in section B1) may be needed? *if yes go to 14* *if no go to 22*		
14. Does the known geographical distribution of the pest include ecoclimatic zones comparable with those of the PRA area? *if yes go to 18* *if no go to 15*		
15. Is it probable, nevertheless, that the pest could survive and thrive in a wider ecoclimatic zone that could include the PRA area? *if yes go to 18* *if no go to 16*		
16. Could the ecoclimatic requirements of the pest be found in protected conditions in the PRA area? *if yes go to 17* *if no go to 22*		
17. Is a host plant grown in protected conditions in the PRA area? *if yes go to 18* *if no go to 22*		

Potential economic importance		
Economic impact principally concerns direct damage to plants but may be considered very broadly, to include also social and environmental aspects. The effect of the presence of the pest on exports from the PRA area should also be allowed for. *In deciding whether economically important damage or loss to plants may occur, it is necessary to consider whether climatic and cultural conditions in the PRA area are conducive to damage expression, which is not always the case even if both host and pest survive under these conditions.* *Note: when performing a PRA on a pest that is transmitted by a vector, consider also any possible damage that the vector may cause.*		
18. With specific reference to the host plant(s) which occur(s) in the PRA area, and the parts of those plants which are damaged, does the pest in its present range cause significant damage or loss? *if yes go to 21* *if no go to 19*	Yes	Oak decline poses a serious threat to European Forestry. *P. quercina* is strongly involved in the oak decline complex on a wide range of site conditions by causing a chronic decline that eventually leads to death and by predisposing oaks to a series of abiotic and biotic stress factors.
19. Could the pest, nevertheless, cause significant damage or loss in the PRA area, considering ecoclimatic and other factors for damage expression? *if yes go to 21* *if no go to 20*		
20. Would the presence of the pest cause other negative economic impacts (social, environmental, loss of export markets)? *if yes go to 21* *if no go to 22*		
21. This pest could present a risk to the PRA area **Go To Section B**		
22. This pest does not qualify as a quarantine pest for the PRA area and the assessment can stop *However, if this is the first time that the decision-making scheme has directed you to this point, it may be worth returning to the question that led you here and continuing through the scheme in case the remaining questions strongly indicate categorization as a possible quarantine pest. In this latter case, seek a second opinion to decide whether the answers which led you to this point could be given a different reply.*		

Section B: Quantitative evaluation

The second part of the risk assessment process firstly estimates the probability of the pest being introduced into the PRA area (its entry and establishment) and secondly makes an assessment of the likely economic impact if that should happen. From these two aspects, it should be possible to consider the level of "pest risk" presented by the pest; this can then be used in the pest risk management phase to decide whether it is necessary to take phytosanitary measures to prevent the introduction of the pest, or if the measures chosen are appropriate for the level of risk. The questions in this section require an evaluation from minimum probability or impact (1) to maximum probability or impact (9). This must be done by an expert who can make an estimate according to the information provided (following the format of the check-list of EPPO (OEPP/EPPO, 1993a) and also according to comparison with other pests.
Answer as many of the following questions as possible, insofar as they are relevant to the pest concerned. If you cannot answer a particular question, do not give any score. Note whether this is because of lack of information or because the question is irrelevant to the pest concerned.

Questions marked with an asterisk (*) *are to be considered as more important than the others in the same section.*

1. Probability of introduction
Introduction, as defined by the FAO Glossary of Phytosanitary Terms, is the entry of a pest resulting in its establishment.

Entry

List the pathways that the pest could be carried on. *Note: a pathway can be any form of human activity that could transport the pest from a particular origin: e.g. plants and plant products moving in trade, any other traded commodity, containers and packing, ships, planes, trains, road transport, passengers, mail, etc. Note that similar means of pest transport from different origins can present greatly different probabilities of introduction, depending on the concentration of the pest in the area of origin. The pathways given should be only those already in operation, or proposed.*		1) Plants for planting of *Quercus* spp. (from infested nursery beds) 2) Plants for planting of non-host plants (from infested nursery beds) 3) Soil from infested oak stands adhering to logging machines, machines for construction of forest roads, cars trecking boots
1.1 How many pathways could the pest be carried on? *few = 1* *many = 9*	3	Oak plants and non-host plants from infested nursery beds, wild oak plants and non-host plants from infested oak stands, soil particles from infested oak stands adhering to logging machines, machines for the construction of forest roads, cars and trecking boots
1.2 For each pathway, starting with the most important pathway identified above (i.e. that which carries the greatest trade or which is most likely to act as a means of introduction) and then in descending order of importance, answer questions 1.3 – 1.13. If one of the questions 1.3a, 1.5a, 1.7a or 1.12a is answered by 'no', the pathway could not act as a means of entry for the pest, and the scheme will return directly to this point, omitting later questions. Use expert judgement to decide how many pathways to consider. ***Go to 1.3***		

Pathway 1: Plants for planting of *Quercus* from infested nurseries

1.3a Could the pest be associated with the pathway at origin? *Note: does the pest occur in the area of origin? Is the pest in a life stage which would be associated with commodities, containers, or conveyances?* *if yes go to 1.3b* *if no go to 1.2*	Yes	*P. quercina* was found to be present in nurseries in Germany and France.
1.3b How likely is the pest to be associated with the pathway at origin? [i.e. are all areas infested or highly infested; will every consignment or part of it be infested?] *not likely = 1* *very likely = 9*	5	There are only a few studies on the occurrence of *P. quercina* in nurseries. However, their results indicate a wide distribution of *P. quercina* in nurseries. In Germany *P. quercina* was recovered from oak plants coming from 5 out of 5 nurseries tested (Jung unpublished). Also in France *P. quercina* was isolated from nursery grown oak plants (Delatour *et al.* 2001b)
1.4 Is the concentration of the pest on the pathway at origin likely to be high? [i.e. will there be many individuals associated with the consignment?] *not likely = 1* *very likely = 9*	6	In the 5 cases tested in Germany most oak plants have been infested (Jung unpublished).
1.5a Could the pest survive existing cultivation or commercial practices? *Note: these are practices mainly in the country of origin, such as pesticide application, removal of substandard produce, kiln-drying of wood.* *if yes go to 1.5b* *if no go to 1.2*	Yes	
1.5b How likely is the pest to survive existing cultivation or commercial practices? *not likely = 1* *very likely = 9*	7	The thickwalled oospores of *P. quercina* are capable of surviving unfavourable conditions for several years.
1.6 How likely is the pest to survive or remain undetected during existing phytosanitary procedures? *Note: existing phytosanitary measures (e.g. inspection, testing or treatments) are most probably being applied as a protection against other (quarantine) pests; the assessor should bear in mind that such measures could be removed in the future if the other pests were to be re-evaluated.* *The likelihood of detecting the pest during inspection or testing will depend on a number of factors including:* • *ease of detection of the life stages which are likely to be present. Some stages are more readily detected than others, for example insect adults may be more obvious than eggs;* • *location of the pest on the commodity. Surface feeders are more readily detected than internal feeders;*	7	The thickwalled oospores of *P. quercina* are not very sensitive to metalaxyl (Jung unpublished), and it is rather likely that they also survive fungicides that are commonly used in nurseries. *P. quercina* is unlikely to be detected during regular inspections since the period that oak plants for forestry use are growing in well-drained nursery beds (2-3 years) is too short for developing extensive fine root damages that would lead to above-ground symptoms. Moreover, fine root symptoms caused by *P. quercina* are not distinguishable from those caused by other *Phytophthora* species.

• *symptom expression - many diseases may be latent for long periods, at certain times of the year, or may be without symptoms in some hosts or cultivars and virulent in others;* • *distinctiveness of symptoms - the symptoms might resemble those of other pests or sources of damage such as mechanical or cold injury;* • *the intensity of the sampling and inspection regimes;* • *distinguishing the pest from similar organisms.* *not likely = 1* *very likely = 9*		
1.7a Could the pest survive in transit? *Note: consideration should be given to:* • *speed and conditions of transport;* • *vulnerability of the life-stages likely to be transported;* • *whether the life cycle is of sufficient duration to extend beyond time in transit;* • *the number of individuals likely to be associated with a consignment.* *Interception data can be used to estimate the ability of a pest to survive in transit.* *if yes go to 1.7b* *if no go to 1.2*	Yes	
1.7b How likely is the pest to survive in transit? *not likely = 1* *very likely = 9*	9	The oospores of *P. quercina* are able to survive in soil particles and fine root fragments for considerable time, even under dry conditions.
1.8 Is the pest likely to multiply during transit? *not likely = 1* *very likely = 9*	1	*P. quercina* needs free water for the formation of sporangia, release of zoospores and infection of fine roots.
1.9 How large is movement along the pathway? [i.e. how much trade?] *not large = 1* *very large = 9*	7	Between 1996/97 and 2001/2002 Germany has imported more than 18 million nursery grown *Q. robur* and *Q. petraea* plants from other EU countries and more than 270000 oak plants from non-EU countries (Anon. 1997, 1998, 1999, 2000c, 2001, 2002). A much higher number of oak plants for forestry use are produced by German nurseries.
1.10 How widely is the commodity to be distributed throughout the PRA area? *Note: the more scattered the destinations, the more likely it is that the pest might find suitable habitats.* *not widely = 1* *very widely = 9*	9	Nursery grown oak plants are commonly used and widely distributed throughout Germany and the EU for the regeneration of mature harvested oak stands, for afforestations on former agricultural lands and for the replacement of pure conifer forests by mixed or hardwood forests.

1.11 How widely spread in time is the arrival of different consignments? *Note: introduction at many different times of the year will increase the probability that entry of the pest will occur at a life stage of the pest or the host suitable for establishment.* *not widely = 1* *very widely = 9*	4	Plantings of oaks are only carried out in spring and autumn.
1.12a Could the pest transfer from the pathway to a suitable host? *Note: consider innate dispersal mechanisms or the need for vectors, and how close the pathway on arrival is to suitable hosts.* *if yes go to 1.12b* *if no go to 1.2*	Yes	
1.12b How likely is the pest to be able to transfer from the pathway to a suitable host? *not likely = 1* *very likely = 9*	9	The nursery grown oak plants are suitable hosts. Moreover, transfer of *P. quercina* from infected nursery-grown oak plants to oaks in the field seems likely, since this mode of spread was recently demonstrated to occur on a large scale for *Alnus glutinosa* and the alder *Phytophthora* (Jung *et al.* 2003b).
1.13 Is the intended use of the commodity (e.g. processing, consumption, planting, disposal of waste) likely to aid introduction? *Note: consider whether the intended use of the commodity would destroy the pest or whether the processing, planting or disposal might be done in the vicinity of suitable hosts.* *not likely = 1* *very likely = 9*	9	Nursery-grown oak plants are used for the establishment of forest stands and amenity plantings. In addition, small nurseries often purchase oak plants from large nurseries and grow them for another 1 or 2 years in their beds before resale. This system facilitates the introduction of *P. quercina* to many nurseries.
Sum of entry potential via infested nursery stock of oak =	73	
No. of questions answered =	11	
Mean of Entry potential via infested nursery stock of oak =	**6.6**	
Pathway 2: Plants for planting of non-host plants from infested nurseries		
1.3a Could the pest be associated with the pathway at origin? *Note: does the pest occur in the area of origin? Is the pest in a life stage which would be associated with commodities, containers, or conveyances?* *if yes go to 1.3b* *if no go to 1.2*	Yes	*P. quercina* was found to be present in the rhizosphere of non-host plants (*Alnus glutinosa*) growing on a field of a German nursery that was planted with *Q. robur* 3 years ago (Jung *et al.* 2003b).
1.3b How likely is the pest to be associated with the pathway at origin? [i.e. are all areas infested or highly infested; will every consignment or part of it be infested?] *not likely = 1*	2	The finding of *P. quercina* in the rhizosphere of *A. glutinosa* plants was only casual. There are no studies on the occurrence of *P. quercina* in nursery grown non-host plants. However, due to the long survival time of the oospores a wide distribution of *P. quercina* in nursery grown non-host plants is suggested.

very likely = 9		
1.4 Is the concentration of the pest on the pathway at origin likely to be high? [i.e. will there be many individuals associated with the consignment?] *not likely = 1* *very likely = 9*	3	The concentration of *P. quercina* in the rhizosphere of non-host plants is most probably markedly lower than in oak plants.
1.5a Could the pest survive existing cultivation or commercial practices? *Note: these are practices mainly in the country of origin, such as pesticide application, removal of substandard produce, kiln-drying of wood.* *if yes go to 1.5b* *if no go to 1.2*	Yes	
1.5b How likely is the pest to survive existing cultivation or commercial practices? *not likely = 1* *very likely = 9*	7	The thickwalled oospores of *P. quercina* are capable of surviving unfavourable conditions for several years.
1.6 How likely is the pest to survive or remain undetected during existing phytosanitary procedures? *Note: existing phytosanitary measures (e.g. inspection, testing or treatments) are most probably being applied as a protection against other (quarantine) pests; the assessor should bear in mind that such measures could be removed in the future if the other pests were to be re-evaluated.* *The likelihood of detecting the pest during inspection or testing will depend on a number of factors including:* • *ease of detection of the life stages which are likely to be present. Some stages are more readily detected than others, for example insect adults may be more obvious than eggs;* • *location of the pest on the commodity. Surface feeders are more readily detected than internal feeders;* • *symptom expression - many diseases may be latent for long periods, at certain times of the year, or may be without symptoms in some hosts or cultivars and virulent in others;* • *distinctiveness of symptoms - the symptoms might resemble those of other pests or sources of damage such as mechanical or cold injury;* • *the intensity of the sampling and inspection regimes;* • *distinguishing the pest from similar organisms.* *not likely = 1* *very likely = 9*	8	The thickwalled oospores of *P. quercina* are not very sensitive to metalaxyl (Jung unpublished), and it is rather likely that they also survive fungicides that are commonly used in nurseries. *P. quercina* is unlikely to be detected during regular inspections since it is specific to oak species and will not cause damage to non-host plants.
1.7a Could the pest survive in transit? *Note: consideration should be given to:* • *speed and conditions of transport;* • *vulnerability of the life-stages likely to be transported;* • *whether the life cycle is of sufficient duration to extend beyond time in*	Yes	

transit; • *the number of individuals likely to be associated with a consignment.* *Interception data can be used to estimate the ability of a pest to survive in transit.* *if yes go to 1.7b* *if no go to 1.2*		
1.7b How likely is the pest to survive in transit? *not likely = 1* *very likely = 9*	9	The oospores of *P. quercina* are able to survive in soil particles and fine root fragments for considerable time, even under dry conditions.
1.8 Is the pest likely to multiply during transit? *not likely = 1* *very likely = 9*	1	*P. quercina* needs free water for the formation of sporangia, release of zoospores and infection of fine roots.
1.9 How large is movement along the pathway? [i.e. how much trade?] *not large = 1* *very large = 9*	5	Every year Germany is importing millions of nursery grown non-host plants from other EU countries and from non-EU countries (Anon. 1997, 1998, 1999, 2000c, 2001, 2002). A much higher number of non-host plants for forestry use are produced by German nurseries.
1.10 How widely is the commodity to be distributed throughout the PRA area? *Note: the more scattered the destinations, the more likely it is that the pest might find suitable habitats.* *not widely = 1* *very widely = 9*	9	Nursery grown non-host plants are commonly used and widely distributed throughout Germany and the EU for the regeneration of mature harvested forest stands, for afforestations on former agricultural lands and for the replacement of pure conifer forests by mixed or hardwood forests.
1.11 How widely spread in time is the arrival of different consignments? *Note: introduction at many different times of the year will increase the probability that entry of the pest will occur at a life stage of the pest or the host suitable for establishment.* *not widely = 1* *very widely = 9*	4	Plantings of trees are only carried out in spring and autumn.
1.12a Could the pest transfer from the pathway to a suitable host? *Note: consider innate dispersal mechanisms or the need for vectors, and how close the pathway on arrival is to suitable hosts.* *if yes go to 1.12b* *if no go to 1.2*	Yes	
1.12b How likely is the pest to be able to transfer from the pathway to a suitable host? *not likely = 1* *very likely = 9*	8	Oaks are usually planted in mixed forests. Therefore, a transfer from infected nursery-grown non-host plants to non-infected oak plants is highly probable. Moreover, transfer of *P. quercina* from infected nursery-grown non-host plants to oaks in the field seems likely, since this mode of spread was recently demonstrated to occur on a large scale for *Alnus glutinosa* and the alder *Phytophthora* (Jung *et al.* 2003b).

1.13 Is the intended use of the commodity (e.g. processing, consumption, planting, disposal of waste) likely to aid introduction? *Note: consider whether the intended use of the commodity would destroy the pest or whether the processing, planting or disposal might be done in the vicinity of suitable hosts.* *not likely = 1* *very likely = 9*	9	Nursery-grown non-host plants are used for the establishment of forest stands and amenity plantings. In addition, small nurseries often purchase oak plants from large nurseries and grow them for another 1 or 2 years in their beds before resale. This system facilitates the introduction of *P. quercina* to many nurseries.
Sum of entry potential via infested nursery stock of non-host plants =	65	
No. of questions answered =	11	
Mean of Entry potential via infested nursery stock of non-host plants =	**5.9**	
Pathway 3: Soil from infested oak stands adhering to logging machines, machines for construction of forest roads, cars, trecking boots, oak plants and non-host plants		
1.3a Could the pest be associated with the pathway at origin? *Note: does the pest occur in the area of origin? Is the pest in a life stage which would be associated with commodities, containers, or conveyances?* *if yes go to 1.3b* *if no go to 1.2*	Yes	Transport of soilborne *Phytophthora* species with infested soil particles is wellknown.
1.3b How likely is the pest to be associated with the pathway at origin? [i.e. are all areas infested or highly infested; will every consignment or part of it be infested?] *not likely = 1* *very likely = 9*	5	*P. quercina* is widely distributed in soils of oak stands throughout the PRA region (Germany) and the EU/EPPO. Therefore, spread of *P. quercina* with soil particles adhering to machines for logging or road construction is rather likely.
1.4 Is the concentration of the pest on the pathway at origin likely to be high? [i.e. will there be many individuals associated with the consignment?] *not likely = 1* *very likely = 9*	2	Size and volume of soil particles adhering to machines coming from oak stands is rather small. The concentration of *P. quercina* in forest soils is depending on the soil conditions. In sandy to sandy-loamy soils with pH ($CaCl_2$) <4.0 there are often only a few oaks infested whereas in sandy-loamy to clayey soils with higher pH the pathogen is often distributed throughout the stands.
1.5a Could the pest survive existing cultivation or commercial practices? *Note: these are practices mainly in the country of origin, such as pesticide application, removal of substandard produce, kiln-drying of wood.* *if yes go to 1.5b* *if no go to 1.2*	-	not applicable
1.5b How likely is the pest to survive existing cultivation or commercial practices? *not likely = 1*	-	not applicable

very likely = 9		
1.6 How likely is the pest to survive or remain undetected during existing phytosanitary procedures? *Note: existing phytosanitary measures (e.g. inspection, testing or treatments) are most probably being applied as a protection against other (quarantine) pests; the assessor should bear in mind that such measures could be removed in the future if the other pests were to be re-evaluated.* *The likelihood of detecting the pest during inspection or testing will depend on a number of factors including:* • *ease of detection of the life stages which are likely to be present. Some stages are more readily detected than others, for example insect adults may be more obvious than eggs;* • *location of the pest on the commodity. Surface feeders are more readily detected than internal feeders;* • *symptom expression - many diseases may be latent for long periods, at certain times of the year, or may be without symptoms in some hosts or cultivars and virulent in others;* • *distinctiveness of symptoms - the symptoms might resemble those of other pests or sources of damage such as mechanical or cold injury;* • *the intensity of the sampling and inspection regimes;* • *distinguishing the pest from similar organisms.* *not likely = 1* *very likely = 9*	9	There are no phytosanitary measures applied as a protection against the transport of pests with infested soil particles adhering to machines, cars, boots or wild seedlings coming from oak stands in the PRA region and the EU/EPPO region.
1.7a Could the pest survive in transit? *Note: consideration should be given to:* • *speed and conditions of transport;* • *vulnerability of the life-stages likely to be transported;* • *whether the life cycle is of sufficient duration to extend beyond time in transit;* • *the number of individuals likely to be associated with a consignment.* *Interception data can be used to estimate the ability of a pest to survive in transit.* *if yes go to 1.7b* *if no go to 1.2*	Yes	
1.7b How likely is the pest to survive in transit? *not likely = 1* *very likely = 9*	9	Oospores of *P. quercina* are known to survive in soil particles without presence of host plants and even under dry conditions for considerable time.
1.8 Is the pest likely to multiply during transit? *not likely = 1* *very likely = 9*	1	*P. quercina* needs free water for formation of sporangia, release of zoospores and infection of fine roots.
1.9 How large is movement along the pathway? [i.e. how much trade?] *not large = 1*	1	The soil particles adhering to machines or boots are rather small, and the probability that they are transported to oak stands on suitable sites rather than other forest types or non-

very large = 9		forests seems rather low.
1.10 How widely is the commodity to be distributed throughout the PRA area? *Note: the more scattered the destinations, the more likely it is that the pest might find suitable habitats.* *not widely = 1* *very widely = 9*	4	Logging activities and the construction of forest roads are increasingly carried out by private companies that are acting on a regional, national or even on an international scale rather than on a local scale. Wild seedlings of oaks and non-host species are only rarely and locally used for new plantings.
1.11 How widely spread in time is the arrival of different consignments? *Note: introduction at many different times of the year will increase the probability that entry of the pest will occur at a life stage of the pest or the host suitable for establishment.* *not widely = 1* *very widely = 9*	7	Logging activities are usually carried out during the cold season whereas forest roads are usually built in the warm season. Trecking activities occur throughout the year.
1.12a Could the pest transfer from the pathway to a suitable host? *Note: consider innate dispersal mechanisms or the need for vectors, and how close the pathway on arrival is to suitable hosts.* *if yes go to 1.12b* *if no go to 1.2*	Yes	
1.12b How likely is the pest to be able to transfer from the pathway to a suitable host? *not likely = 1* *very likely = 9*	2	The probability that soil particles from infested oak stands are transported to yet uninfested oak stands (e.g. plantations newly established with non-infested nursery stock) on suitable sites seems rather low. In addition, a successful transfer seems only probable if the infested soil particles are deposited uphill of oak stands.
1.13 Is the intended use of the commodity (e.g. processing, consumption, planting, disposal of waste) likely to aid introduction? *Note: consider whether the intended use of the commodity would destroy the pest or whether the processing, planting or disposal might be done in the vicinity of suitable hosts.* *not likely = 1* *very likely = 9*	-	not applicable
Sum of Entry potential via infested soil particles =	40	
No. of questions answered =	9	
Mean of Entry potential via infested soil particles =	**4.4**	
Sum of Entry potential in total =	181	
No. of questions answered =	32	
Mean of Entry potential in total =	**5.67**	

Establishment		
1.14 How many host-plant species are present in the PRA area? *one or very few = 1* *many = 9*	3	4 host species (*Q. robur*, *Q. petraea*, *Q. cerris* and *Q. pubescens*) are present in Germany. 5 additional host species are present in the EPPO region (*Q. ilex*, *Q. suber*, *Q. frainetto*, *Q. hartwissiana* and *Q. vulcanica*).
1.15 How extensive are the host plants in the PRA area? *rare = 1* *widespread = 9*	9	*Q. robur* and *Q. petraea* are common forest and amenity trees in Germany whereas *Q. pubescens* is only present in Southwestern Germany. *Q. cerris* is rarely planted as amenity tree or forest tree. Susceptible oak species are widespread throughout the EU/EPPO region.
1.16 If an alternate host is needed to complete the life cycle, how extensive are such host plants in the PRA area? *rare = 1* *widespread = 9*	-	

1.17 *1If a vector is needed for dispersal, how likely is the pest to become associated with a suitable vector? *Note: is the vector present in the PRA area, could it be introduced or could another vector be found?* *not likely = 1* *very likely = 9*	-	
1.18 Has the pest been recorded on crops in protected conditions elsewhere? (Answer this question only if protected cultivation is important in the PRA area.) *no = 1* *often = 9*	-	
1.19 How likely are wild plants (i.e. plants not under cultivation, including weeds, volunteer plants, feral plants) to be significant in dispersal or maintenance of populations? *not likely = 1* *very likely = 9*	7	*P. quercina* was recovered from managed and non-managed oak forests as well as from amenity trees. Non-managed 'wild' stands and amenity trees of oaks are widespread, and certainly significant for maintenance and probably also for dispersal of populations.
1.20 *How similar are the climatic conditions that would affect pest establishment in the endangered area and in the area of origin? *Note: the climatic conditions in the PRA area to be considered may include those in protected cultivation.* *not similar = 1* *very similar = 9*	9	The PRA area is probably part of the area of origin. Within the PRA area many sites which are not covered by oak stands and therefore are not infested by *P. quercina* will be afforested with oak plants. These endangered sites have similar climatic conditions as already infested sites in the PRA area. The known range of *P. quercina* covers most ecoclimatic

[1] Questions marked with an asterisk are to be considered as more important than the others in the same section.

		regions of EU/EPPO.
1.21 How similar are other abiotic factors in the PRA area and in the area of origin? *Note: the major abiotic factor to be considered is soil type; others are, for example, environmental pollution, topography/orography.* *not similar = 1* *very similar = 9*	9	The PRA area is probably part of the area of origin. Therefore, other abiotic factors such as soil type are very similar.
1.22 How likely is the pest to have competition from existing species in the PRA area for its ecological niche? *very likely = 1* *not likely = 9*	6	Since *P. quercina* is usually the most prevalent *Phytophthora* species in oak stands with presence of a rich community of *Phytophthora* species, this pathogen is likely to be a strong competitor for its ecological niche.
1.23 How likely is establishment to be prevented by natural enemies already present in the PRA area? *very likely = 1* *not likely = 9*	9	No natural enemies have been identified.

1.24 *If there are differences in the crop environment in the PRA area to that in the area of origin, are they likely to aid establishment? *Note: factors that should be considered include time of year that the crop is grown, soil preparation, method of planting, irrigation, whether grown under protected conditions, surrounding crops, management during the growing season, time of harvest, method of harvest, etc.* *not likely = 1* *very likely = 9*	-	not applicable
1.25 Are the control measures which are already used against other pests during the growing of the crop likely to prevent establishment of the pest? *very likely = 1* *not likely = 9*	7	No control measures are currently used in oak forests. Due to the rather low sensitivity of *P. quercina* oospores to fungizides and their long survival time, the control measures which are already used in nurseries are unlikely to prevent establishment of *P. quercina* in nursery beds, as indicated by recent findings of the pathogen in nurseries.
1.26 *Is the reproductive strategy of the pest and duration of life cycle likely to aid establishment? *Note: consider characteristics which would enable the pest to reproduce effectively in a new environment, such as parthenogenesis/self-crossing, duration of the life cycle, number of generations per year, resting stage, etc.* *not likely = 1* *very likely = 9*	8	The short life cycle (sexual reproduction = 1-2 weeks; asexual reproduction via zoospores = 48-72 hrs) and the long survival time of the oospores together with their low sensitivity to various abiotic factors are very likely to aid establishment.
1.27 How likely are relatively low populations of the pest to become established? *not likely = 1* *very likely = 9*	6	The capability of the oospores of *P. quercina* to survive over considerable periods and germinate readily after onset of favourable environmental conditions together with the extremely short asexual reproductive period (48-72 hrs.) enable even low populations of the pathogen to become established.
1.28 How probable is it that the pest could be eradicated from the PRA area ? *very likely = 1* *not likely = 9*	9	Soilborne *Phytophthora* species with long survival times of their oospores are very difficult to eradicate. Moreover, *P. quercina* is already widespread in the PRA area.
1.29 How genetically adaptable is the pest? *Note: is the species polymorphic, with, for example, subspecies, pathotypes? Is it known to have a high mutation rate? This genotypic (and phenotypic) variability facilitates the pest's ability to withstand environmental fluctuations, to adapt to a wider range of habitats, to develop pesticide resistance and to overcome host resistance.* *not adaptable = 1* *very adaptable = 9*	5	*P. quercina* is rather polymorphic (39% of polymorphic bands in an AFLP analysis with 80 isolates (Jung & Cooke in prep.)). Results of a soil infestation test as well as the wide range of site conditions of the stands from which *P. quercina* can be recovered indicate that the pathogen is able to adapt to different site conditions (Jung *et al.* 2000; 2003a).

1.30 *How often has the pest been introduced into new areas outside its original range? *Note: if this has happened even once before, it is important proof that the pest has the ability to pass through most of the steps in this section (i.e. association with the pathway at origin, survival in transit, transfer to the host at arrival and successful establishment). If it has occurred often, it suggests an aptitude for transfer and establishment.* *never = 1* *often = 9*	-	Origin and original range of *P. quercina* are not known at present.
Sum of Establishment potential =	87	
No. of questions answered =	12	
Mean of Establishment potential =	**7.25**	
Sum of Entry and Establishment potential =	268	
No. of questions answered =	44	
Mean risk of Entry and Establishment =	**6.1**	

2. Economic Impact Assessment

Identify the potential hosts in the PRA area, noting whether wild or cultivated, field or glasshouse. Consider these in answering the following questions. When performing a PRA on a pest that is transmitted by a vector, consider also any possible damage that the vector may cause.
According to the pest and host(s) concerned, it may be appropriate to consider all hosts together in answering the questions once, or else to answer the questions separately for specific hosts.

Note that, for most pest/crop/area combinations, precise economic evaluations are lacking. In this section, therefore, expert judgement is asked to provide an evaluation of the likely scale of impact. Both long-term and short-term effects should be considered for all aspects of economic impact.

2.1 *How important is economic loss caused by the pest within its existing geographic range? *little importance = 1* *very important = 9*	4	Oak decline is a serious threat to forestry in the PRA area and in the EU. In many stands dieback and mortality of oaks rather than silvicultural concepts are driving thinning and logging activities, and oaks have to be removed before reaching valuable dimensions. In the 1990s the proportion of dead or dying oak trees in the annual harvest of the State Forestry in Lower-Frankonia ranged from 5 to almost 100% (Anon. 2000c). *P. quercina* is known to be strongly involved in the decline complex on a wide range of site conditions, but due to the complexity of disease the importance of economic losses caused by *P. quercina* itself is difficult to assess.
2.2 How important is environmental damage caused by the pest within its existing geographic range?	3	On sites with a high soil pH (>6.0 in $CaCl_2$) oaks are selectively disfavoured by *P. quercina* fine root damage, and

Note: environmental damage may be impact on ecosystem health, such as effects on endangered/threatened species, keystone species or biodiversity. *little importance = 1* *very important = 9*		therefore are overgrown and replaced by tree species that are not susceptible to *P. quercina* such as *Fraxinus excelsior*, *Acer pseudoplatanus* and *Fagus sylvatica*. However, in general oaks are not in danger of becoming extincted by *P. quercina*.
2.3 How important is social damage caused by the pest within its existing geographic range? *Note: social effects could be, for example, damaging the livelihood of a proportion of the human population, or changing the habits of a proportion of the population (e.g. limiting the supply of a socially important food).* *little importance = 1* *very important = 9*	1	None reported.
2.4 *How extensive is the part of the PRA area likely to suffer damage from the pest? *Note: the part of the PRA area likely to suffer damage is the endangered area, which can be defined ecoclimatically, geographically, by crop or by production system (e.g. protected cultivation).* *very limited = 1* *whole PRA area = 9*	5	*P. quercina* is widespread in almost all ecoclimatic zones of Germany and the EU/EPPO region. I estimate that geographically and ecoclimatically more than 75% of Germany and the EU, and more than 50% of EPPO are endangered or are already suffering of damage. However, *P. quercina* is restricted by soil conditions and presence of oaks. In the PRA area all sites with soil pH >3.5 (in $CaCl_2$) and sandy-loamy to clayey soil texture that are presently covered by oak stands or are planned to be converted to oak stands are endangered. Such sites are distributed throughout the PRA area, but due to geology their proportion is higher in Southern than in Northern Germany. I estimate that ecologically 10% of Germany and EPPO are endangered or already suffering.
Spread potential is an important element in determining how fast economic impact is expressed and how readily a pest can be contained.		
2.5 *How rapidly is the pest liable to spread in the PRA area by natural means? *very slowly = 1* *very rapidly = 9*	2	Natural spread of soilborne *Phytophthora* species is rather slow and occurs primarily via zoospores in soil water and runoff, and secondly by infested soil particles (containing oospores or zoospores) transported by animals.
2.6 How rapidly is the pest liable to spread in the PRA area by human assistance? *very slowly = 1* *very rapidly = 9*	6	As indicated by experiences in Australia and Oregon, the spread of soilborne *Phytophthora* species by human assistance (infested nursery stock, soil particles adhering to machines for logging and road building, cars, boots) is likely to occur rather rapidly.
2.7 How likely is it that the spread of the pest could be contained within the PRA area? *Note: consider the biological characteristics of the pest that might allow it to be contained in part of the PRA area; consider the practicality and*	6	*P. quercina* is already widespread in oak stands in the PRA area, and was shown to occur in nurseries. However, spread by natural means is rather slow so that spread to oak plantations established in the future might at least be slowed down

costs of possible containment measures. *very likely = 1* *not likely = 9*		considerably if introduction of *P. quercina* via infested nursery stock or soil particles from infested oak stands could be prevented.
2.8 *Considering the ecological conditions in the PRA area, how serious is the direct effect of the pest on crop yield and/or quality likely to be? *Note: the ecological conditions in the PRA area may be adequate for pest survival but may not be suitable for significant damage on the host plant(s). Consider also effects on non-commercial crops, e.g. private gardens, amenity plantings.* *not serious = 1* *very serious = 9*	4	*P. quercina* is part of the complex disease oak decline, and therefore the direct effect of the pathogen on oak production is difficult to assess. There is certainly no direct effect on the quality of oak timber, but decrease of increment growth may prevent trees from reaching valuable dimensions Recent findings (Jung unpublished) indicate that afforestations of former agricultural sites as well as amenity plantings of oaks are likely to suffer from severe dieback caused by the interaction of *P. quercina*, waterlogging due to compacted subsoil, and high pH and fertility of the soil.
2.9 How likely is the pest to have a significant effect on producer profits due to changes in production costs, yields, etc., in the PRA area? *not likely = 1* *very likely = 9*	5	Oak decline is a serious threat to forestry in the PRA area and in the EU, and *P. quercina* is strongly involved on a wide range of site conditions. In the case that the production of oak plants in nurseries has to be containerised in order to avoid potential spread of *P. quercina* from infested nursery beds to new plantations the production costs for oak plants would increase significantly. Curative measures in diseased amenity and roadside trees are very expensive.

2.10 How likely is the pest to have a significant effect on consumer demand in the PRA area? *Note: consumer demand could be affected by loss in quality and/or increased prices.* *not likely = 1* *very likely = 9*	4	The quality of oak timber is not markedly reduced by oak decline, and therefore the oak timber market is not likely to be seriously affected. However, if it turns out that *P. quercina* is already widespread in nurseries (as indicated) it is likely that the consumers of nursery-grown oak plants (forestry, horticulture, landscape gardeners) will prefer natural regeneration of oak stands, seeding of acorns or planting of other tree species instead of oaks.
2.11 How likely is the presence of the pest in the PRA area to affect export markets? *Note: consider the extent of any phytosanitary measures likely to be imposed by trading partners.* *not likely = 1* *very likely = 9*	5	Export markets for oak timber are unlikely to be affected because timber is not a means of spread of soilborne *Phytophthora* species. However, since *P. quercina* can be spread by oak plants and even by non-host plants that were grown on former oak beds (Jung *et al.* 2003b) the export markets for nursery plants might be affected.
2.12 How important would other costs resulting from introduction be? *Note: costs to the government, such as research, advice, publicity, certification schemes; costs (or benefits) to the crop protection industry.* *little importance = 1*	3	Potential costs for the government: advice of owners of infested nurseries and plantations, and subsidization of the replacement of plantations that are suffering from serious damage by *P. quercina*. Curative measures in diseased amenity and roadside trees are very expensive.

very important = 9		
2.13 How important is the environmental damage likely to be in the PRA area? *little importance = 1* *very important = 9*	3	On sites with a high soil pH (>6.0 in $CaCl_2$) oaks are selectively disfavoured by *P. quercina* fine root damage, and therefore are overgrown and replaced by tree species that are not susceptible to *P. quercina* such as *Fraxinus excelsior*, *Acer pseudoplatanus* and *Fagus sylvatica*. However, oaks are not in danger of becoming extincted by *P. quercina*.
2.14 How important is the social damage likely to be in the PRA area? *little importance = 1* *very important = 9*	1	No social damage is presently known or expected.
2.15 How probable is it that natural enemies, already present in the PRA area, will affect populations of the pest if introduced? *very likely = 1* *not likely = 9*	9	No natural enemies of *P. quercina* are known.
2.16 How easily can the pest be controlled? *Note: difficulty of control can result from such factors as lack of effective plant protection products against this pest, occurrence of the pest in natural habitats or amenity land, simultaneous presence of more than one stage in the life cycle, absence of resistant cultivars).* *easily = 1* *with difficulty = 9*	5	In the field, soilborne *Phytophthora* species with long-living oospores which are capable to multiply their inoculum from low almost undetectable levels enormously within relatively short periods of favourable environmental conditions are very difficult to control. Moreover, *P. quercina* is already widespread in the PRA area. In nurseries, *P. quercina* could be easily controlled if oaks were grown from acorns in containers filled with thermo-sterilized substrate.

2.17 How likely are control measures to disrupt existing biological or integrated systems for control of other pests? *not likely = 1* *very likely = 9*	1	Not likely because the only efficient measure against *P. quercina* in nurseries would be to grow oaks from acorns in containers filled with thermo-sterilized substrate. For infested oak forests no economically reasonable control measure is known at present.
2.18 How likely are control measures to have other undesirable side-effects (for example on human health or the environment)? *not likely = 1* *very likely = 9*	1	Chemical control of *P. quercina* appears to be inefficient and uneconomical, and therefore applications of fungicides that could have undesirable side-effects are not likely.
2.19 Is the pest likely to develop resistance to plant protection products? *not likely = 1* *very likely = 9*	5	*P. quercina* is rather polymorphic (39% of polymorphic bands in an AFLP analysis with 80 isolates (Jung & Cooke in prep.)), and adaptable to very different site conditions (Jung *et al.* 2000; 2003a). Moreover, *P. quercina* has a very short asexual lifecycle and a short sexual life cycle with the possibility of both inbreeding and outcrossing. Therefore, *P. quercina* is likely to develop resistance to fungicides as already

		demonstrated for *P. infestans* (Schlenzig 1997).
Total economic risk =	73	
No. of questions answered =	19	
Mean risk of Economic impact =	**3.84**	
Summary		
Risk of Introduction (entry and establishment) =	**6.1**	
Risk of Economic impact =	**3.84**	
After completing this section, the assessor should comment on whether sufficient information exists to trust the answers given; or if he/she knows of other relevant factors that have not been considered in this evaluation		

3. Final Evaluation

At the end of the procedure, the assessor will have at his disposal:
(1) one or several sets of replies (1-to-9 scores) to questions 1.1-1.13, for one or several pathways (if no pathways have been retained, the probability of introduction will be zero);
(2) one set of replies (1-to-9 scores) to questions 1.14-1.30;
(3) one or several sets of replies (1-to-9 scores) to questions 2.1-2.19, for single, grouped or separate hosts (according to the manner of answering which has been chosen).

The assessor should first consider the quality and quantity of the information used to answer the questions, and give an overall judgement of how reliable the pest risk assessment can be considered. If other relevant information is available that has not been considered, this should be noted.

By the means of his choice, the assessor should attempt to make a separate estimate of the probability of introduction of the pest and its probable level of economic impact. As explained in the introduction, these estimates cannot, on the basis of the procedure used in the scheme, be expressed in absolute units. The numerical scores may be combined, weighted and averaged in appropriate ways that may enable the assessor who uses them consistently to make useful comparisons between pests, pathways and hosts. No particular mode of calculation is specifically recommended by EPPO. Certain questions have been identified as more important than others, and the assessor should take due account of this.

The assessor may then combine his estimates of probability of introduction and probable economic impact to formulate a single estimate of pest risk. This may usefully be compared with one or several reference levels of risk to decide whether the pest should be considered to be a quarantine pest, so that phytosanitary measures should be taken against it.

Finally, the scores given in answer to the different sections (particularly that on pathways) may be used again in pest risk management.

The information on biology, pathology and means of spread of *P. quercina* was sufficient and reliable. All available data on the geographical distribution of *P. quercina* was used, but more investigations are needed on the distribution in nurseries and on the presence in those EU/EPPO regions from which the pathogen was not yet recorded. In contrast, there are almost no experiences with the control of *P. quercina*, and general experiences from the control of soilborne *Phytophthora* species have been used. Considering all available data on geographical distribution, the biology of *P. quercina*, the amount of nursery trade and the distribution of oak decline I estimate that *P. quercina* is almost non-limited in the PRA area and widespread throughout most of the EU/EPPO region. In my opinion *P. quercina* is also rather common in many nurseries, and the risk of introduction to yet uninfested EU/EPPO regions, uninfested nurseries and oak plantations established in the future is rather high if the system of producing oak plants in nurseries will not be changed. No data are available on the direct economic impact of *P. quercina*, and general informations on the economic costs of oak decline are not very useful, since it is a complex disease and the contribution of the single factors is impossible to assess. Nevertheless, it is obvious that oak decline is a serious threat to European Forestry, and *P. quercina* is strongly involved on a wide range of sites whereas on others it may play a minor role, if at all.

Conclusions

P. quercina is already widespread on a wide range of sites in stands and amenity plantings of oaks in Germany and the EU/EPPO region. From this point, a declaration of *P. quercina* as a quarantine pest for the EU and EPPO and EU/EPPO import recommendations/regulations seems not justified. However, in Germany and the EU pure conifer stands on wet or periodically wet sites are vulnerable to storm damages. Many of these stands as well as many agricultural sites where crop production has been stopped have already been converted into pure or mixed oak stands, subsidized by the national governments and the EU, and this process is likely to be continued in the future. Moreover, oaks are often used for amenity plantings. These sites are usually not infested by *P. quercina* and other *Phytophthora* species that are pathogenic to oaks. Due to the lack of competitors, compaction of the subsoil that leads to internal waterlogging, and high pH and fertility of many of these soils *P. quercina* has the potential to become a serious pest in such plantings if introduced via infested nursery stock. At present there are only a few investigations on the presence of *P. quercina* in nurseries, but they are indicating a rather widespread occurrence. More data are needed and consideration needs to be given as how to prevent the introduction of *P. quercina* via infested nursery stock to new forest, horticultural and amenity plantings as well as to yet uninfested nurseries. An efficient control measure would be the production of oak plants in containers filled with sterilized substrate rather than in nursery beds.