Pest risk assessment for the European Community: plant health: a comparative approach with case studies

Prima phacie

Mycosphaerella dearnessii

Pest Risk Assessment: Revised Test Method 4b[1]
With EU legislation in place

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[1] Method 4b describes risk elements using an ordinal scale of 5 categories (very low, low, medium, high, very high)

Preface

Pest risk assessment provides the scientific basis for the overall management of pest risk. It involves identifying pests and characterizing the risks associated with those pests by estimating their probability of introduction (entry, transfer and establishment) as well as the severity of the consequences to crops and the wider environment as a result of their introduction.

Risk assessments are science-based evaluations. They are neither scientific research nor are they scientific manuscripts. The risk assessment forms a link between scientific data and decision makers and should expresses risk in terms appropriate for decision makers.

Note

Risk assessors will find it useful to have a copy of International Standards for Phytosanitary Measures No. 5, the Glossary of Phytosanitary Terms (IPPC, 2007)[1], ISPM No. 11, Pest risk analysis for quarantine pests, including analysis of environmental risks and living modified organisms (IPPC, 2004)[2] and the EFSA guidance document on a harmonized framework for pest risk assessment (EFSA, 2010)[3] to hand as they read this document and conduct a pest risk assessment.

[2] ISPMs Nos. 5 and 11 available at https://www.ippc.int/index.php?id=ispms&no_cache=1&L=0
[3] EFSA Journal 2010, **8**(2),1495-1561, Available at http://www.efsa.europa.eu/en/scdocs/doc/1495.pdf

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Executive Summary

Provide a technical summary reflecting the content of the assessment (the questions addressed, the information evaluated, and the key issues which resulted in the conclusion)

The purpose of this pest risk assessment was to evaluate the plant health risk associated with *Mycosphaerella dearnessi* (brown spot needle blight) within the framework of EFSA project CFP/EFSA/PLH/2009/01.

Pest biology (see datasheet for details)

- Identity of the pest

  Preferred scientific name (teleomorph): *Mycosphaerella dearnessi* M. E. Barr (1972)
  Anamorph: *Lecanosticta acicola* (Thüm.) Syd. (1924) (syn. *Scirrhia acicola*)

- Life history
  Mycosphaerella dearnessii produces conidia and ascospores, both of which can cause infection. In cool climates (e.g. north- and mid-central United States) only conidia are produced (Fig. 1A) (Phelps *et al.,* 2002). However, in warm moist climates (e.g. southern United States), both spore types are produced (Fig. 1B). *M. dearnessii* survives the winter in lesions on dead needles, either still attached to the plant or fallen ones. Spores are released only during wet weather and never at low temperatures (near 2^0C) (CABI/EPPO, 1997). Conidia produced in acervuli on infected needles are released in gelatinous masses under moist conditions, such as rainfall, dew or fog, and are splash-dispersed or washed-off by rain to nearby susceptible tissues, where new infections may occur. The conidia can also be spread by insects and on forestry equipment, such as shearing tools (Skilling and Nicholls, 1974). Ascospores produced in ascomata on infected dead needles are wind-disseminated causing scattered infections at great distances from the initial foci (Phelps *et al*., 2002).

  Infection of pine needles by *M. dearnessii* spores occurs primarily in the spring, but under moist conditions, host plants may become infected throughout the growing season (from spring to late summer) (Hildebrand, 2005). In general, succulent pine needle tissues are more susceptible to infection by *M. dearnessii* than mature tissues. Spore germination occurs over a wide range of temperatures (5-35^0C) (Anonymous, 1989). Following germination on the needle surface, hyphae enter the needle through the stomata (Setliff and Patton, 1974). However, under certain conditions, the pathogen may also enter through wounds (Skilling and Nicholls, 1974; Kais, 1975a; Kais 1978). Warm and wet conditions favour the infection of susceptible pine species by *M. dearnessii* and the development of the disease (CABI, 2011). Although infection can occur over a wide range of temperatures, it is most rapid in longleaf pine if day and night temperatures are about 30°C and 21°C, respectively (Sinclair *et al.*, 1987). Depending on host type and age, the incubation period (time between infection and symptom development) varies from 1-2 months (on young needles) to 4-7 months (on older foliage) (CABI/EPPO, 1997). Two toxins produced by *M. dearnessii* are considered to be involved in the pathogenesis (Yang *et al*., 2002). Conidial stromata begin to form as soon as the mesophyll tissues become necrotic and the invading mycelium becomes intracellular (Wolf and Barbour, 1941). After a period of stroma development, mature conidiomata break through the epidermis.

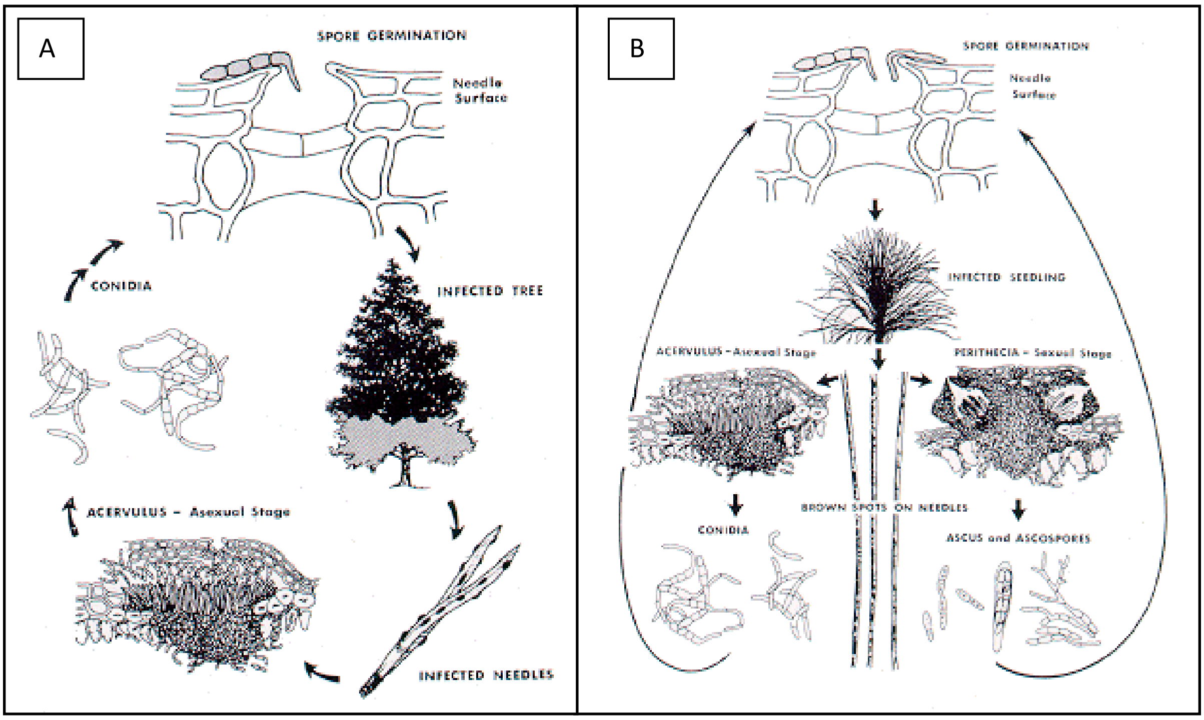

Figure 1. Life cycles of *Mycosphaerella dearnessii.* (A): on longleaf pine (*Pinus palustris*) or in cool climates; (B): on Scots pine (*P. sylvestris*) or in warm, moist climates (Phelps *et al*., 2002)

In areas where both the anamorph and the teleomorph are present, ascomata develop and mature within 2 to 3 months after infected needle tissues die (approximately in late August) (Lightle, 1960). Although ascospores are released in September, infection is restricted probably due to the increased needle resistance (CABI/EPPO, 1997). The disease cycle renews the following spring when the overwintering fruiting bodies release conidia and/or ascospores.

In warm, less seasonal climates of Central America, the conidial cirri remain on the needles for many months and it is significant that the conidia in lowland tropical areas are considerably larger, thick-walled, heavily pigmented and ornamented than those found in areas of high altitude and with cloud forests (Evans, 1984). It is unclear whether this variation is determined environmentally or genetically.

Pathogenicity variation has also been detected within *M. dearnessii* population (Phelps *et al.,* 2002). Fungal isolates obtained from Scots pines (*P. sylvestris*) in the northern-central United States differ both in cultural characteristics and in virulence from isolates obtained from longleaf pines (*P. palustris*) in the southern Unites States, with the latter being physiologically similar to isolates originating from China (Patton, 1997).

Affected Plant Stages

Mycosphaerella dearnessii affects only the needles of its hosts and although most infections occur in spring, under moist conditions, needles may become infected throughout the growing season (spring to late summer)
Flowering stage
Fruiting stage
Seedling stage
Vegetative growing stage

- Host range / habitat

All pine species are potential hosts of *M. dearnessii*. The disease affects trees of all sizes and ages but is most damaging on young ones.

Major hosts
Pinus attenuata (knobcode pine), *Pinus banksiana* (jack pine), *Pinus contorta* (lodgepole pine), *Pinus echinata* (shortleaf pine), *Pinus elliottii* (slash pine), *Pinus glabra* (spruce pine), *Pinus halepensis* (Aleppo pine), *Pinus monticola* (western white pine), *Pinus mugo* (mountain pine), *Pinus muricata* (bishop pine), *Pinus nigra* (black pine), *Pinus palustris* (longleaf pine), *Pinus pinaster* (maritime pine), *Pinus pinea* (stone pine), *Pinus radiata* (radiata pine), *Pinus resinosa* (red pine), *Pinus rigida* (pitch pine), *Pinus serotina* (pond pine), *Pinus strobus* (eastern white pine), *Pinus sylvestris* (Scots pine),*Pinus taeda* (loblolly pine), *Pinus thunbergii* (Japanese black pine), *Pinus virginiana* (scrub pine)

Minor hosts
Picea glauca (white spruce), *Pinus ayacahuite* (Mexican white pine), *Pinus caribaea* (Caribbean pine), *Pinus maximinoi* (thin-leaf pine), *Pinus oocarpa* (ocote pine), *Pinus patula* (Mexican weeping pine), *Pinus ponderosa* (ponderosa pine), *Pinus tecunumanii* (tecun uman pine)

Important hosts of *M. dearnessii* in the EPPO region are: *P. contorta, P. halepensis, P. muricata, P. palustris, P. pinaster, P. pinea, P. radiata, P. strobes, P. sylvestris* and *P. taeda* (CABI/EPPO, 1997). However, certain pine species, such as *P. banksiana,* have shown to be highly resistant (Skilling and Nicholls, 1974), whereas traces of infection were observed on *Picea glauca*, following its artificial inoculation with high inoculum concentration (Siggers, 1944; Punithalingham and Gibson, 1973; Evans, 1984; Skilling and Sinclair *et al.*, 1987).

M. dearnessii appears to be a highly adaptable pathogen with wide ecological tolerance and host range (Evans, 1984). It is considered to be indigenous to Central America and a common representative of the pine mycroflora in those areas. The pathogen has a wide habitat range in pine forests of Central America. More specifically, it occurs on *P. caribaea* in the humid, coastal, tropical savanna and in the dry, inland valleys, on *P. oocarpa* in both wet and dry, subtropical, upland habitats, on *P. tecumumanii* and *P. maximinoi* in the increasingly wet cloud forest areas and on pines of high altitude in the cooler, almost temperate regions of Honduras and the highlands of Guatemala and Mexico (Evans, 1984). Each change of habitat appears to involve a significant variation in fungal morphology, particularly in conidial pigmentation or ornamentation and size. However, it has not still conclusively proven, if these forms are morphotypes, resulting from phenotypic plasticity, or ecotypes, involving genetically adapted forms of the fungus.

- Means of dispersal / spread

Mycosphaerella dearnessii infective propagules (conidia, ascospores) are spread by wind and/or water (rain or irrigation). Spread of *M. dearnessii* over relatively short distances (within a tree or between trees) occurs by water-splashed conidia produced in acervuli on infected needles either on those still attached to the pine seedlings/trees or on casted ones (CABI/EPPO, 1997). Conidia may be either splash-dispersed onto the tree canopy by rain, overhead or sprinkler irrigation water or washed-off by rain, dew or overhead irrigation from the upper infected needles to the lower ones. However, conidia can be dispersed over longer distances by wind-driven rain.

In areas where both anamorph and teleomorph are present (e.g. southern USA), spread of *M. dearnessii* over longer distances may also occur by wind-disseminated ascospores forcibly discharged from ascomata during rain, dew formation or fog (Kais, 1971).

Long-distance spread of the pathogen is most likely to occur by human-assisted movement of infected nursery stock, particularly latently infected one (Skilling and Nicholls, 1974). Infected pine seedlings were most probably the means by which the pathogen spread from the southern to the northern United States (Skilling and Nicholls, 1974). Pine seeds contaminated with infected needle debris may also spread the pathogen over long distances (CABI/EPPO, 1997).

M. dearnessii conidia can also be dispersed by insects or on forestry equipment, such as contaminated shearing tools (Skillings and Nicholls, 1974).

Time period considered by this assessment

The risk assessment has been conducted considering a time horizon of five (5) years. Any climate changes potentially occurring during these five years have not been taken into account.

Geographic Distribution

Mycosphaerella dearnessii is believed to be of Central American origin. It mainly attacks pines from Central to North America but also in localities of South America, Asia and Africa (Fig. 2 and updated datasheet). In Europe, the pathogen has been detected in Bulgaria on *Pinus nigra* (Kovacevski, 1938; Petrak, 1961) in Spain on *P. radiata* (Martinez, 1942), in Yugoslavia on *P. halepensis* (Evans, 1984) in Georgia (ex-USSR) on *Pinus* sp. (Schischkina and Tzanava, 1967), in France on *P. attenuata x radiata*, *P. radiata, P. taeda,* and *P. attenuata* (Chandelier *et al*., 1994), in Switzerland on *P. mugo* and *P. uncinata* (Holdenrieber and Sieber, 1995), in Southern Germany on *P. mugo* (Pehl, 1995), in Italy on *P. mugo* (La Porta and Capretti, 2000), in Slovenia on *P. sylvestris* (Jurc and Jurc, 2009; EPPO 2008a), in Croatia (Novak-Agbaba and Halambek, 1997; CABI/EPPO, 1997), in Lithuania (EPPO, 2010) and in Austria on *P. mugo* (Brandstetter and Cech, 1999).

Table 1. Geographic distribution of *M. dearnessii* (CABI, 2011)	
North America	Canada (localized: Alberta, Manitoba, Ontario), Mexico, USA.
South America **Central America and the Caribbean**	Chile, Colombia Belize, Costa Rica, Cuba, Guatemala, Honduras, Jamaica, Nicaragua
Europe	Austria (localized), Belarus, Bulgaria (localized), Croatia (localized), Czech Republic (localized), France (localized), Germany (localized), Italy (localized), Georgia, Macedonia, Slovenia (localized), Switzerland
Africa	Malawi, South Africa
Asia	China, Japan, Republic of Korea

Pathways

Mycosphaerella dearnessii is reported to be present in several localities within the PRA area (EU-27 Member States, excluding the ultra peripheral regions, i.e. the French Overseas Departments, the Spanish Canary Isles, the Portuguese Azores and the Madeira) (see above under Geographic distribution and updated datasheet). Hosts of *M. dearnessii* are exclusively species of the genus *Pinus.* The pathogen affects only the pine needles causing needle blights and premature defoliation.

The pathogen is considered a harmful organism under the EU Council Directive 2000/29/EC. According to the Directive (Annex III, Part A, point 1) the importation into all Member States of *Pinus* L. plants, other than fruit and seeds, originating in non-European countries is prohibited. Annex IV, Part A, Section I, point 9 of the Council Directive 2000/29/EC describes special requirements which must be laid down by all Member States for the introduction into and movement within all Member States of plants of *Pinus* L., intended for planting, other than seeds. According to these requirements, plants of *Pinus* L., intended for planting, other than seeds, must be accompanied by official statement that no symptoms of *Scirrhia acicola* have been observed at the place of production on in its immediate vicinity since the beginning of the last complete cycle of vegetation. Taking into account Annex III, Part A, point 1 of the Council Directive, the requirements of Annex IV, Part A, Section I, point 9, refer to *Pinus* spp. plants intended for planting and originating in non-EU European countries.

Under the above-mentioned EU legislation, the major pathway of new entry of *M. dearnessii* into the PRA area was identified in the present risk assessment to be: host plants for planting, including rooted Christmas pine trees originating in non-EU European countries. A similar pathway, namely host plants for planting, including rooted Christmas pine trees originating in non-European countries is blocked due to the EU legislation. Three other potential pathways, namely (i) natural means pathway (wind, rain, insects, birds, etc), (ii) host plant material for decorative purposes (e.g., pine branches, etc), and (iii) pine seeds contaminated with infected needles, were considered of minor importance and thus, they were not evaluated in the present risk assessment.

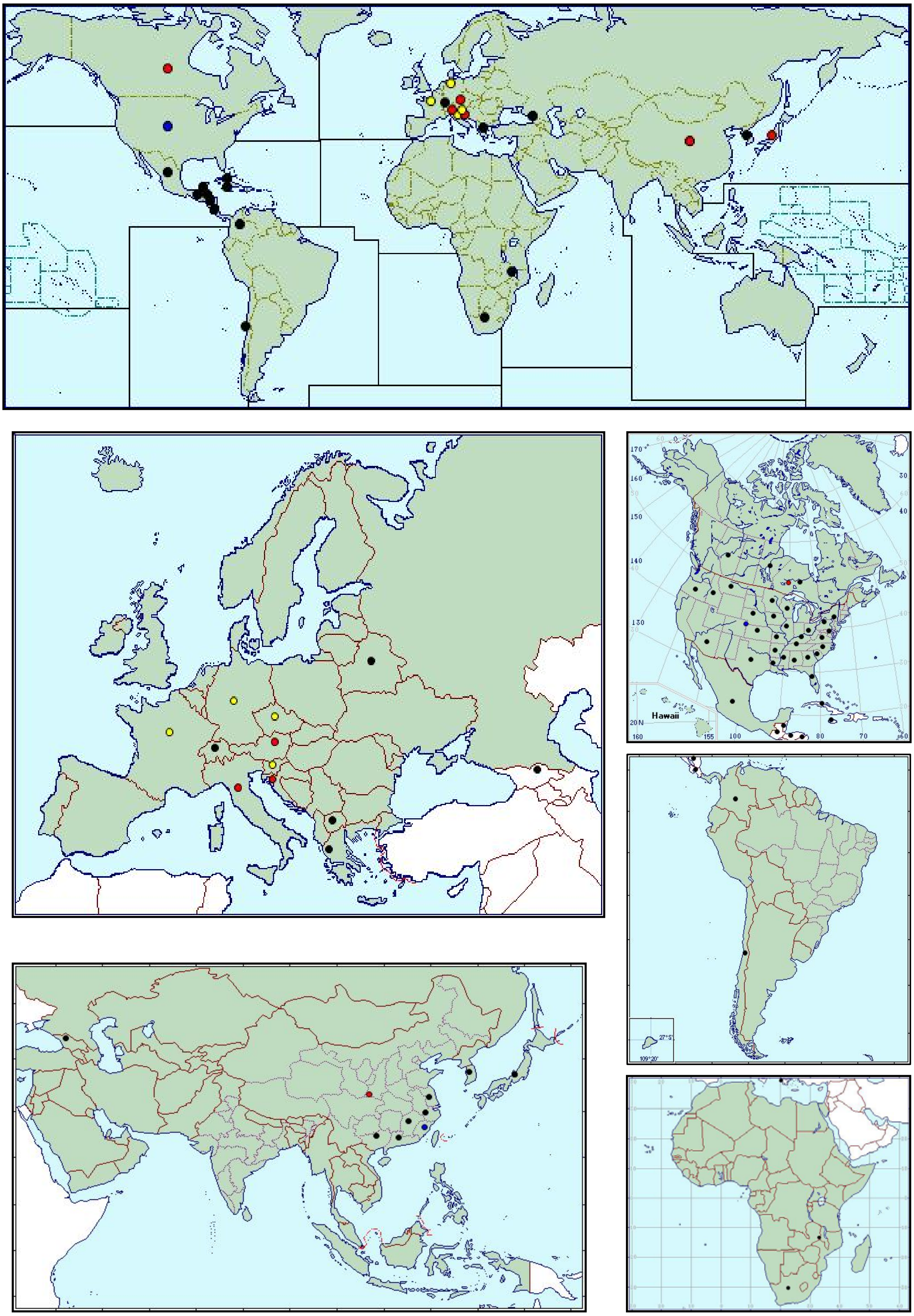

Figure 2. Geographic distribution of *Mycosphaerella dearnessii* (CABI, 2011)
●=Present, no further details; ●=Widespread; ●=Localised; ●=Confined and subject to quarantine; ●=Occasional or few reports; ●=Evidence of pathogen

<u>Pathway</u> : Host plants for planting, including rooted Christmas pine trees

Summary of risk elements

- Likelihood of entry and transfer (*summarise 2.08*)

Mycosphaerella dearnessii has been reported to be present in the risk assessment area (i.e. EU-27 MSs, excluding the ultra peripheral regions, i.e. the French Overseas Departments, the Spanish Canary Isles, the Portuguese Azores and the Madeira) and is considered a harmful organism under the Council Directive 2000/29/EC. Hosts of *M. dearnessii* are exclusively species of the genus *Pinus*. The pathogen infects pine needles causing yellowing of young needles, especially on the lower crown, resulting in needle blight and premature defoliation.

M. dearnessii is widespread in some areas (e.g. USA) and localised in others (e.g. non-EU European countries and EU Member States). The pathogen has a long incubation period (1-7 months) depending on the host type and age. On pine host plants intended for planting and originating in infested areas, *M. dearnessii* may be present in the form of latent mycelium (asymptomatic plants), acervuli with conidia and/or ascomata with ascospores (symptomatic plants). The latter have been reported only from the southern United States. Control measures (cultural, chemical, etc) applied in nurseries and plantations in the infested areas may reduce the infection level but they do not eliminate the pathogen.

Under the current EU legislation (EU Council Directive 2000/29/EC, Annexes II, III and IV), the likelihood of new entry and transfer of *M. dearnessii* into the risk assessment area on pine plants intended for planting (including Christmas pine trees) and originating in infested non-EU European countries has been estimated by the Bayesian Belief Network (BBN) model to be rather medium (46% likelihood) to high (30% likelihood) and it is in agreement with the assessor's judgment.

- Potential area occupied at time horizon (*summarise extent of spread*, *3.02*)

M. dearnessii infective propagules (conidia, ascospores) are dispersed by wind and/or water (rain or irrigation). Spread of *M. dearnessii* over relatively short distances (within a tree or between trees) occurs by water-splashed conidia produced in acervuli on infected needles either still attached to the trees or on fallen ones. In areas where both anamorph and teleomorph are present (e.g. southern USA), spread of *M. dearnessii* over longer distances may also occur by wind-disseminated ascospores forcibly discharged from ascomata during rain, dew formation or fog. The sticky spores of *M. dearnessii* can also be dispersed by insects or by human assistance (e.g. movement of infected pine plants, forestry tools, clothes, shoes, vehicles, etc.) allowing dissemination of the pathogen over longer distances. Based on the above, the epidemiology of the disease and the historical records on the distribution of brown-spot needle blight in the risk assessment area, it is expected that, given spread of the pathogen occurs both by natural means and human assistance, the potential area occupied by the pathogen at the time horizon considered in this risk assessment (i.e. 5 years) is expected to be 1/3 to 2/3 of the endangered area (70% likelihood).

- Consequences (*summarise the combination of 3.03 and 3.04*)

In the USA, *M. dearnessii* affects a wide range of pine species, with the highest consequences on young trees of *P. palustris* (longleaf pine) and *P. sylvestris* (Scots pine). The disease affects only the needles causing blight, premature defoliation and stunting of longleaf pine seedlings. However, severe infections may result in repeated defoliations, seedlings death or in decrease of the annual growth of *P. palustris*. The disease has been reported to reduce the annual growth of southern pines by more than 0.453 million m^3 of timber. Due to premature needle loss, the disease makes pines in landscapes unsightly and pines in Christmas tree plantations unmarketable. In the risk assessment area, *M. dearnessii* has been reported from several EU-Member States to cause needle blight and premature defoliation on pine trees growing in nature reserves and urban sites (i.e. private and public gardens). No other consequences of the disease on the affected pine species have been reported in the PRA area and, so far, the disease has not been detected in pine nurseries/seed orchards/plantations.

M. dearnessii has no negative impact on the biodiversity in the risk assessment area, as (i) it causes only needle blight and premature defoliation of susceptible pine species grown in nature reserves and urban sites, and (ii) longleaf pine (*P. palustris*), which is the most seriously affected in the USA pine species, is not native to Europe. However, potential establishment of the pathogen in pine nurseries/seed orchards/plantations might have a negative impact on the environment, as numerous fungicide applications will be required during the growing period to provide adequate protection of young pine seedlings.

Under the current EU legislation, the potential consequences of the pathogen in the risk assessment area have been estimated by the BBN model to be low (50% likelihood) to medium (50% likelihood), which is in agreement with the assessor's judgment.

- Pest risk (*summarise 3.06, the combination of likelihood of entry & transfer 2.0, with potential impact, 3.05)*.

Under the current EU legislation, the overall risk posed by *M. dearnessii* in the risk assessment area has been estimated by the BBN model to be low (59% likelihood) to medium (26% likelihood) and it is rather in agreement with the assessor's judgment.

Uncertainties

Summarise major uncertainties and report on what happens if those risk elements that are most uncertain are changed (e.g. become less uncertain) – how does the overall risk profile of expected risk change? Describe changes in the bar chart showing expected risk if uncertainty is changed.

<u>Entry and transfer</u>

In the present risk assessment and with the EU legislation in place, medium uncertainties were identified around the likelihood of entry and transfer of the pathogen on pine host plants for planting originating in infested non-EU European countries, due to lack of available information or incomplete data on the following:

- The prevalence of the pathogen in nurseries/plantations in infested Non-EU European countries, and
- The volume of host plants intended for planting and originating in infested Non-EU European countries that could potentially be imported annually into the risk assessment area in the absence of the current EU legislation

Potential area occupied at time horizon

Some uncertainties were also identified around the potential area occupied by the pathogen at the time horizon considered in the present risk assessment (5 years), due to lack of information or incomplete data on:

- The movement/trading of pine host plants for planting within the risk assessment area
- The spread of the pathogen in the risk assessment area following the detection of the first outbreaks

Consequences

Medium uncertainties were also identified with respect to the direct consequences of the pathogen on pine hosts grown in the risk assessment area, due to lack of information on:

- The level of susceptibility of native pine species, varieties or hybrids growing in the risk assessment area to the infection by *M. dearnessii*
- The virulence of *M. dearnessii* strains present in infested areas
- The potential effects of the disease on susceptible pine species grown in managed environments (nurseries, plantations) in the risk assessment area, once the pathogen establishes in such environments

Conclusion

Text

Keywords: brown-spot needle blight, *Lecanosticta acicola, Mycosphaerella dearnessii*, *Pinus* spp.*,* planting material, risk assessment, *Scirrhia acicola*

Stage 1 – Initiation

1.1 Background and Initiation

Provide the background and terms of references as provided by the originator of the risk assessment request (European Commission, European Parliament, Member States, or EFSA)

The purpose of this assessment is to evaluate the plant health risk of *Mycosphaerella dearnessii* (brown spot needle blight) within the framework of EFSA project CFP/EFSA/PLH/2009/01 (Prima phacie).

The terms of reference are described in EFSA call CFP/EFSA/PLH/2009/01, Pest risk assessment for the European Community plant health: A comparative approach with case studies (EFSA, 2009). The text in Section 1.4 of the call, "Structure and essential requirements of the proposal", pages 7-9, provide the terms of reference e.g. that a systematic review of risk assessment methodologies, with emphasis on quantitative and semi-quantitative approaches, used in pest risk assessment to analyse and predict the likelihood of entry, establishment and spread, the potential negative consequences, the overall risk characterisation and the associated level of uncertainties be assessed, together with a systematic review of the methods used to assess the effectiveness of management options in reducing the risk of introduction and/or spread. The quantification of economic losses in monetary values and the assessment of potential effects on export markets, employment and tourism were not to be included.

Initiation Point

This assessment was initiated as a case study pest to be examined within EFSA project CFP/EFSA/PLH/2009/01 (Prima phacie). *Mycosphaerella dearnessii* had been selected as a case study pest because it satisfied a number of criteria needed to provide a range of contrasting pest examples for consideration in the project.

1.2 Identification of the risk assessment area

The risk assessment area is the 27 Member States of the EU with the focus on the continental European area, specifically excluding the ultra-peripheral regions, i.e. the French overseas departments, Spanish Canary Isles and Portuguese Azores and Madeira.

1.3 Available pertinent regulatory information

(i) Previous risk assessment or pest risk analysis?

Hildebrand, D.M. 2005. Pest Reports: *Mycosphaerella dearnessii*. North America Forest Commission Exotic Forest Pest Information System (ExFor) Database. Available at: http://spfnic.fs.fed.us/exfor/data/pestreports.cfm?pestidval=40&langdisplay=english

(ii) Available Pest Fact Sheets/ Pest Alerts etc.

Anonymous, 2011. Brown Spot of Pine-*Mycosphaerella dearnessii*. Kansas State University Agricultural Experiment Station and Cooperative Extension Service, 2 p.

Barry, J.E., Hurst, K.D., Ford, V.L. and Kirkpartick, T.L. 2010. Brown Spot Needle Blight. In: Pine Needle Diseases in Arkansas. University of Arkansas, Division of Agriculture, Cooperative Extension Service. 8 p.
Available at: http://www.uaex.edu/Other_Areas/publications/PDF/FSA-5022.pdf

CABI/EPPO, 1992. Data Sheets on Quarantine Pests. *Mycosphaerella dearnessi and Mycosphaerella pini*. In: Quarantine Pests for Europe, CAB International, Wallingford, UK. p. 536-542.

CABI, 2011. Invasive Species Compendium (Beta): *Mycosphaerella dearnessii*. Available at: http://www.cabi.org/isc/?compid=5&dsid=49057&loadmodule=datasheet&page=481&site=144

Munck, I.A., Ostofsky, W.D., and Burns, B. 2011. Pest alert: Eastern White Pine Needle Damage. USDA Forest Service.
Available at: na.fs.fed.us/pubs/palerts/white_pine/eastern_white_pine.pdf

(iii) Current regulatory status

What is the pest's status in the Plant Health Directive (Council Directive 2000/29/EC

- Legislation on host plants (*Pinus* spp.)

- The Council Directive 2000/29/EC Annex III, Part A, point 1 prohibits the introduction, among others, of plants of *Pinus* L. other than fruit and seeds from non-European countries. This regulation has been introduced because of other harmful organisms.

- Legislation specific to *Mycosphaerella dearnessii*

Mycosphaerella dearnessii is classified as a harmful organism for the European Community and is listed as *Scirrhia acicola* (Dearn.) Siggers in:

- Annex II, Part A, Section I, point 14 of the Council Directive 2000/29/EC ("Harmful organisms not known to occur in the Community and relevant for the entire Community and whose introduction into, and spread within all EU Member States shall be banned if they are present on certain plants or plant products"). According to this protective measure, the introduction into and spread within all EU Member States shall be banned if *Scirrhia acicola* is present on plants of *Pinus* L. other than fruit and seeds.
- Annex IV, Part A, Section I, point 9 of the Council Directive 2000/29/EC describes special requirements which must be laid down by all Member States for the introduction into and movement within all Member States of plants of *Pinus* L., intended for planting, other than seeds. According to these requirements, plants of *Pinus* L., intended for planting, other than seeds must be accompanied by official statement that no symptoms of *Scirrhia acicola* have been observed at the place of production on in its immediate vicinity since the beginning of the last complete cycle of vegetation. Taking into account Annex III, Part A, point 1 of the Council Directive, the requirements of Annex IV, Part A, Section I, point 9, refer to *Pinus* spp. plants intended for planting and originating in non-EU European countries.

(iv) What is the pest's status in the European and Mediterranean Plant Protection Organisation (EPPO)? (*put tick (✓) in box if relevant*) (www.eppo.org)

EPPO List:	A1 regulated pest list		A2 regulated pest list		Action list		Alert list	
				✓				

1.4 Strategy of data searching (*identity of databases, data banks and information systems, key search terms and strategies applied, and the time period covered should be provided*)

Information searches were performed consulting several sources such as:

- Abstracting databases: e.g. AGRICOLA, CAB Abstracts, ISI Web of Knowledge
- Internet search machines: Google Scholar
- EPPO information systems: e.g. EPPO reporting service, EPPO PQR v 4.6
- Europhyt (for notifications of interceptions)
- Information from Member States on issues related to host distribution at a national level was acquired via a questionnaire prepared in the framework of the Prima Phacie project and distributed by EFSA to all NPPOs.
- References and information obtained from experts and from citations within other references.

1.5 Time period considered in this assessment
(*Likelihoods of future events are only meaningful when a time period is specified. Choices that might be considered include: 3 months (short term, e.g. following discovery of an outbreak or other new potential threat), 5 years (medium term), or 30 years (long term). Choose a time scale and briefly explain why such a horizon was selected. – note whether climate change was taken into account. If climate change is taken into account, note the climate change scenarios considered.*

The risk assessment has been conducted considering a time horizon of five (5) years. Any climate changes potentially occurring during these five years have not be taken into account.

1.6 Introductions or interceptions (reported from EU or elsewhere)
Provide information on interceptions or reports of pest spread and note whether the pest has a history of increasing its area of distribution.

Mycosphaerella dearnessii appears to be of Central American origin (Evans, 1985). The pathogen has a wide host and habitat range and occurs on pines in tropical to temperate zones. It attacks pines from Central to North America, but also in localities of South America, Asia, Africa and Europe.

Mycosphaerella dearnessi has already been reported from several European countries, including EU-Member States. The pathogen is present, though at a localized scale, in

Bulgaria, Spain Georgia, France, Switzerland, Southern Germany, Austria, Italy, Croatia, Czech Republic, Estonia, Belarus and Slovenia. It causes needle blight and premature defoliation on pine trees growing mainly in nature reserves and urban sites (i.e. private and public gardens), but the origin of these outbreaks is not known. Jankovský *et al*. (2009) assumed that tourists played an important role in the spread of *M. dearnessii* in Czech Republic, as the disease was first detected on 10-60 year old *P. rotundata* trees (bog pine) grown in two nature conservation sites located in the vicinity of popular tourist trails.

According to the EU interception database (Europhyt, 2011), there have been only two interceptions of *M. dearnessii* and *M. pini* in the EU-Member States. More specifically, in May 2008, there was one interception of the pathogen in Poland on *Pinus* sp. plants intended for planting and originating in Estonia and in May 2011 another one in Romania on *Pinus* sp. plants intended for planting and originating in the Republic of Moldova.

Stage 2 - Pest Risk Assessment
(Outline approach)

This method for pest risk assessment involves first evaluating the likelihood of pest entry and transfer to a host within the risk assessment area. Likelihood of entry is assessed by considering five factors:

(i) likelihood of association with commodity on the pathway at origin,
(ii) pest survival during post harvest treatment,
(iii) pest survival during storage and transport,
(iv) pest survival during current phytosanitary procedures, and
(v) the quantity of commodity imported.

The likelihood that sufficient numbers of pest will transfer from a pathway to a suitable host in order to initiate a new population is then considered. The combined likelihoods of entry and transfer via each pathway are then combined before likelihood of establishment is taken into account. Assessors then move onto assess consequences of establishment.

Each risk element or sub-element is divided into five categories. Assessors review data / evidence and allocate % likelihood to appropriate categories, either selecting a single category or spreading their judgment between categories. Guidance is provided to interpret the categories in order to provide some consistency.

Overall potential impact is determined via use of BBN software based on matrices that combine consequences of establishment with establishment potential **given entry and transfer**. Likelihood of entry and transfer is then combined with potential impact using the BBN software to estimate pest risk.

Acknowledgement
Method 4b has largely adopted questions from the USDA pathway initiated pest risk assessment method (USDA, 2000). However, the arrangement and structure of questions has been revised by Prima phacie so that the method is more aligned with EFSA needs.

Reference

USDA Guidelines for pathway initiated pest risk assessments v 5.02 (2000).

Likelihood of pest entry and transfer to a host

2.0 List and describe the pathways for pest entry into the risk assessment area
A pathway is "*any means that allows the entry or spread of a pest*" (ISPM No. 5, IPPC, 2007*). Remember to consider potential pathways that are closed due to existing phytosanitary measures but which could be opened if the phytosanitary measures were changed.*

Entry is "*Movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled*" (ISPM No. 5, IPPC, 2007).

Copy 2.1a to 2.7a for each pathway, and give responses for each individual pathway. Label questions 2.1b for the second pathway assessed, 2.1c for the third pathway etc.

Mycosphaerella dearnessii is a pine foliage fungal pathogen causing needle blight and premature defoliation. It is present in the PRA area, though with a localized distribution.

According to Council Directive 2000/29/EC (Annex III, Part A, point 1) the importation into all Member States of *Pinus* L. plants, other than fruit and seeds, originating in non-European countries is prohibited. Annex IV, Part A, Section I, point 9 of the Council Directive 2000/29/EC describes special requirements which must be laid down by all Member States for the introduction into and movement within all Member States of plants of *Pinus* L., intended for planting, other than seeds. According to these requirements, plants of *Pinus* L., intended for planting, other than seeds, must be accompanied by official statement that no symptoms of *Scirrhia acicola* have been observed at the place of production on in its immediate vicinity since the beginning of the last complete cycle of vegetation. Taking into account Annex III, Part A, point 1 of the Council Directive, the requirements of Annex IV, Part A, Section I, point 9, refer to *Pinus* spp. plants intended for planting and originating in non-EU European countries.

Based on the above EU legislation, one major pathway of new entry of *M. dearnessii* into the PRA area was identified in the present risk assessment to be: host plants for planting, including rooted Christmas pine trees originating in non-EU European countries. Three other potential pathways, namely (i) by natural means pathway (wind, rain, insects, birds, etc), (ii) host plant material for decorative purposes (e.g., pine branches, etc), and (iii) pine seeds contaminated with infected needles, were considered of minor importance and thus, they were not evaluated in the present risk assessment.

Pathway	Pathway name	Summary description of pathway
a.	Host plants for planting, including rooted Christmas pine trees, originating in non-EU European countries	*Pinus* spp. plants intended for planting, including rooted Christmas pine trees, which are imported into the risk assessment area from non-EU European countries

Note that on occasions risk assessments are initiated by a review of phytosanitary policy, e.g. for pests already present and perhaps widespread in an area and which therefore may *no longer be suited to being dealt with using official phytosanitary measures. In such a situation, the likelihood of pest introduction is relevant only for limited parts of the area where the pest does not occur, or where it is not widely distributed and remains under official control. Assessment of pest entry could then be restricted to such areas.*

Although *M. dearnessii* is already present in some EU Member States, its distribution is localized mainly to natural reserves and urban sites. Therefore, in the present risk assessment, the likelihood of pest introduction will be considered to be relevant for the whole PRA area (EU-27 Member States).

Uncertainties (regarding pathways)

Following EFSA Guidance (EFSA, 2010), to ensure transparency in risk assessment, uncertainties should be identified, characterized and documented within all risk assessments. Identifying uncertainties can show not only which aspects of an assessment are uncertain but the degree of uncertainty and can help identify where further work could usefully reduce uncertainty.

Describe the uncertainties regarding the identification of pathways.

Mycosphaerella dearnessii is a foliage pathogen of pine species. No other plant parts are affected and the pathogen has not been reported to be seed- or soil-borne. Therefore, in this risk assessment, only the host plants for planting pathway (including rooted Christmas pine trees) has been identified as the major pathway for the entry of the pathogen from infested non-EU European countries into the PRA area. No uncertainties have been identified with respect to the pathway of entry considered in this risk assessment, i.e. Host plants for planting.

The following three additional pathways of entry of the pathogen from infested non-European countries into the PRA area were considered of minor importance.

- By <u>natural means</u>: its minor importance is due to the poor natural spread capacity that has been observed for this pathogen (see section 3.2).
  Uncertainties: As the pathogen is present in some of the non-EU European countries, uncertainties exist with respect to the potential of entry of *M. dearnessii* into the risk assessment area on the natural means pathway from infested non-EU European countries, neighbouring the EU Member States (i.e. Switzerland, Croatia, Former Yugoslav Republic of Macedonia, Belarus, Moldova, Georgia) (CABI, 2011).
- <u>Host plant material for decorative purposes</u> (e.g. pine branches, etc): its minor importance is due to the end-use of this material (i.e. for Christmas decoration). However, even if such material is disposed in close proximity to susceptible hosts, the prevailing environmental conditions during and after Christmas and particularly the low temperatures will most probably be unfavourable for the spread of the pathogen.
  Uncertainties: Whether waste management is a common practice in all the EU-27 Member States
- <u>Seeds contaminated with infected needles</u>: its minor importance is due to the high temperatures (32-43°C) and low humidity (30%) during the kiln-drying process applied to pine cones in order to facilitate seed extraction (Aldous, 1972), which will most probably

be lethal to the pathogen. According to Kais (1975), long periods at high temperatures (35^0C) are lethal to *in vitro* spore germination and germ tube elongation of *M. dearnessii*.

Uncertainties: The survival potential of the pathogen during the processing of pine cones/seeds contaminated with infected needles, due to lack of relevant studies.

<u>Pathway</u>: Host plants for planting (including rooted Christmas pine trees) originating in non-EU European countries

Pinus spp. plants intended for planting, including rooted Christmas pine trees, imported into the risk assessment area from non-EU European countries

2.01a Likelihood of the pest being associated, spatially and temporally, with the pathway at origin
(*There must be some likelihood of association otherwise there is no pathway*).

Take into account pre-harvest cultivation and husbandry practices such as existing pest management measures, choice of cultivar, and applications of plant protection products. If phytosanitary measures (i.e. statutory risk reduction measures) are already in place against this or other pests at origin, specify whether these are being <u>taken</u> into account or not.

Information / evidence:
Provide reasoning then give judgment
Mycosphaerella dearnessii has a wide host and habitat range and affects pines in tropical to temperate zones.

It is a foliage pathogen of *Pinus* spp. causing yellowing of young needles, especially on the lower crown, resulting in premature defoliation of seedlings in nurseries and young trees in pine plantations (Boyer, 1990; Phelps *et al*., 2002). Infection of pine needles by *M. dearnessii* spores occurs primarily in the spring, but under moist conditions, host plants may become infected throughout the growing season (from spring to late summer) (Hildebrand, 2005). On infected pine needles the pathogen produces conidia and ascospores, both of which can cause infection (Phelps *et al.,* 2002). In warm, moist climates (e.g. southern United States), both spore types are produced, whereas, in cooler climates (e.g. north- and mid-central United States) only conidia have been detected (Phelps *et al.,* 2002). Brown-spot needle blight has a long incubation period (time between infection and symptom development), which, depending on host type and age, varies from 1-2 months (on young needles) to 4-7 months (on older needles) (CABI/EPPO, 1997). *M. dearnessii* may be present on needles of susceptible host plants intended for planting in the form of latent mycelium in asymptomatic plants and/or fruiting bodies (acervuli with conidia and/or ascomata with ascospores) in symptomatic ones.

In the infested areas outside Europe (e.g. USA), silvicultural and chemical control measures are used for the management of brown-spot needle blight.

Cultural and sanitary measures
In plantations and young natural stands of longleaf pine (*P. palustris*), brown-spot needle blight can be controlled by prescribed ground fires. The fire-resistant terminal bud of young longleaf pines in the grass stage can survive these low-intensity fires, which are used in winter to destroy dead infected foliage that harbors the pathogen (Sinclair *et al.,* 1987; Phelps *et al.,* 2002). Vigorous seedlings in the grass stage with root-collar diameters greater than 0.2 cm possess a great ability to survive fire (Phelps *et al*., 2002). A careful prescribed burn destroys the infected needles and eliminates the inoculum sources for several years. Timing of prescribed fires is very important. Burns should be made only when brown-spot needle blight has developed to a damaging extent (Phelps *et al*., 2002). Another practical suppression method is shelterwood regeneration. This is the most promising approach to

natural regeneration of longleaf pine in which seedlings are established as advanced reproduction under overstories of medium density. The pine canopy then protects the regenerated seedlings from infection by *M. dearnessii* (Phelps *et al*., 2002). As dense planting supports infection enough space is kept between seedlings, in both nurseries and plantations. While the foliage is wet, shearing and other cultural operations that could spread spores of the pathogen are avoided (Sinclair *et al.,* 1987). In infested areas, planting different pine species or varieties prevents catastrophic losses (Phelps *et al.,* 2002).

Chemical control

Brown-spot needle blight is easily managed by fungicide sprays in pine nurseries, seed orchards and plantations (Siggers, 1932; 1944; Phelps *et al*., 2002). The fact that (i) conidia may be produced in any season throughout the year and be dispersed by rain-splash, (ii) ascospores are formed on dead needle tissues mostly on fallen needles and are disseminated by air currents, and (iii) several crops of new needles may be formed within a year, indicates that numerous sprayings would be required to give adequate protection of susceptible pine species. According to Phelps *et al.* (2002), Skilling and Nicholls (1974) and Kais (1975b), in nurseries, seed orchards, and plantations of longleaf pines (*P. palustris*) and Scots pines (*P. sylvestris*), sprays with Bordeaux mixture, chlorothalonil, benomyl, copper hydroxide or captafol are used for the control of brown-spot needle blight. Seedlings are usually sprayed at 10- to 30-day intervals, depending on the amount of rainfall, from the beginning of spring through late summer. It is important to initiate spraying in the spring when the newly emerging fascicled needles are 2 to 5 cm long. Usually four to six applications are sufficient (Phelps *et al.*, 2002). It is also recommended to make a final spray just prior to planting. This will ensure protection during establishment of seedlings in the field.

Host plant resistance

In the case of longleaf pine (*P. palustris*), resistant progenies and selections of resistant stock are used in the USA for reducing infection by the pathogen (Phelps *et al*., 2002). Long-needled varieties of Scots pine (*P. sylvestris*) such as Austrian Hills and German are somewhat resistant to infection by *M. dearnessii* and thus, they are preferred in Christmas tree plantations to reduce infections by *M. dearnessii* (Kais and Peterson, 1986; Phelps *et al*., 2002).

According to Annex IV, Part A, Section I, point 9 of the Council Directive 2000/29/EC, plants of *Pinus* L., intended for planting, other than seeds, imported into the EU-27 Member States must be accompanied by official statement that no symptoms of *Scirrhia acicola* have been observed at the place of production on in its immediate vicinity since the beginning of the last complete cycle of vegetation. Taking into account Annex III, Part A, point 1 of the Council Directive, the requirements of Annex IV, Part A, Section I, point 9, refer to *Pinus* spp. plants intended for planting and originating in non-EU European countries.

M. dearnessii has been reported to be present, though with a localised distribution, in the following non-EU European countries: Switzerland, Croatia, Former Yugoslav Republic of Macedonia, Belarus, Georgia (CABI, 2011). Although there is no official report that the pathogen has been detected in the Republic of Moldova, according to the EU interception database (Europhyt, 2011), in May 2011, Romania intercepted *M. dearnessii* on *Pinus* sp. plants intended for planting and originating in the Republic of Moldova.

No information is available on the (i) potential occurrence of *M. dearnessii* on nursery-grown susceptible pine species in the infested non-EU European countries, (ii) the location of the pine nurseries or Christmas pine tree plantations, where pine seedlings intended for planting and Christmas pine trees for decorative purposes are produced, and (iii) measures (cultural, chemical, etc) applied in the above-mentioned areas for the control of the pathogen.

Regular surveys in pine nurseries during the growing period may allow the detection of infected symptomatic pine seedlings but not of the latently infected (asymptomatic) ones. In addition, as the symptoms of brown-spot needle blight are very similar to those caused by other pine needle pathogens (e.g. *M. pini*, etc), adverse environmental conditions or nutrient deficits (Hartmann *et al*., 1988), reliable detection and identification of *M. dearnessii* is only possible by laboratory testing. Nevertheless, surveys during the growing season at the places of production will most probably reduce the risk of the pathogen being associated with the pathway at origin.

Mycosphaerella dearnessii infective propagules (conidia, ascospores) are dispersed by wind and/or water (rain or irrigation) (see section Means of dispersal/spead). Spread of *M. dearnessii* over relatively short distances (within a tree or between trees) occurs by water-splashed conidia produced in acervuli on infected needles either still attached to the trees or on fallen ones (CABI/EPPO, 1997). As the teleomorph has not been reported outside the southern United States (Phelps *et al*., 1978), it is expected that in the infested non-EU European countries only conidia are produced. Thus, considering that spread of the pathogen by natural means is likely to be limited, surveys during the growing season of the immediate vicinities of the places of production will further reduce the likelihood of the pathogen to be introduced into the risk assessment area on pine nursery plants/Christmas pine tree plantations.

There have been only two interceptions of *M. dearnessii* in the EU-Member States (Europhyt, 2011). More specifically, in May 2008, the pathogen was intercepted in Poland on *Pinus* sp. plants intended for planting and originating in Estonia and in May 2011, *M. dearnessi* was intercepted in Romania on *Pinus* sp. plants intended for planting and originating in the Republic of Moldova (non-EU European country).

Uncertainties regarding likelihood of the pest being associated with the pathway at origin

Due to lack of relevant information, there are high uncertainties are related to:

(i) the prevalence of *M. dearnessii* in the infested regions of the non-EU European countries
(ii) the location of pine nurseries and plantations grown with Christmas pine trees in the above areas, and
(iii) the measures (cultural, chemical, etc) applied in the infested non-EU European countries for the control of the pathogen

Conclusions

Based on the above, it may be concluded that:

- *M. dearnessii* is reported to be present, though with a localized distribution, in regions of the infested non-EU European countries

- As the teleomorph has not been reported outside the southern United States, *M. dearnessii* may be present on infected pine host plants originating in the infested non-EU European countries, in the form of latent mycelium (asymptomatic plants) and/or acervuli with conidia (symptomatic plants)
- Control measures (cultural, chemical, etc) applied in pine nurseries and plantations may reduce the infection level but they do not eliminate the pathogen. However, no information is available on the measures applied in infested non-EU European countries for the control of the pathogen
- Despite the long incubation period of the pathogen (1-7 months) and the possible confusion of disease symptoms, it is expected that, under the current EU legislation, the likelihood of the pest being associated with pine plants intended for planting (including rooted Christmas pine trees) and imported into the risk assessment area from infested non-EU European countries is rather low to medium, with a medium uncertainty.

2.01a: Likelihood of association with the pathway at origin			
Rating	**Description** (likelihood of association is ....)	**Justification summary**	**Probability Assignment** [1]
Very Low	< 0.01% (less than one in ten thousand lots[2] of the commodity are likely to be contaminated / infested)		10%
Low	Between 0.01% and 0.1% (between one in ten thousand and one in one thousand lots[2] are likely to be contaminated / infested)	*M. dearnessii* is present in some of the non-EU European countries Control measures (cultural, chemical) may reduce the infection level but do not eliminate the pathogen Regular surveys at the places of production will reduce the risk of *M. dearnessii* entering the PRA area on pine host plants intended for planting	30%
Medium	Between 0.1% and 1% (between one in one thousand and one in one hundred lots[2] of the commodity are likely to be contaminated / infested)	*M. dearnessii* is present in some of the non-EU European countries Control measures (cultural, chemical) may reduce the infection level but do not eliminate the pathogen Regular surveys at the places of production will reduce the risk of *M. dearnessii* entering the PRA area on pine host plants intended for planting	40%
High	Between 1% and 10% (between one in one hundred and one in ten lots[2] of the commodity are likely to be contaminated / infested)	*M. dearnessii* has a long incubation period and disease symptoms are similar to those caused by other pathogens, adverse environmental conditions, nutrient deficits, etc.	10%

Very High	> 10% (more than one in ten lots[2] of the commodity are likely to be contaminated / infested)	*M. dearnessii* has a long incubation period and disease symptoms are similar to those caused by other pathogens, adverse environmental conditions, nutrient deficits, etc.	10%
		Check sum =	100%

[1] Spread your judgment according to your belief / evidence.

[2]**Lot**: a number of units of a single commodity, identifiable by its homogeneity of composition, origin etc., forming part of a consignment (ISPM no. 5, IPPC, 2007).
A consignment may be several lots or a single lot.

The assessment of pest entry and transfer (2.01 -2.06) is based on considering "lots". However, if an alternative unit would be more appropriate then describe the chosen unit and ordinal scale using five categories.

2.02a Likelihood of surviving postharvest treatments / measures (before pest entry into risk assessment area)

Given that a proportion of lots/ consignments may be infested / contaminated, consider the proportion of infested/contaminated lots that are likely to remain infested/contaminated after any manipulation, handling or specific phytosanitary treatment to which the commodity is subjected. Examples of postharvest treatments include culling, washing, chemical treatment and cold storage. If there are no post harvest treatments the likelihood of survival should probably be considered "very high".

If post-harvest phytosanitary measures (i.e. statutory risk reduction measures) are already in place, specify whether these are being taken into account or not.

Information / evidence: *Provide reasoning then give judgment*

Brown-spot needle blight has a long incubation period (time between infection and symptom development), which, depending on host type and age, varies from 1-2 months (on young needles) to 4-7 months (on older foliage) (CABI/EPPO, 1997). During this period, plants remain asymptomatic.

Repeated fungicide sprays applied in pine nurseries, seed orchards and plantations may reduce the level of infection by *M. dearnessii*, but they do not eliminate the pathogen, particularly on latently infected plants (Skilling and Nicholls, 1974; Kais, 1975b; Phelps *et al*., 2002).

In addition, symptoms of brown-spot needle blight may be confused with those caused by adverse environmental conditions, such as chlorofluorocarbon and sulphur dioxide pollution or nutrient deficits, such as magnesium and potassium (Hartmann *et al*., 1988).The macroscopic symptoms of the brown-spot needle blight and the morphological features of *M. dearnessii* can easily be confused with those of the red band needle blight caused by *M. pini* (anamorph: *Dothistroma septosporum*) especially at the beginning of the disease development and later, if typical red bands either have not been produced yet or are suppressed (Pehl and Wulf, 2001). Moreover, some disease stages of cercospora needle blight (brown needle disease) of pines, caused by *Mycosphaerella gibsonii* (anamorph: *Pseudocercospora*), are very similar to those of brown-spot needle blight (*M. dearnessii*). Because of the very similar morphological features, the teleomorphs of the three *Mycosphaerella* species on pines (i.e. *M. dearnessii, M. pini, M. gibsonii*) are difficult to be distinguished without any other characteristics, as for example the profuse reddish tint of the necrotic needle tissue typical of the infection by *M. pini* (Evans, 1984). Culling in pine nurseries and Christmas tree plantations and/or before shipping of the pine plants intended for planting may allow the detection, removal and destruction of infected symptomatic pine seedlings but not of the latently infected (asymptomatic) ones. Reliable detection and identification of *M. dearnessii* on infected pine plants can only be made by laboratory examination based on the cultural, morphological and molecular characters of the anamorphs.

Mycosphaerella dearnessii infective propagules (conidia, ascospores) are dispersed by wind and/or water (rain or irrigation) (see section Means of dispersal/spead). Spread of *M.*

dearnessii over relatively short distances (within a tree or between trees) occurs by water-splashed conidia produced in acervuli on infected needles either still attached to the trees or on fallen ones (CABI/EPPO, 1997). As the teleomorph has not been reported outside the southern United States (Phelps *et al*., 1978), it is expected that in the infested non-EU European countries only conidia are produced. Thus, considering that spread of the pathogen by natural means is likely to be limited, surveys during the growing season of the immediate vicinities of the places of production will further reduce the likelihood of the pathogen to be introduced into the risk assessment area on pine nursery plants/Christmas pine tree plantations.

Uncertainties regarding likelihood of the pest surviving postharvest treatments/ measures (before pest entry into the risk assessment area)
Due to the variable incubation period (1-7 months, depending on host type and age), there are uncertainties whether the latently infected pine plants for planting will have developed symptoms by the time of their import into the PRA area. Moreover, it is not known if the pathogen is present in pine nurseries, seed orchards, plantations in the infested areas and whether the management measures (cultural, chemical, etc) potentially applied in those areas are effective in controlling the pathogen.

Conclusions
Based on the above, it may be concluded that:

- latently infected by *M. dearnessii* pine plants for planting (asymptomatic) originating in infested with *M. dearnessii* non-EU European countries will most probably escape visual inspection during the growing season, whereas the latent mycelium present in those plant tissues, under favourable environmental conditions, could develop fruiting bodies (i.e. acervuli with conidia) introducing in this way the organism into the risk assessment area, and
- symptomatic host plants for planting, originating in infested with *M. dearnessii* non-EU European countries may also escape detection by visual inspection during the growing season, as brown-spot needle blight symptoms are very similar to those caused by other pine needle pathogens, adverse environmental conditions or nutrient deficits.
- Under the current EU legislation, the likelihood of infected pine plants for planting (including Christmas pine trees) originating in infested non-EU European countries to remain infected after existing management measures is rather low to medium.

2.02a: Likelihood that an infested/contaminated commodity remains infested/contaminated after existing postharvest treatments/measures			
Rating	**Description** (likelihood of remaining infested/contaminated / pest survival is ....)	**Justification summary**	**Probability Assignment** [1]
Very Low	< 0.01% (less than one in ten thousand lots[2] of the original commodity are likely to remain contaminated / infested)		0%
Low	Between 0.01% and 0.1% (between one in ten thousand and one in one thousand lots[2] of the original commodity are likely to remain contaminated / infested)		30%

Medium	Between 0.1% and 1% (between one in one thousand and one in one hundred lots[2] of the original commodity are likely to remain contaminated / infested)		50%
High	Between 1% and 10% (between one in one hundred and one in ten lots[2] of the original commodity are likely to remain contaminated / infested)	*M. dearnessi* may be present in needles of susceptible pines without any visible symptoms/signs Symptoms are similar to other diseases, adverse environmental conditions, nutrient deficits, etc. Detection of the organism is unlikely based only on visual inspection. Control measures (cultural, chemical) reduce infection but do not eliminate the pathogen	20%
Very High	> 10% (more than one in ten lots[2] of the original commodity are likely to remain contaminated / infested)	*M. dearnessi* may be present in needles of susceptible pines without any visible symptoms/signs Symptoms are similar to other diseases, adverse environmental conditions, nutrient deficits, etc. Detection of the organism is unlikely based only on visual inspection. Control measures (cultural, chemical) reduce infection but do not eliminate the pathogen	0%
		Check sum =	100%

[1] Spread your judgment according to your belief / evidence

[2]**Lot**: a number of units of a single commodity, identifiable by its homogeneity of composition, origin etc., forming part of a consignment (ISPM no. 5, IPPC, 2007).
A consignment may be several lots or a single lot.

2.03a Likelihood of surviving storage and transport

Given that a proportion of lots/ consignments may still be infested / contaminated, estimate the proportion of lots that are likely to remain infested/contaminated because the pest can survive storage and transport; consider speed and conditions of transport and duration of the life cycle of the pest in relation to time in storage and transport, commercial procedures (e.g. refrigeration) applied to consignments in the country of origin, during shipping, and in the country of destination, that could affect the likelihood of pest survival. Take into account previous live interceptions on this or similar pathways (see 1.6).

If phytosanitary measures (i.e. statutory risk reduction measures) are already in place which act on the likelihood of pest survival during storage and transport, specify whether these are being taken into account or not.

Information / evidence: Provide reasoning then give judgment

No information was found on the transport and storage conditions of pine plants intended for planting, including rooted Christmas pine trees originating in non-EU European countries. However, it may be assumed that pine plants are most probably transported and stored under conditions that do not stress or injure the plant tissues, i.e. under low temperatures (0.5-3.3^{0}C) and high relative humidity (85-95%) (UF, 2010; Anonymous, 2011; Reynolds, undated). Based on the literature, in the areas of its present distribution, *M. dearnessii* survives the winter on infected needles still attached to the tree or on fallen ones.

Studies conducted in Finland on the survival of *M. pini*, a closely related to *M. dearnessii* species, showed that temperatures between -70^{0}C and 5^{0}C, did not affect the survival of *M. pini* conidia produced in acervuli on infected pine needles (Metla, 2009). As *M. dearnessii* has similar biology and epidemiology with *M. pini*, the results of the above-mentioned studies could be extrapolated to *M. dearnessii*. Therefore, it is assumed that *M. dearnessii* in the form of latent mycelium present in asymptomatic (latently infected) needles and/or acervuli/ascomata produced on symptomatic needles will most likely survive during transport and storage of pine plants intended for planting. This is further supported by the two interceptions of the organism on *Pinus* spp. plants imported into the PRA area (Europhyt, 2011).

Uncertainties regarding likelihood of the pest surviving storage and transport

There are uncertainties with respect to:

(i) the precise conditions during transport and storage of pine plants for planting, and the time taken for the transport of such material from infested non-EU European countries to the PRA area, due to lack of relevant data

(ii) the effect of the low transport and storage temperatures on the potential survival of *M. dearnessii*, due to lack of relevant studies on this *Mycosphaerella* species

Conclusions

Taking into account the interception of the organism in the risk assessment area and the fact that in the areas of its present distribution *M. dearnessii* survives the winter on infected needles (still attached to the tree or fallen ones), it may be concluded that the low temperatures (0.5-3.3^{0}C) during the transport and storage of infected host plants intended for planting will most probably not affect the survival of the pathogen. This is likely to be supported by the results of relevant studies conducted with *M. pini*, a closely related to *M. dearnessii* species.

2.03a: Likelihood of surviving storage and transport			
Rating	**Description** (likelihood of remaining contaminated / pest survival is ....)	**Justification summary**	**Probability Assignment** [1]
Very Low	< 0.01% (less than one in ten thousand lots[2] of the original commodity are likely to remain contaminated / infested)		0%
Low	Between 0.01% and 0.1% (between one in ten thousand and one in one thousand lots[2] of the original commodity are likely to remain contaminated / infested)		0%
Medium	Between 0.1% and 1% (between one in one thousand and one in one hundred lots[2] of the original commodity are likely to remain contaminated / infested)		0%
High	Between 1% and 10% (between one in one hundred and one in ten lots[2] of the original commodity are likely to remain contaminated / infested)	Transport/storage conditions would probably not affect the pathogen	20%
Very High	> 10% (more than one in ten lots[2] of the original commodity are likely to remain contaminated / infested)	Transport/storage conditions would probably not affect the pathogen	80%
		Check sum =	100%

[1] Spread your judgment according to your belief / evidence

[2]**Lot**: a number of units of a single commodity, identifiable by its homogeneity of composition, origin etc., forming part of a consignment (ISPM no. 5, IPPC, 2007). A consignment may be several lots or a single lot.

2.04a Likelihood of pest surviving current phytosanitary procedures at the point of entry or elsewhere in the risk assessment area

Given that a proportion of lots may still be infested / contaminated, estimate the proportion of lots that are likely to remain infested/contaminated because the pest survives existing phytosanitary procedures e.g. it is not detected at entry and/ or it can survive any existing phytosanitary procedures within the pest risk assessment area. Take into account the intensity of sampling and inspection and ease of detecting and distinguishing the pest from other organisms.

Information / evidence: Provide reasoning then give judgment

Brown-spot needle blight has a long incubation period (time between infection and symptom development), which, depending on host type and age, varies from 1-2 months (on young needles) to 4-7 months (on older foliage) (CABI/EPPO, 1997). During this period, plants remain asymptomatic.

Repeated fungicide sprays applied in pine nurseries, seed orchards and plantations may decrease the level of infection by *M. dearnessii*, but they will not eliminate the pathogen, particularly on latently infected plants (Phelps *et al*., 2002; Skilling and Nicholls, 1974; Kais, 1975b).

In addition, symptoms of brown-spot needle blight may be confused with those caused by adverse environmental conditions or nutrient deficits, such as magnesium and potassium (Hartmann *et al*., 1988).The macroscopic symptoms of the brown-spot needle blight and the morphological features of *M. dearnessii* can easily be confused with those of the red band needle blight caused by *M. pini* (anamorph: *Dothistroma septosporum*) especially at the beginning of the disease development and later, if typical red bands either have not been produced yet or are suppressed (Pehl and Wulf, 2001). Moreover, some disease stages of cercospora needle blight (brown needle disease) of pines, caused by *Mycosphaerella gibsonii* (anamorph: *Pseudocercospora*), are very similar to those of brown-spot needle blight (*M. dearnessii*). Because of the very similar morphological features, the teleomorphs of the three *Mycosphaerella* species on pines (i.e. *M. dearnessii, M. pini, M. gibsonii*) are difficult to be distinguished without any other characteristics, as for example a profuse reddish tint of the necrotic needle tissue typical of the infection by *M. pini* (Evans, 1984). Reliable detection and identification of the above-mentioned *Mycosphaerella* species on infected pine plants for planting can only be made by laboratory examination based on the cultural, morphological and molecular characters of the anamorphs.

Therefore, under the current EU legislation, infected by *M. dearnessii* host pine plants for planting, particularly asymptomatic (latently infected), originating in infested non-EU European countries and imported into the PRA area will most probably escape border inspection, whereas the latent mycelium, present in those plant tissues, under favourable environmental conditions, can develop fruiting bodies (i.e. acervuli with conidia) introducing in this way the organism into the risk assessment area.

Uncertainties regarding likelihood of the pest surviving current phytosanitary procedures

Due to the variable incubation period (1-7 months, depending on host type and age), there are uncertainties whether the latently infected pine plants for planting will have developed symptoms by the time of their import into the PRA area.

Conclusions

The likelihood of *M. dearnessii* to survive existing management procedures and remain undetected on pine plants for planting, including rooted Christmas trees, originating in infested non-EU European countries, is estimated as high to very high, with a medium uncertainty.

2.04a: Likelihood of pest surviving current phytosanitary procedures			
Rating	**Description** (likelihood of remaining contaminated/ pest survival is ....)	**Justification summary**	**Probability Assignment** [1]
Very Low	< 0.01% (less than one in ten thousand lots[2] of the original commodity are likely to remain contaminated / infested)		0%
Low	Between 0.01% and 0.1% (between one in ten thousand and one in one thousand lots[2] of the original commodity are likely to remain contaminated / infested)		0%
Medium	Between 0.1% and 1% (between one in one thousand and one in one hundred lots[2] of the original commodity are likely to remain contaminated / infested)		0%
High	Between 1% and 10% (between one in one hundred and one in ten lots[2] of the original commodity are likely to remain contaminated / infested)	*M. dearnessi* may be present in pine needles without any visible symptoms/signs Symptoms are similar to other diseases, adverse environmental conditions, nutrient deficits, etc. Detection of the organism is unlikely based only on visual inspection	50%
Very High	> 10% (more than one in ten lots[2] of the original commodity are likely to remain contaminated / infested)	*M. dearnessi* may remain in needles without any visible symptoms/signs Symptoms are similar to other diseases, adverse environmental conditions, nutrient deficits, etc. Detection of the organism is unlikely based only on visual inspection	50%
	Check sum =		100%

[1] Spread your judgment according to your belief / evidence

[2]**Lot**: a number of units of a single commodity, identifiable by its homogeneity of composition, origin etc., forming part of a consignment (ISPM no. 5, IPPC, 2007).
A consignment may be several lots or a single lot.

2.05a Quantity of commodity imported annually

Quantity of commodity imported annually: The likelihood that a pest will enter depends on the amount of the potentially-infested commodity that is imported. For qualitative pest risk assessments, the amount of commodity imported is estimated in units of tonnes, or other metric such as standard 40 foot long shipping containers.

If the quantity of commodity imported is better described using alternative units, such as the number of plants for planting, assessors should devise a 5 level scale and provide some reasoning to support use of the scale.

Information / evidence: *Provide reasoning then give judgment*

Pinus is a widespread genus that is of ornamental, environmental and wood production interest. According to the requirements of the current EU legislation (Council Directive 2000/29/EC Annex III, Part A, point 1 and Annex IV, Part A, Section I, point 9), plants of *Pinus* L., intended for planting, other than seeds originating in non-EU European countries should be accompanied by official statement that no symptoms of *Scirrhia acicola* (*M. dearnessii*) have been observed at the place of production or in its immediate vicinity since the beginning of the last complete cycle of vegetation.

Under the current EU legislation and based on the available in the Eurostat (2008) data, in 2008, 104 tonnes of fresh Christmas trees and 66 tonnes of live forest trees were imported into the EU-27 Member States. However, it is not known if those trees originated in non-EU European countries infested with *M. dearnessii* and if pine species susceptible to the pathogen were also imported in order to be used as Christmas trees. No detailed data is available with respect to the volume of pine plants intended for planting that are imported annually from non-EU European countries into the PRA area.

As pine plants imported into the risk assessment area are intended for planting in nurseries, plantations, seed orchards, private and public gardens, roadsides, etc, in both rural and urban regions, it is expected that, in the absence of the EU legislation, medium to high volumes of pine host plants for planting would be potentially imported into the PRA area, irrespective of their origin (infested/non-infested areas) and the presence/absence of the pathogen.

Uncertainties regarding the quantity of commodity imported annually

There are high uncertainties with respect to the volume of host plants intended for planting (including rooted Christmas pine trees) that are imported annually from infested non-EU European countries into the PRA area.

Conclusions

Based on the above, it may be concluded that:

- *Pinus* is a widespread genus that is of ornamental, environmental and wood production interest.
- Pine plants imported into the risk assessment area will be widely distributed as they are intended for planting in nurseries, plantations, seed orchards, private and public gardens, roadsides, etc, in both rural and urban regions.
- In the absence of any legislation, it is expected that medium to high volumes of pine host plants for planting would be potentially imported annually into the PRA area, irrespective of their origin (infested/non-infested areas) and the presence/absence of the pathogen.

2.05a Quantity of annual imports (Examples provided for tonnes and containers, other units can be used) (If an alternative scale is used, describe each category in the scale)				
Rating	**Tonnes imported into PRA area (per year)**	**Number of containers (per year)**	**Justification summary**	**Probability Assignment** [1]
Very low	< 100	<10 containers		0%
Low	100 – 1,000	10- 100 containers		0%
Medium	1,000 -100,000	100 – 10,000 containers	*Pinus* is of ornamental, environmental and wood production interest Pine plants imported into the PRA area are intended for planting in nurseries, plantations, seed orchards, private and public gardens, roadsides, etc, in both rural and urban regions.	60%
High	100,000 – 1,000,000	10,000 – 100,000 containers	*Pinus* is of ornamental, environmental and wood production interest Pine plants imported into the PRA area are intended for planting in nurseries, plantations, seed orchards, private and public gardens,	30%

			roadsides, etc, in both rural and urban regions.	
Very high	> 1,000,000	> 100,000 containers	*Pinus* is of ornamental, environmental and wood production interest Pine plants imported into the PRA area are intended for planting in nurseries, plantations, seed orchards, private and public gardens, roadsides, etc, in both rural and urban regions.	10%
			Check sum =	100%

[1] Spread your judgment according to your belief / evidence

2.06a Likelihood of transfer via pathway

Consider the likelihood that the commodity will be distributed and subsequently allow the pest to transfer to a suitable host. For example, consider the geographic location of likely markets and the proportion of the commodity that is likely to move to locations where the pest could transfer to a host. Even if infested commodities are shipped to areas where environmental factors allow establishment, unless the pest can locate a host, establishment will not be possible. Consider the intended use of the commodity, e.g. plants for planting or produce for processing and consumption; likelihood of transfer from by-products of processing, or disposal of the commodity in the vicinity of suitable hosts; the pests ability to disperse and whether vectors provide a route from the pathway to a host; the time of year at which import takes place.

If possible consider the likelihood that sufficient numbers of the pest will transfer from the pathway to a suitable host in order to potentially initiate a new population. The reproductive strategy of the pest should be taken into account. Alternatively consider the potential number of "transfer events" that could occur per infested/contaminated consignment that has entered. See table for descriptions.

Information / evidence: *Provide reasoning then give judgment*

Mycosphaerella dearnessii is a foliage pathogen of *Pinus* spp. causing yellowing of young needles, especially on the lower crown, resulting in premature defoliation of seedlings in nurseries and young trees in pine plantations (Boyer, 1990; Phelps *et al*., 2002). On infected pine needles the pathogen produces conidia and ascospores, both of which can cause infection (Phelps *et al.,* 2002). In warm moist climates (e.g. southern United States), both spore types are produced, whereas, in cooler climates (e.g. north- and mid-central United States) only conidia have been detected (Phelps *et al.,* 2002).

Infected pine seedlings or young trees imported into the PRA area from non-EU European countries are most likely to be planted in pine nurseries, plantations, native forests, or as amenity trees in private and public gardens, roadsides, etc. both in rural and urban areas. *M. dearnessii* may be present on this plant material as (i) latent mycelium, which under favourable environmental conditions can develop acervuli with conidia, and (ii) acervuli with conidia (Phelps *et al*., 2002). From these inoculum sources, the pathogen is able to be dispersed by water splash (rain or irrigation water) and infect susceptible pine trees grown in close proximity (see also section on Means of dispersal/spread). However, conidia transported by wind-driven rain can transfer the pathogen to susceptible pine hosts grown at greater distances.

The pathogen's conidia can also be transferred to susceptible hosts grown in the PRA area by insects, and by human assistance on contaminated forestry equipment (e.g. shearing tools), clothes, shoes or vehicles (Skilling and Nicholls, 1974; Keßler *et al*., 2011).

Uncertainties regarding likelihood of transfer

There are uncertainties with respect to the maximum distance and height from inoculum sources over which conidia of *M. dearnessii* can be dispersed by natural means (rain, wind-driven rain, insects, etc), as there are no relevant studies.

Conclusions

Based on the above it may be concluded that:

- Pines are widely grown in the PRA area in nurseries, seed orchards, plantations, native forests as well as in private and public gardens, roadsides, etc both in rural and urban areas.
- On infected pine seedlings/young trees imported into the PRA area, the pathogen may be present as latent mycelium, acervuli with conidia and/or ascomata with ascospores.
- From the inoculum sources (i.e. imported infected pine seedlings/young trees) the pathogen can be transferred by various means (natural and human-assisted) to infect susceptible pine hosts grown in close proximity and at greater distances.

2.06a: Likelihood pest will transfer in sufficient numbers to a host			
Rating	**Description** (likelihood of pest transfer is ....)	**Justification summary**	**Probability Assignment** [1]
Very low	< 0.01% (less than one in ten thousand contaminated lots will provide transfer opportunities)		%
Low	Between 0.01% and 0.1% (between one in ten thousand and one in one thousand contaminated lots will provide transfer opportunities)		%
Medium	Between 0.1% - 1% (between one in one thousand and one in one hundred contaminated lots will provide transfer opportunities)		%
High	Between 1% and 10% (between one in one hundred and one in ten contaminated lots will provide transfer opportunities)	Hosts widespread in PRA area Dissemination of the pathogen within the PRA area by natural means and human assistance	50%
Very high	> 10% (more than one in ten contaminated lots will provide transfer opportunities)	Hosts widespread in PRA area Dissemination of the pathogen within the PRA area by natural means and human assistance	50%
	Check sum =		100%

[1] Spread your judgment according to your belief / evidence

2.07a Overall likelihood of entry and transfer via the pathway: Host plants for planting, including rooted Christmas pine trees

Use the BBN to combine the scores to questions 2.01 to 2.06, which all relate to the likelihood of pest entry then transfer. Present it as Figure x.

The result of combining scores to individual questions 2.01(a) to 2.05(a), that relate to likelihood of entry is combined with score for likelihood of transfer 2.06(a) using a BBN model to provide an assessment of potential for entry and transfer of *M. dearnessii* on the pine host plants for planting pathway is shown in Figures i (a) and (b).

The model suggests that, under the current EU legislation, the potential for entry and transfer of *M. dearnessii* into the risk assessment area via pine host plants for planting, including rooted Christmas pine trees, originating in infested non-EU European countries, is rather moderate (46% likelihood) to high (30% likelihood) with a medium uncertainty.

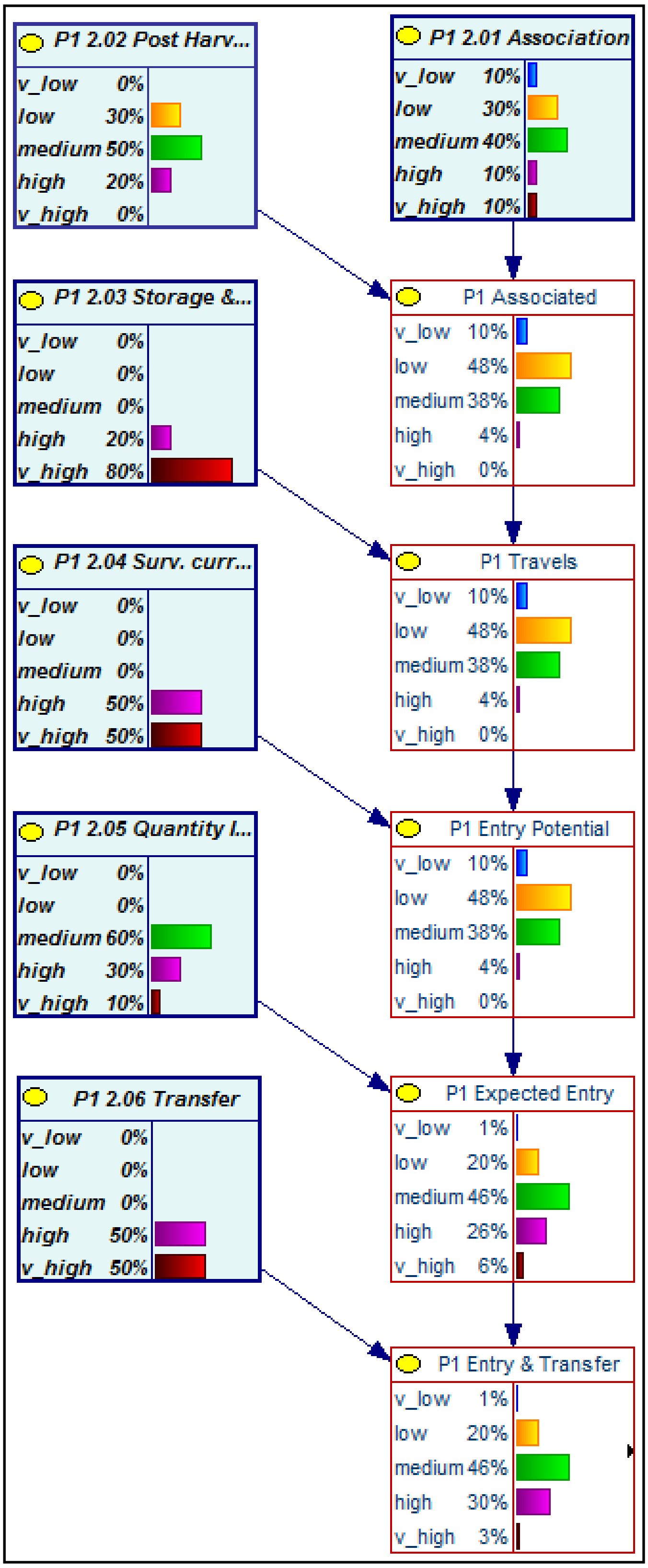

Figure i (a). BBN model results for the potential of entry and transfer of *Mycosphaerella dearnessii* on the pine host plants for planting (including rooted Christmas pine trees) pathway, under the current EU legislation

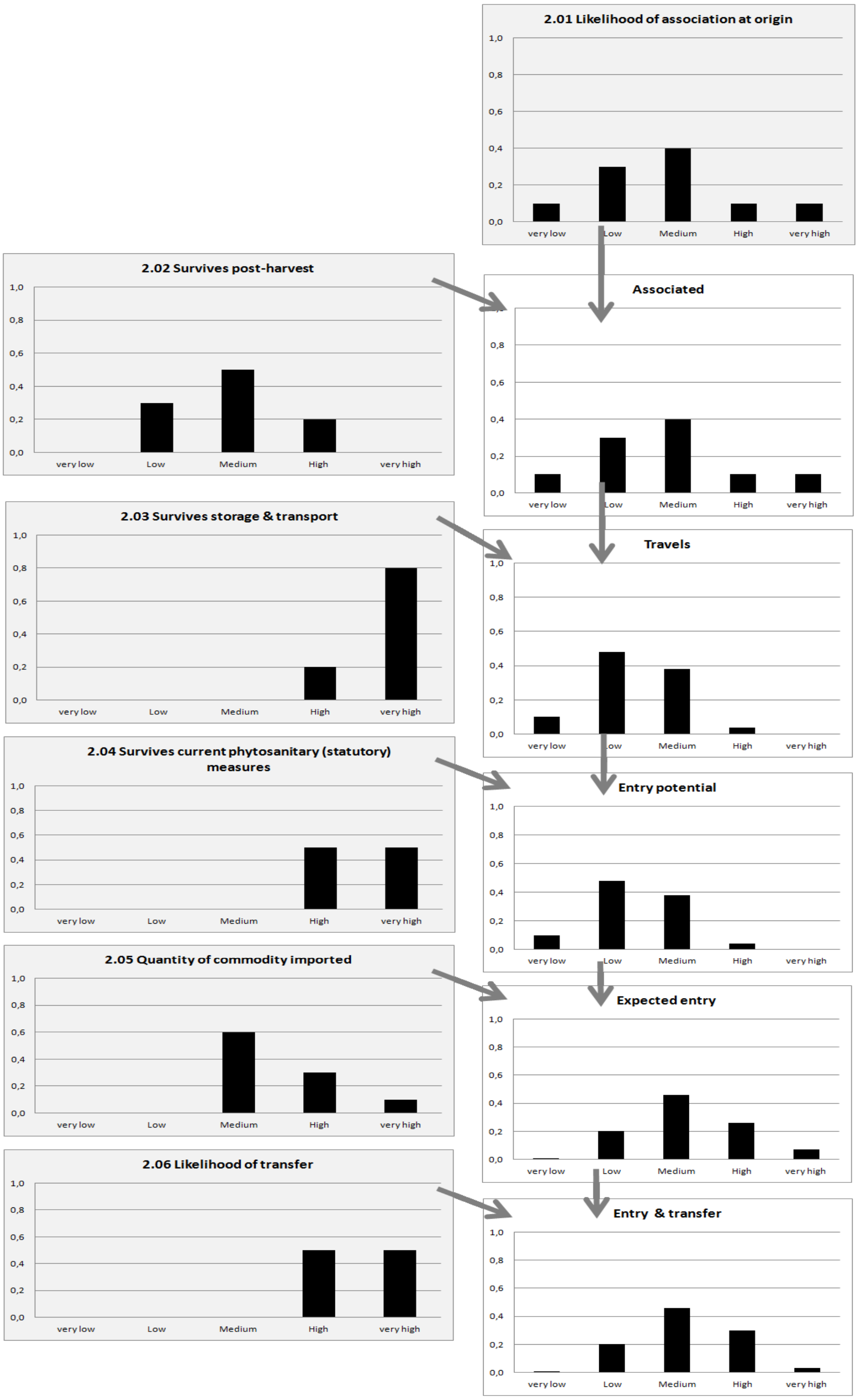

Figure i (b): Graphical representation of combining scores for questions 2.01 to 2.06, using a BBN to give the overall likelihood of entry and transfer of *Mycosphaerella dearnessii* on the pine host plants for planting (including rooted Christmas pine trees) pathway, under the current EU legislation

If there are multiple pathways, repeat steps 2.01 to 2.07 for each pathway.

Uncertainties regarding likelihood of entry and transfer
(Summarise uncertainties from 2.01 to 2.06)

In the present risk assessment and with the EU legislation in place, medium uncertainties were identified around the likelihood of entry and transfer of the pathogen on pine host plants for planting originating in infested non-EU European countries, due to lack of available information or incomplete data on the following:

- the prevalence of *M. dearnessii* in the infested areas
- the location of pine nurseries and plantations grown with Christmas pine trees in the infested areas
- the measures (cultural, chemical, etc), potentially applied in the infested non-EU European countries for the control of the pathogen
- whether the latently infected pine plants for planting will have developed symptoms by the time of their import into the PRA area.
- the efficacy of the measures (cultural, chemical, etc) potentially applied in those areas in controlling the pathogen
- the precise conditions during transport and storage of pine plants for planting, and the time taken for the transport of such material from infested non-EU European countries to the PRA area
- the effect of the low transport and storage temperatures on the potential survival of *M. dearnessii*, due to lack of relevant studies on this *Mycosphaerella* species
- the volume of host plants intended for planting (including rooted Christmas pine trees) that are imported annually from infested non-EU European countries into the PRA area.

Conclusions

2.08 Overall likelihood of entry and transfer via all pathways assessed

Combine all pathways a, b, c etc.

Only one major pathway of entry of *M. dearnessii* into the risk assessment area was identified and assessed in the present risk assessment.

Uncertainties regarding likelihood of entry and transfer via all pathways combined
(Summarise uncertainties 2.08a, 2.08b, 2.08c etc.)
Text

Conclusions

Figure y: Graphical representation of combining results from 2.08 for all pathways

3.00 Potential for pest establishment[4] and extent of spread given entry and transfer

Having transferred to a host we next consider whether the pest will survive and reproduce to initiate a population that will establish.

3.01 Environmental suitability (particularly considering climate and hosts)

When introduced to new areas, pests can be expected to behave as they do in their native areas if host plants and climates are similar. Ecological zonation and the interactions of the pests and their biotic and abiotic environments are considered here, with a focus on hosts and climate so that an assessment is based on availability of both host material and suitable climatic conditions.

If a pest's distribution is likely to be limited by frosts and/ or low winter temperatures first consider which ***hardiness zones the pest currently occurs*** *in outside of the risk assessment area. Next consider* ***the area occupied by hosts in relevant hardiness zones within the risk assessment area*** *(see Maps in Annex 1 and 2).*

If a pest's distribution is likely to be limited by a lack of accumulated temperature, e.g. low summer temperatures, first consider where the pest occurs in terms of accumulated degree day zones outside of the risk assessment area. Next consider the area occupied by hosts in relevant degree day zones within the risk assessment area (see Maps in Annex 1 and 2).

Recall that hardiness maps and accumulated degree day maps are based on 30 year averages. In reality the areas of each zone vary year to year.

Taking into account the area of suitable climate and availability of host plants judge what area the pest could potentially establish in.

In addition to climate and host, many other factors can be taken into account when assessing likelihood of establishment. ISPM 11 lists other factors to consider, e.g. biotic factors such as the reproductive strategy of the pest, whether the species is polymorphic and the degree to which the pest has demonstrated the ability to adapt to conditions like those in the risk assessment area; the minimum population needed for establishment; competition and natural enemies. Abiotic factors in the environment such as soil type could also be important.

Where applicable, practices employed during the cultivation/production of the host crops should be compared to determine if there are differences in such practices between the risk assessment area and the origin of the pest that may influence its ability to establish. Pest control programs already in the risk assessment area which reduce the probability of establishment should be taken into account. ***Pests for which control is not feasible should be considered more likely to establish than those for which treatment is easily***

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[4] *Establishment; Perpetuation, for the foreseeable future, of a pest within an area after entry* (ISPM No. 5, IPPC, 2007).

***accomplished**. The probability of establishment in a protected environment, e.g. in glasshouses, should also be considered.*

Contracting parties to the IPPC recognise the necessity for preventing the international spread of plant pests and their introduction into endangered areas (FAO, 1997). The IPPC defines "endangered area" as "an area where ecological factors favour the establishment of a pest whose presence in the area will result in economically important loss". For the purposes of EFSA, assessors are advised to interpret endangered area as "the area where ecological factors favour the establishment of a pest whose presence in the area will result in harmful consequences to cultivated and managed plants[5] and/ or the environment".

If the risk assessment has been initiated by a review of phytosanitary policy where the pest is already present and perhaps widespread in an area, the likelihood of pest establishment should focus on those parts of the area where the pest does not occur.

Fill out table 3.01 by considering how much of the HOST area within the pest risk assessment area is suitable for the pest's establishment taking into account relevant factors such as where host distribution overlaps with suitable climatic conditions (e.g. plant hardiness zones or accumulated degree day zones). For example an assessor could judge that it is 75% likely that 1/3 – 2/3 of the host area is suitable for establishment but 25% likely that between 2/3 and 90% of host area is suitable.

In Table 3.01 distinguish between the host area suitable for establishment and the ENDANGERED AREA which is, for the purposes of EFSA, the area where ecological factors favour the establishment of a pest whose presence in the area will result in harmful consequences to cultivated and managed plants and/ or the environment. In making a judgment regarding the endangered area, the rate of pest population development and any threshold required for harmful pest consequences to materialize within cultivated and managed plants could be taken into account. The magnitude of consequences is considered in Q 3.03 and 3.04.

Sophisticated quantitative environmental modelling could be used to more precisely identify the area where establishment is most likely and to identify the endangered area.

Information / evidence: *Provide reasoning then give judgment.*

Hosts of *M. dearnessii* are exclusively within the genus *Pinus* (see section Host range and updated datasheet). The disease affects trees of all sizes and ages but is most damaging on young ones.

Pine species are among the most widely occurring trees in the Northern hemisphere, where they are important components of boreal, temperate, sub-tropical and tropical forests. Pines are extensively grown in all the EU-27 Member States both in the open and under protected

[5] Managed plants are those plants appreciated / valued/ desired by man, whose growth and spread / distribution are modified by human intervention. It would include plants grown in private gardens.

conditions (nurseries) (Fig. 3) (EFSA, 2010). Forests are one of Europe's most important renewable resources and provide multiple benefits to society and the economy. They are also important for the conservation of European nature. Forests and other wooded land in the EU-27 Member States cover approximately 177 million ha (over 40 % of the EU territory), of which 58% is covered by mixed or broadleaved trees and 42% is covered by naturally coniferous forests (FAO, 2007; European Commission: 2011 http://ec.europa.eu/agriculture/fore/index_en.htm). Coniferous trees are mostly spruce (*Picea* spp.) and pine (*Pinus* spp.) trees. Pines are highly valued for introduction and planting in many parts of the EU because they are fast growing, easily cultivated and suitable for industrial plantations, agroforestry and community forestry. Pines supply many valuable products, including lumber, pulpwood, fuelwood, resin and edible nuts (FAO/IPGRI, 1996). As a result of afforestation programmes and due to natural regeneration on marginal lands, forest cover in the EU has increased over the past few decades (Fig. 4).

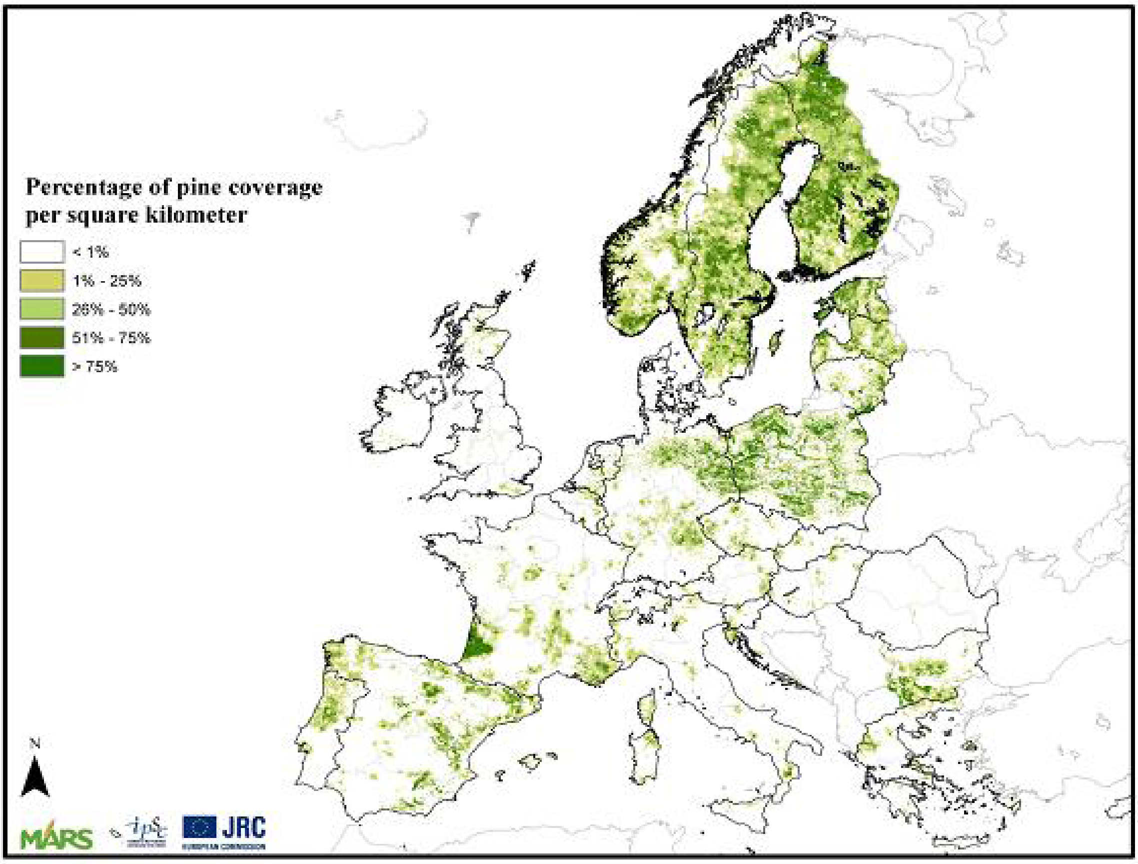

Figure 3: Geographic distribution of *Pinus brutia, P. canariensis, P. cembra, P. contorta, P. halepensis, P. leucodermis, P. mugo, P. nigra, P. pinaster, P. pinea, P. radiata, P. strobus, P. sylvestris, P. uncinata and Pseudotsuga menziesii* in Europe. Map compiled by Joint Research Center–SPRA based on JRC (2009a) (EFSA, 2010)

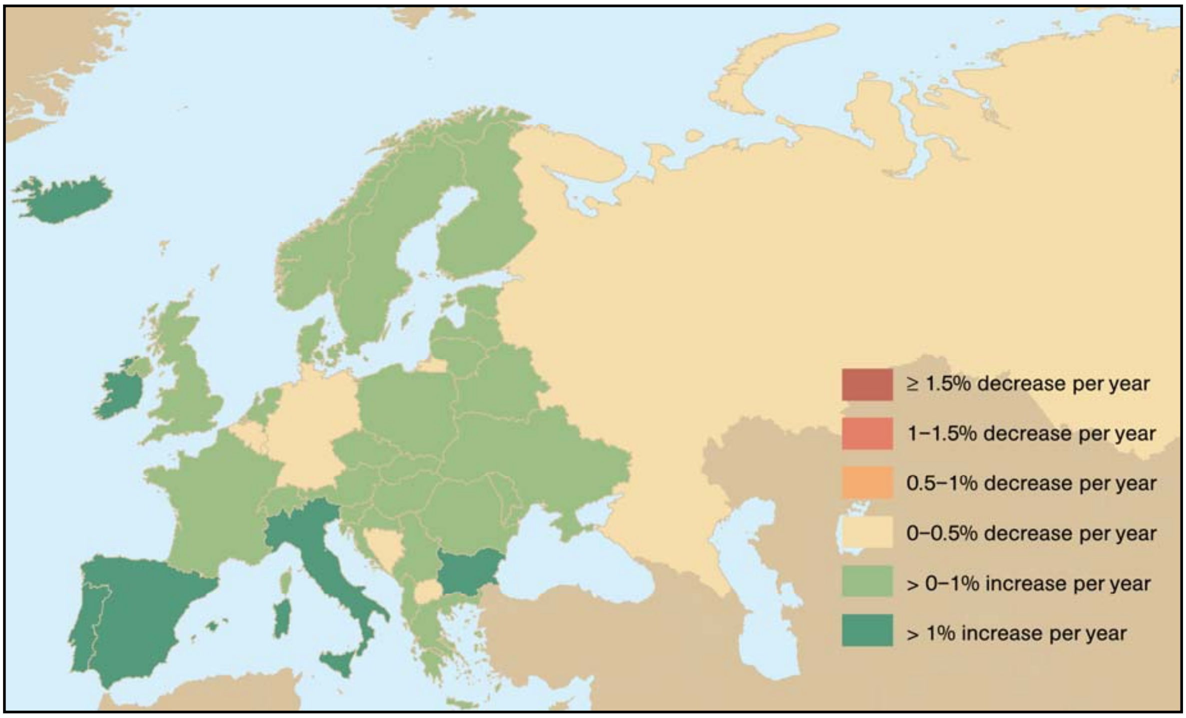

Figure 4. Changes in forest area in Europe over the period 2000-2005 (FAO, 2007)

The natural distribution in the risk assessment area of four predominant pine species, namely *P. sylvestris, P. halepensis, P. nigra* and *P. pinaster,* which are also main hosts of *M. dearnessii,* is shown in Figs 5-8, respectively (EUFORGEN, 2009). However, no data was found on the distribution within the risk assessment area of other native to Europe pine species, such as *P. pinea, P. pinaster, P. peuce, P. canariensis, P. cembra, P. brutia, P. heldreichii, P. leucodermis,* etc, and no information exists on the level of their susceptibility to *M. dearnessii* infection. Nevertheless, the real distribution in the RISK ASSESSMENT area of pine species, many of which have been reported to be hosts *M. dearnessii,* is considered to be wider than that shown in Fig. 3 and Figs 5-8, as pines are extensively grown not only in native forests but also in nurseries, seed orchards, plantations, and public and private gardens, roadsides, etc. both in urban and rural regions of the RISK ASSESSMENT area.

Mycosphaerella dearnessi has been reported from several European countries, including EU-Member States. In the RISK ASSESSMENT area, the pathogen is present, though at a localized scale, in Bulgaria, Spain, France, Southern Germany, Austria, Italy, Croatia, Czech Republic, Estonia, and Slovenia. *M. dearnessii* has been reported to cause needle blight and premature defoliation on several *Pinus* species, such as *P. mugo*, *P. sylvestris*, *P. nigra, P. radiata, P. halepensis, P. attenuata* x *radiata*, *P. radiata, P. taeda, P. attenuata* and *P. uncinata* growing mainly in nature reserves and urban sites (i.e. private and public gardens) of the risk assessment area (Kovacevski, 1938; Martinez, 1942; Petrak, 1961; Schischkina and Tzanava, 1967; Evans, 1984; Chandelier *et al*., 1994; Holdenrieber and Sieber, 1995; Pehl, 1995; Brandstetter and Cech, 1999).

Limited information exists on the environmental conditions, particularly temperature and relative humidity that favour the infection of pines by *M. dearnessii*. However, as spore germination is required for infection, it is assumed that the environmental conditions that are

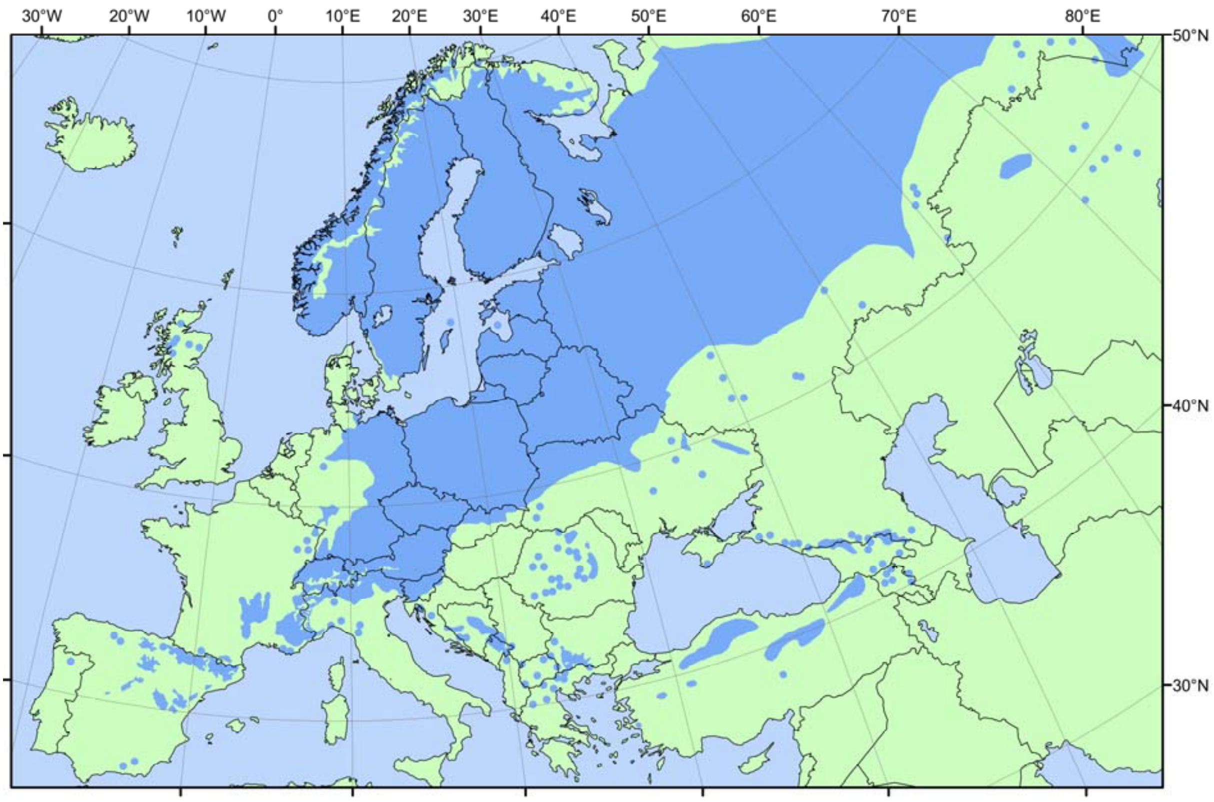

Figure 5. Natural distribution of *Pinus sylvestris* (Scots pine) in Europe
Source : EUFORGEN 2009, www.euforgen.org

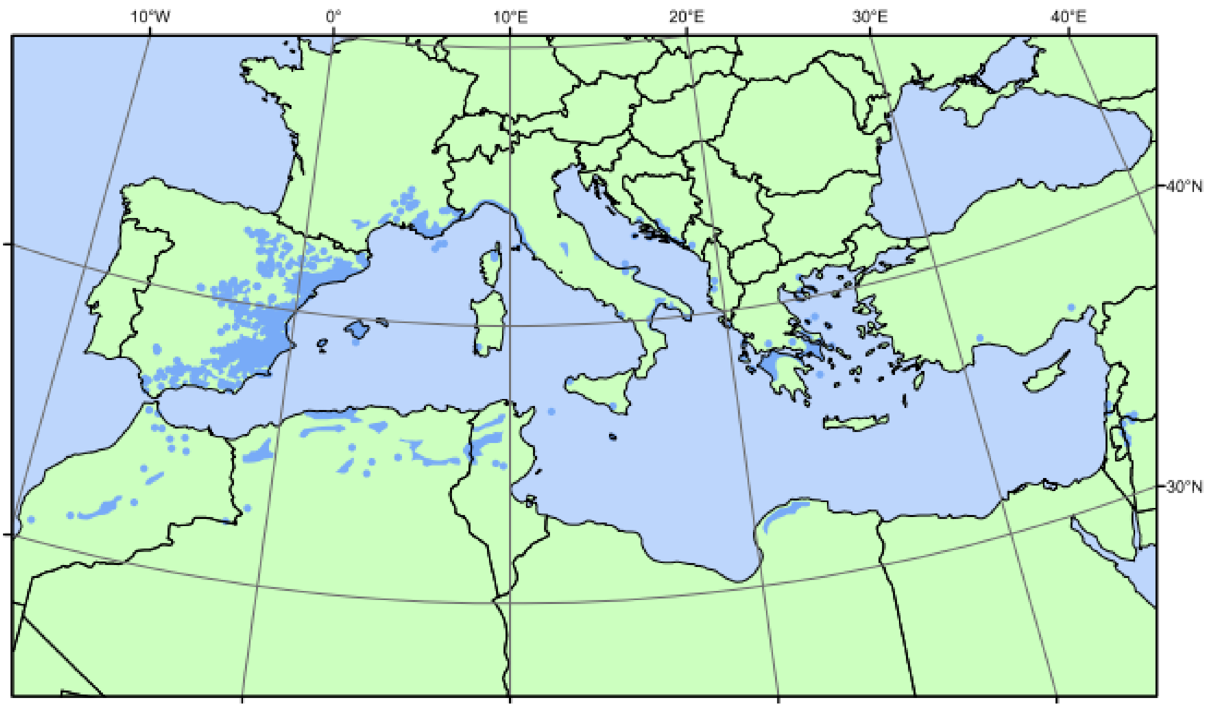

Figure 6. Natural distribution of *Pinus halepensis* (Aleppo pine) in Europe
Source : EUFORGEN 2009, www.euforgen.org

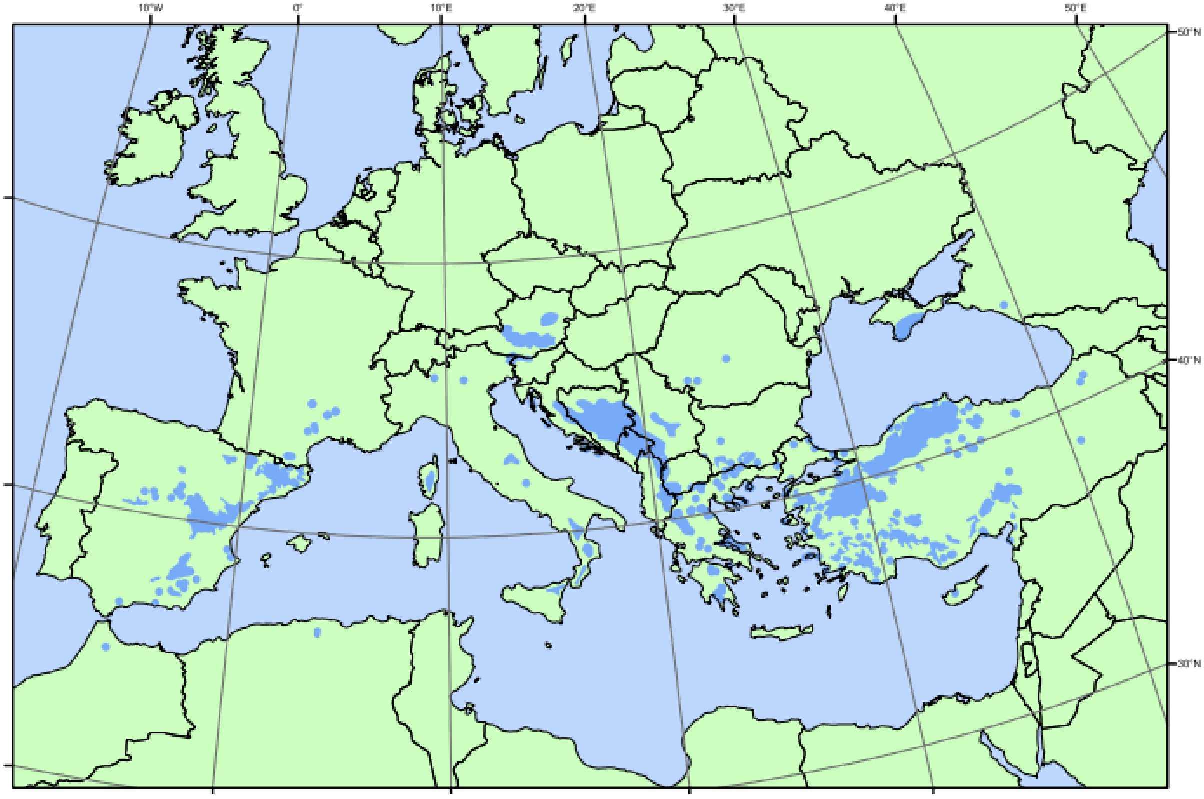

Figure 7. Natural distribution of *Pinus nigra* (Black pine) in Europe
Source : EUFORGEN 2009, www.euforgen.org

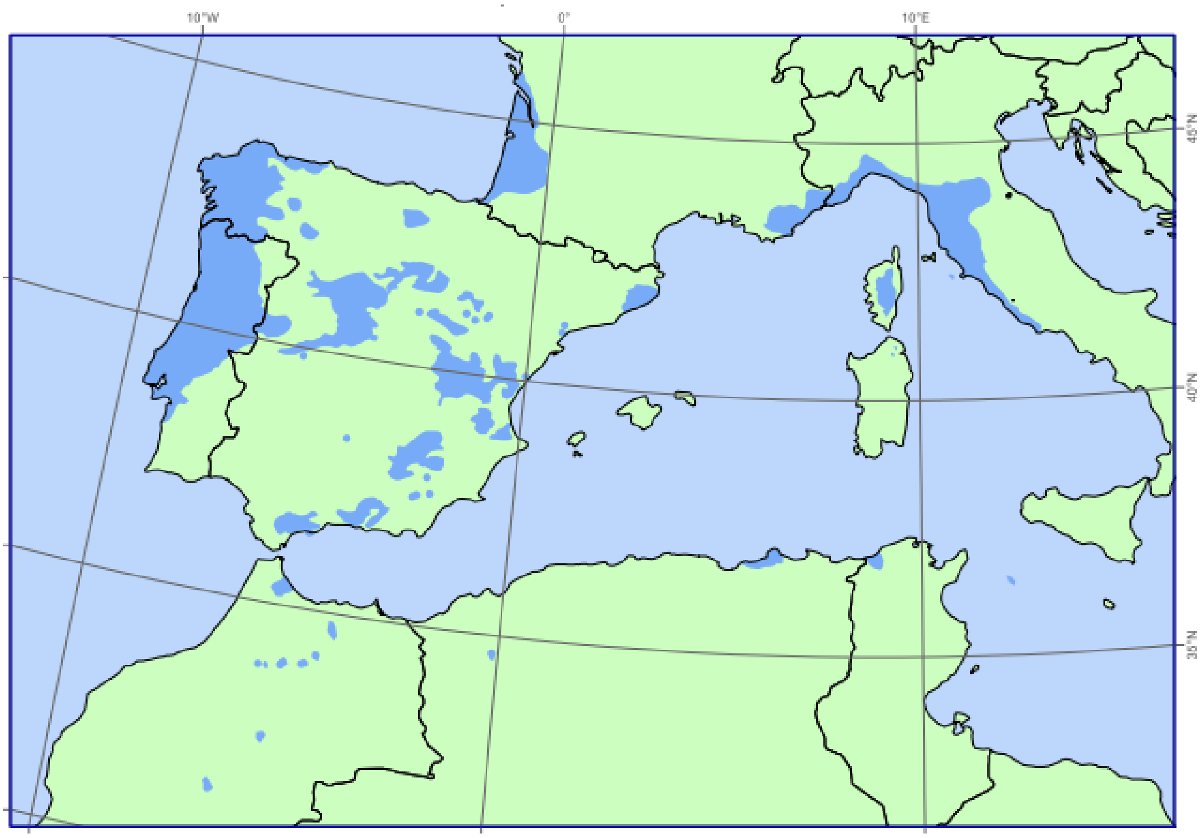

Figure 8. Natural distribution of *Pinus pinaster* (Maritime pine) in Europe
Source : EUFORGEN 2009, www.euforgen.org

conductive for spore germination are also favourable for infection. According to Sinclair *et al.* (1987) and Phelps *et al.* (2002), wet conditions favour conidial germination of *M. dearnessii* and the development of the disease. Infection can occur over a wide range of temperatures, but it is most rapid if day and night temperatures are about 30°C and 21°C, respectively (Sinclair *et al*., 1987). However, temperatures of 35^0C during the day and 27^0C during the night are lethal to conidial germination or germ tube elongation of *M. dearnessii* (Kais, 1975). Studies have also shown that conidia of *M. dearnessii* can withstand long dry periods (10 days) and cause severe infection when high humidity resumes (Kais, 1975). Suto and Ougi (1998) reported that *in vitro* germination of conidia of *M. dearnessii* occurred at temperatures between 10 and 30^0C, with an optimum germination at 25-30^0C. No conidial germination was recorded at 5 and 35^0C. The same authors reported that colonies of the pathogen on PDA plates grew at temperatures between 10 and 30^0C, but no mycelial growth was observed at 5 and 35^0C (Suto and Ougi, 1998). When the plates were then transferred to 20^0C, no mycelial growth was observed on the plates than had been previously incubated at 35^0C, which indicates that high temperatures might not favour the survival of *M. dearnessii* mycelium.

Comparison of data on the current geographic distribution of *M. dearnessii* (Fig. 2) and the world plant hardiness zones (Annex 1a) shows that the pathogen has a wide ecological range, as it occurs in plant hardiness zones from 2-3 (Northern USA, Canada, China) to 11-12 (Central America, Caribbean), with most of the infested areas being located between zones 6 to 11. The risk assessment area extends mainly between plant hardiness zones 2 and 9 (Annex 1b). Although there are no precise data on the exact distribution of *M. dearnessii* in the risk assessment area, based on the location of the EU-Member States in which the pathogen has been detected, it may be considered that the infested by *M. dearnessii* regions in the risk assessment area are within the plant hardiness zones 6-8 (Annex 1b).

Comparison of data on the current geographic distribution of *M. dearnessii* (Fig. 2) and the world maps of accumulated temperature base 5^0C and 10^0C (Annexes 2 & 3, respectively), shows that *M. dearnessii* is currently distributed in zones between 500°C and more than 4000°C (annual degree days base 5°C) (Annex 2a) and between 250°C and 6000°C (annual degree days base 10°C) (Annex 3a), which indicates that the pathogen has established in areas with a wide range of temperatures. Similar temperature conditions occur in many parts of the PRA area and particularly in most of the central EU-Member States in which the pathogen has already been detected (Annexes 2b & 3b).

Based on the geographic distribution of *M. dearnessii* and the several pine species affected worldwide, Evans (1984) assumed that the pathogen is a highly adaptable organism with wide ecological tolerance and host range. According to the same author, *M. dearnessii* poses a threat to exotic pine species not only in the tropics and sub-tropics but also in temperate regions (Evans, 1984). The present geographic distribution of *M. dearnessii* and the numerous pine species affected by the pathogen worldwide corroborate Evans' assumption.

Comparison of the geographic distribution of *M. dearnessii* (Fig. 2) with that of *M. pini* (Fig. 9), the causal agent of red band needle blight of pines, can provide information on the environmental requirements of *M. dearnessii*, as these two species have similar biology and epidemiology (Hartmann *et al*., 1988). Although *M. pini* has a wider distribution than *M. dearnessii*, both pathogens occur simultaneously in several areas worldwide, including the

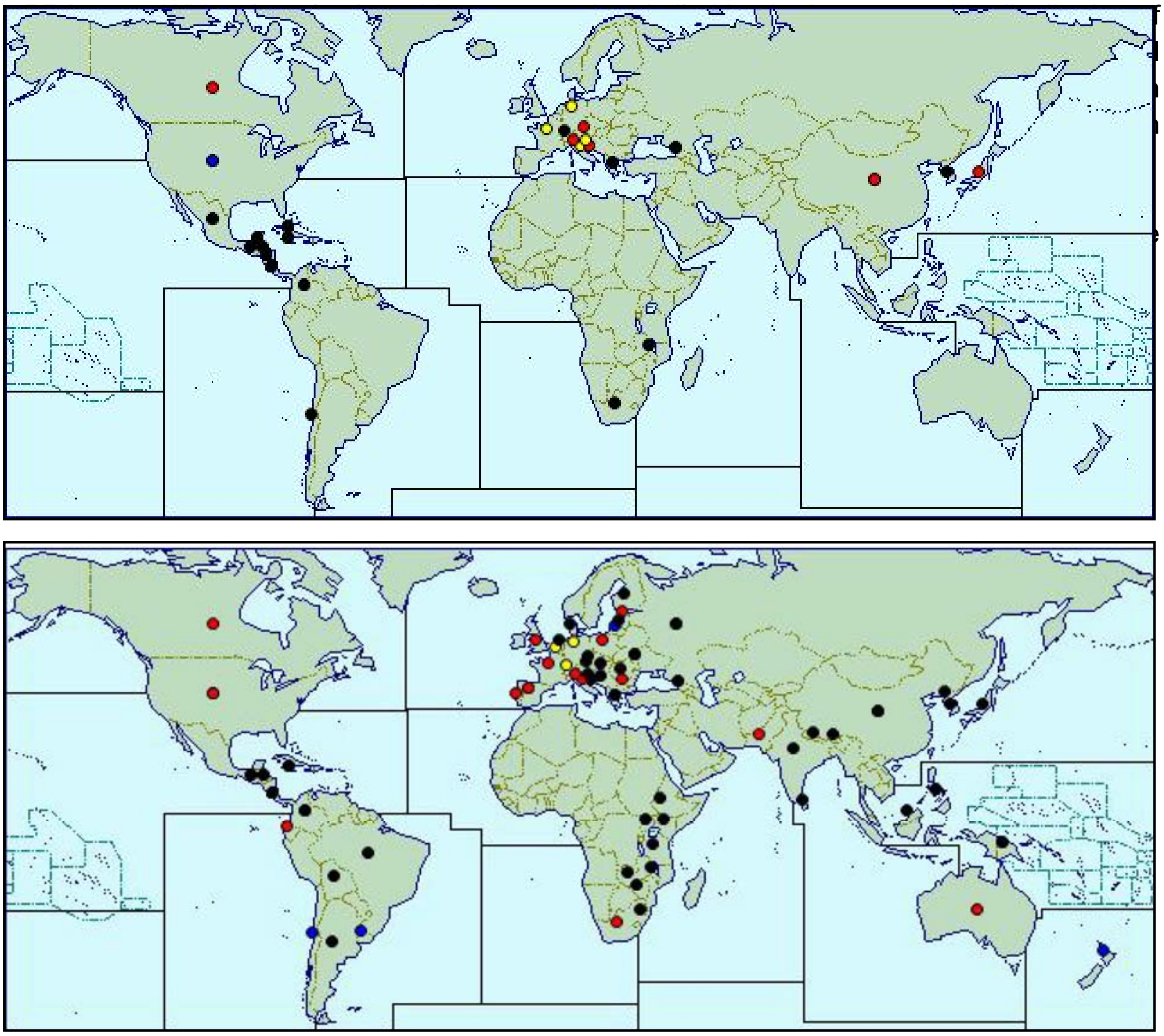

Figure 9. Geographic distribution of *Mycosphaerella dearnessii* (top map) and *M. pini* (bottom map) (CABI, 2011)

Uncertainties regarding environmental suitability

Due to lack of relevant studies or to limited data available, there are uncertainties related to:

(i) the environmental conditions, particularly temperature range and humidity that favour the infection of pine hosts by *M. dearnessii*

(ii) the exact distribution and the prevalence of *M. dearnessii* in the infested EU-Member States

(iii) the exact distribution and density of susceptible pine species grown in native forests, nurseries, seed orchards, plantations, private/public gardens, roadsides, etc. in the PRA area

(iv) the level of susceptibility of native to Europe pine species to infection by *M. dearnessii*

(v) the ability of the pathogen to compete *M. pini* on the same host pine seedlings/trees grown in the PRA area

Comment regarding the endangered area

Taking into account that (i) pine species susceptible to *M. dearnessii* are widely distributed in the PRA area in native forests, nurseries, seed orchards, plantations as well as in public and private gardens, roadsides, etc. both in urban and rural areas, (ii) *M. dearnessii* has been reported to be present in several localities in the PRA area, where it causes needle blights and premature defoliation of susceptible pine species, (iii) the climatic conditions in the greatest part of the PRA area are favourable for the establishment of the pathogen, and (iv) the pathogen is highly adaptable to a wide range of climates and pine species, it may be considered that the endangered area is most likely to be the whole of the PRA area with the exception of the high-mountain zones.

Conclusions

Given the presence of *M. dearnessii* in several localities of the risk assessment area, the widespread distribution of susceptible pine hosts and the adaptability of *M. dearnessii* to various climates and pine species, it may be concluded that, it is 60% likely that 1/3-2/3 of the host area is suitable for establishment and 40% likely that 2/3 to 90% of the host area is suitable for establishment of *M. dearnessii*.

3.01: Environmental suitability (particularly climate and host)				
Rating	**Pest is likely to be able to establish in ...**	**Justification summary**	**Probability for suitable area** [1]	**Probability for endangered area %**
Very low	Less than 10% of host area		0%	0%
Low	Between 10% and 1/3 of host area		0%	0%
Medium	Between 1/3 and 2/3 of host area	Pine hosts are widely distributed in the PRA area Some native pine species resistant to infection *M. dearnessii* adaptable to a wide range of climates and pine species The pathogen is present in several localities in the PRA area Climatic conditions suitable for establishment in the PRA area with the exception of the high mountain zones	60%	60%
High	Between 2/3 and 90% of host area	Pine hosts are widely distributed in the PRA	40%	40%

		area Many native pine species susceptible to infection *M. dearnessii* adaptable to a wide range of climates and pine species The pathogen is present in several localities in the PRA area Climatic conditions suitable for establishment in the PRA area with the exception of the high mountain zones		
Very high	More than 90% of host area	All pine species grown in the PRA area susceptible to infection Pine hosts widely distributed Climatic conditions suitable for establishment in the whole PRA area	0%	0%
	Check sum =		100%	100

[1] Spread your judgment according to your belief / evidence

3.02 Extent of spread

Having found a host and established in the PRA area, a pest will need to spread / disperse after introduction. Consider how quickly the pest could spread. For example, take into account its reproductive potential, suitability of the environment and inherent powers of movement. Assessors should take into account the likelihood that spread may not be contiguous and satellite populations may develop at significant distances from the original point of establishment. Such dispersal could occur via biotic or abiotic vectors, wind, water, or, for example, be facilitated via trade or transport links or via others forms of human assistance, such as movement of infected/infested plant material for propagation purposes (seedlings, scions, budwood).

Taking into account the time horizon considered within this assessment (see Initiation, 1.5) estimate the area likely to be occupied by the pest at that time.[6]. Fill out table 3.02a by estimating the likelihood that the pest would have spread to occupy the given proportion of the host area suitable for establishment within the time period / time horizon considered by this assessment. Then fill out table 3.02b by estimating the likelihood that the pest would have spread to occupy the given proportion of endangered area within the time period / time horizon considered by this assessment.

The tables are used to consider the extent of spread in relation to the area where establishment is suitable. Hence it is recognised that fast moving pests with a large area suitable for establishment may be rated below slower moving pests with much smaller areas suitable for establishment. Quantitative spread modelling could be considered to examine spread more precisely.

Specify the time period / time horizon considered by this assessment (refer to 1.5).

Information / evidence: Provide reasoning then give judgment

M. dearnessii infective propagules (conidia, ascospores) are dispersed by wind and/or water (rain or irrigation) (see section Means of dispersal/spead). Spread of *Mycosphaerella dearnessii* over relatively short distances (within a tree or between trees) occurs by water-splashed conidia produced in acervuli on infected needles either still attached to the trees or on fallen ones (CABI/EPPO, 1997). Conidia are released only during wet weather and never at low temperatures (near 2^{0}C) (CABI/EPPO, 1997). Conidia may be either splash-dispersed onto the tree canopy by rain, overhead or sprinkler irrigation water (in the case of pine nurseries) or washed-off by rain, dew or overhead irrigation from the upper infected needles to the lower ones. By this mechanism, conidia of the pathogen can spread over relatively short distances. As a rule, pathogens disseminated by wind spread over long distances within a short period of time (Aylor, 1990), whereas splash-dispersed pathogens reach mostly short distances from the primary source of inoculum (Huber *et al.,* 1998). However, conidia of *M. dearnessii* can be dispersed over longer distances by wind-driven rain.

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[6] When assessing the extent of spread, be *clear about the scenario being considered e.g. you could be considering a scenario without risk reduction options in place, or a scenario with specific phytosanitary measures that inhibit spread (risk reduction options) in place.*

There are no studies on the distance or height above inoculum sources over which the pathogen's conidia can be dispersed by rain, wind-driven rain or irrigation water. However, studies carried out with other splash-dispersed fungi (Fitt *et al*., 1989) have shown that in still air conidia covered with mucilage, like those of *M. dearnessii*, are splash-dispersed up to a height of not more than 50 cm or up to a distance of 1 m from the inoculum source with their numbers decreasing steeply with increasing height or distance. However, the dispersal pattern of conidia depends on the size of conidia and the velocity of the incident raindrop as well as on the presence of air currents. Rain tower experiments have shown that in still air large raindrops spread the conidia over shorter distances compared with the smaller drops (Fitt *et al.,* 1989). Moreover, water drops formed on the leaves due to fog, dew, mist, overhead or sprinkler irrigation may cause drip-splash of *M. dearnessii* conidia under tree canopies, which may be as important as direct rain-splash. These drip drops may have sufficient impact force for the dispersal of conidia in splash drops because they fall only short distances and thus, they are usually larger than 5 mm in diameter and less likely to break up compared to raindrops (Fitt *et al.,* 1989).

The close spacing and dense foliage of seedlings and trees in pine nurseries and plantations create ideal conditions for short-distance and within trees spread of the pathogen (Phelps *et al.,* 1978). The dense foliage, due to the numerous shearings, provides a favourable microclimate for sporulation and infection by *M. dearnessii* because moisture usually remains on the needles for long periods.

In areas where both anamorph and teleomorph are present (e.g. southern USA), spread of *M. dearnessii* over longer distances may also occur by wind-disseminated ascospores forcibly discharged from ascomata during rain, dew formation or fog (Kais, 1971). Ascomata are produced on either infected dead needles still attached to the trees or in cast needles and ascospores mature at any time between 2 and 3 months after infected needles die (Lightle, 1960). Ascomata and ascospores have not been reported outside the southern United States (Phelps *et al*., 1978).

Long-distance spread of the pathogen is most likely to occur by human-assisted movement of infected nursery stock, as this material will be used for the establishment of new pine plantations (Skilling and Nicholls, 1974). Latently (asymptomatic) infected plant material, poses an even higher risk. Infected host plant material for propagation purposes (pine seedlings) could be freely distributed around the PRA area in the means of trade or movement by individuals. Such human-assisted distribution would lead to the spread of the organism from infested to non-infested regions within the EU-27 Member States. Infected nursery stock was most probably the means by which the pathogen spread from the southern to the northern United States (Skilling and Nicholls, 1974). Seed lots contaminated with infected needle debris may also spread the pathogen over long distances (CABI/EPPO, 1997).

The sticky spores of *M. dearnessii* can also be dispersed by insects or on forestry equipment, such as shearing tools (Skilling and Nicholls, 1974), clothes, shoes, vehicles, etc. allowing dissemination of the pathogen within and between plantations.

Spread is also likely to occur by forest visitors or tourists, intentionally or unintentionally, as the sticky spores of the pathogen can be transported over long distances as contaminants on clothes, shoes or vehicles (Keßler *et al*., 2011). It is assumed that in Czech Republic tourists played an important role in the spread of *M. dearnessii*, as the disease was first detected on 10-60 year old *P. rotundata* trees (bog pine) grown in two nature conservation sites located in the vicinity of popular tourist trails (Jankovský *et al*., 2009). Moreover, machinery and vehicles used in infested urban sites may also spread the pathogen to new areas. The risk is higher in the case of machinery used in the process of eradication of infected trees, unless they are properly cleaned and disinfected.

According to La Porta and Capretti (2000), *M. dearnessii* was first detected in 1997 on *P. mugo* grown in a Botanical Garden in north-eastern Italy and within two years it spread to all 12 *P. mugo* trees of the Botanical Garden. In Switzerland the disease seems to be confined to *P. mugo* and *P. uncinata* grown in parks and gardens near Zurich and it has not reached forest stands (Holdenrieder and Sieber, 1995; Meier *et al.,* 2008; EPPO, 2008b). In Slovenia, brown-spot needle blight has been observed on Scots pine (*P. sylvestris*) and mountain pine (*P. mugo*) in a park in Bled (EPPO 2008a). Records from Austria show that the disease was found in plantations of amenity trees located in towns (Brandstetter and Cech, 1999; 2003). According to Brandstetter and Cech (2003), the number of *M. dearnessii* spores collected in spore traps exposed for a period of two years (2001-2002) in the municipal area of Hollenstein in the valley of the river Ybbs (Lower Austria), was low. In addition, no symptoms were detected in the pine forest surrounding the town during a 6-year monitoring (1996-2002). The authors attributed the rather slow spread of the pathogen to the unfavourable climatic conditions and particularly to the low temperatures. Furthermore, the same authors assumed that the presence of *M. pini* in the same area might have further reduced the infection frequency by *M. dearnessii.* However, in 2008, the pathogen was detected for the first time in mixed forests stands on Scots pines (*P. sylvestris*) adjacent to the town of Hollenstein (Keßler *et al.,* 2011). In 2010, *M. dearnessii* was detected on urban trees in five other towns at a distance of 40 km far from Hollenstein. It is not known if the disease spread from Hollenstein to the other towns by natural means, or the new outbreaks were the result of human-assisted movement of infected plant material (Keßler *et al.,* 2011). No other information is available in the literature on the spread of the pathogen within the infested EU-27 Member States following the detection of the first outbreaks.

Based on the historical records on the distribution of brown-spot needle blight in the PRA area, it may be assumed that the spread of the pathogen is likely to be slow. This might be due to the absence of the teleomorph and subsequently of wind-disseminated ascospores, which could potentially spread the disease over longer distances. In addition, *M. dearnessii* has been reported to be simultaneously present with *M. pini* (anamorph *Dothistroma septosporum*), commonly occurring on several pine species in the PRA area (Jakovský et al. 2009). However, infections by both pathogens on the same tree have not been observed, which indicates a competition phenomenon (Brandstetter and Cech 2003; Jakovský *et al*. 2009; Krehan *et al*., 2003). In addition, the widespread occurrence of *M. pini* in the PRA area on several pine species, some of which are hosts of *M. dearnessii* (i.e. *P. nigra, P. sylvestris and P. mugo)*, might have reduce the infection frequency of those pine species by *M. dearnessii* and subsequently the spread potential of the pathogen in the PRA area (Brandstetter and Cech 2003).

Uncertainties regarding extent of spread

There are uncertainties with respect to the extent of *M. dearnessii* spread within the PRA area within the time horizon considered in this assessment (i.e. 5 years), due to the:

(i) limited information on the spread of the pathogen within the infested EU Member States following the detection of the first outbreaks,

(ii) lack of information on the movement/trading of host plants for propagation purposes within the EU-27 Member States

(iii) unavailability of data on the distribution of susceptible pine species in the PRA area and particularly whether their distribution is continuous or fragmented, and

(iv) lack of data on the volume of pine plants for planting that are traded/moved annually within the risk assessment area

Conclusions

Based on the above, the current distribution of *M. dearnessii* in the PRA area and the information found in the literature according to which:

(i) the pathogen has a relatively long incubation period (1-7 months from infection to symptom development depending on the pine species and tree age),

(ii) the disease is monocyclic (i.e. there is only one infection cycle per year, as acervuli with conidia are produced in spring on needles that had been infected the previous year), and

(iii) the disease usually takes several years to reach epidemic proportions,

it may be concluded that the extent of spread of *M. dearnessii* both in the area of its potential establishment and in the endangered area within the time horizon considered in this risk assessment (i.e. 5 years) is expected to be rather low to very low by natural means and medium to high by human assistance. Therefore, the overall extent of spread is expected to be medium to high with a medium uncertainty.

3.02a: Extent of spread in area of potential establishment at time horizon (5 years)			
Rating	**Within the time horizon considered the pest is likely to have spread to ...**	**Justification summary**	**Probability that given area will be occupied at time horizon [1]**
Very low	Less than 10% of the area suitable for establishment	Spread of *M. dearnessii* by natural means is likely to occur only for short distances from the inoculum sources due to the absence of teleomorph, the long incubation period, and the existence of one disease cycle per year (monocyclic disease)	0%
Low	Between 10% and 1/3 of the area suitable for establishment	The pathogen is expected to spread faster and over longer distances by	0%

		human activities (movement/trade of infected plants, tourists, visitors of forests/nature reserves, etc)	
Medium	Between 1/3 and 2/3 of the area suitable for establishment		70%
High	Between 2/3 and 90% of the area suitable for establishment		30%
Very high	More than 90% of the area suitable for establishment		0%
	Check sum =		100%

[1] Spread your judgment according to your belief / evidence

3.02b: Extent of spread in endangered area at time horizon (5 years)			
Rating	**Within the time horizon considered the pest is likely to have spread to ...**	**Justification summary**	**Probability that given area will be occupied at time horizon[1]**
Very low	Less than 10% of the endangered area	Spread of *M. dearnessii* by natural means is likely to occur only for short distances from the inoculum sources due to the absence of teleomorph, the long incubation period, and the existence of one disease cycle per year (monocyclic disease)	0%
Low	Between 10% and 1/3 of the endangered area	The pathogen is expected to spread faster and over longer distances by human activities (movement/trade of infected plants, tourists, visitors of forests/nature reserves, etc)	0%
Medium	Between 1/3 and 2/3 of the endangered area		70%
High	Between 2/3 and 90% of the endangered area		30%
Very high	More than 90% of the endangered area		0%
	Check sum =		100%

[1] Spread your judgment according to your belief / evidence

Consequences of pest introduction
3.03 Crop consequences (yield and quality)

Introduced pests are capable of causing a variety of direct and indirect impacts. The remit of EFSA limits assessors to consider the consequences of pest introduction on crop yield and quality (crop consequences / impacts) (3.03) and environmental consequences /impacts (3.04) e.g. impacts on ecosystem services or biodiversity itself. We recognise that other types of impacts, listed in ISPM 11, may also occur.

Fill out table 3.03 by taking into account the extent of pest spread within the endangered area up to the time horizon of the assessment, and other factors such as the rate of pest population development and any threshold required for harmful pest consequences to materialize within cultivated and managed plants. Consequences should be estimated taking into account the current situation in the endangered area with respect to the control efforts undertaken by growers /nurserymen/ producers etc. against other pests. Although we recognise that growers may respond by increasing pest management efforts to minimize impacts of a new pest, such additional efforts are not taken into account.

If the risk assessment has been initiated by a review of phytosanitary policy where the pest is already present and action is being taken against it, specify whether consequences are being assessed assuming that action is stopped.

Information / evidence: *Provide reasoning then give judgment*

Brown-spot needle blight causes yellowing and necrosis of young needles, especially on the lower crown, resulting in premature defoliation of seedlings in nurseries and young trees in pine plantations (Boyer, 1990; Phelps *et al*., 1978). Although the symptoms and the epidemiology of brown-spot needle blight are very similar to red band needle blight caused by *M. pini* (teleomorph *Dothistroma septosporum*), its impact has been generally less (Harrington and Wingfield, 1998). However, severe defoliation reduces vigour, which in turn, may result in poor survival and growth of following outplanting (Cordell *et al*., 1989). Most needle shedding occurs the second year of infection (Anonymous, 2007). Severe infections may also retard the growth, whereas attack over several years can kill the trees (Phelps *et al*., 1978; Anonymous, undated; OEPP/EPPO, 2005).

In the USA, *M. dearnessii* attacks 32 pine species in 25 States from coast-to-coast (Kais and Peterson, 1986). It is most common in the South, where it primarily attacks *P. palustris* (longleaf pine) and secondarily other southern pine species. Longleaf pine develops through a grass stage, which is particularly susceptible to *M. dearnessii* (Harrington and Wingfield, 1998). In southern-eastern America, brown-spot needle blight causes severe growth checks to seedlings and young tree plantations of longleaf pine and it is the main limiting factor to the establishment of this species in its natural range (Henry, 1954; Gibson, 1979; CABI/EPPO, 1997; Jewell, 1983). As a consequence, in southern America longleaf pine has been supplanted by other species and now occupies about 25% of the acreage it once dominated (Mann, 1969). According to Phelps *et al*. (1978), the disease reduces the annual growth of southern pines by more than 0.453 million m^3 of timber. Damage is most severe on longleaf seedlings in the grass stage (i.e. those that have not begun active height growth) and heavily infected seedlings may remain at the grass stage for 4-10 years or more, while non-infected seedlings remain in the grass stage for only 1-2 years (Phelps *et al.,* 1978;

Boyer, 1990; Harrington and Wingfield, 1998). Once out of grass stage, longleaf pine is no longer susceptible to brown-spot needle blight (Gwaze *et al*., undated).

In northern America, brown-spot needle blight has become a serious problem to certain varieties of Scots pine (*P. sylvestris* L.) and other pine species grown in Christmas trees plantations (Skilling and Nicholls, 1974). Short-needled Scots pine varieties (i.e. Spanish and French green) are more susceptible than long-needled varieties (i.e. Austrian Hills and German) (Kais and Peterson, 1986). On trees with dense foliage, infection is most common on low branches, leaving bare branches through the winter if infections have been severe (Hartman and Hill, 1996). On these branches, new foliage may be produced the following spring, which also becomes infected. Light infections usually accelerate loss of second- and third-year needles, making trees unsalable (Skilling and Nicholls, 1974; Phelps *et al*., 1978).

In central America, *M. dearnessii* is endemic and omnipresent in native pine forests of *P. caribea, P. oocarpa, P. maximinoi* and *P. patula* from sea level to cloud forest (2000 m altitude), but it has never been associated with a serious needle blight (Evans, 1984). Often secondary needles are affected by the disease, causing premature needle cast on hosts in natural pine stands (CABI, 2011). Severe infection can be observed on hosts at the extremes of their altitudinal range (Evans, 1984). First reports of *M. dearnessii* as a serious needle blight pathogen are on *P. palustris* (longleaf pine) in the Gulf States of the USA (Hedgcock, 1929). This confirms Evans (1984) hypothesis that the fungus is exotic in this region, attacking susceptible and non-adapted indigenous pine species.

According to Phelps *et al*. (1978), pathogenic variation exists within the pathogen's population in the USA. More specifically, isolates obtained from Scots pine in the North-Central States differed in virulence from isolates obtained from longleaf pines in the South.

Pines are extensively grown in all the EU-27 Member States both in the open and under protected conditions (nurseries) (Fig. 2) (EFSA, 2010). Pine species are highly valued for introduction and planting in many parts of Europe because they are fast growing, easily cultivated and suitable for industrial plantations, agroforestry and community forestry. Pines are of economic and environmental interest for all the EU-27 Member States, as they are important components of the European forests supplying many valuable products (e.g. lumber, pulpwood, fuelwood, resin, edible nuts, etc) (FAO/IPGRI, 1996).

In contrast to *M. pini*, which is widespread on many pine species within the PRA area, *M. dearnessii* has been detected mainly on *P. sylvestris, P. mugo, P. nigra, P. radiata, P. attenuata* x *radiata, P. taeda, P. attenuata* and *P. halepensis* in natural reserves and urban sites (Martinez, 1942; Petrak, 1961; Evans, 1984; Chandelier *et al.,* 1994; Hodenrieder and Sieber, 1995; Pehl, 1995; Brandstetter and Cech, 1999). In central Europe the disease has also been detected in swamps on *P. mugo* subsp. *uncinata* (OEPP/EPPO, 2008) and in peat bogs of 10-60 year old *P. rotundata* trees (Jankovský *et al.,* 2009). In all cases, the pathogen has been found to cause needle blights and premature defoliation.

In USA, brown-spot needle blight can easily be controlled by cultural practices (e.g. use of healthy nursery stock, planting of less susceptible pine species and varieties, removal of infected trees, avoid shearing infected trees or plantations during wet weather, prescribed fire, etc) and chemical sprays applied in nurseries, seed orchards and plantations of longleaf pine and Scots pine (Phelps *et al*., 1978; Kais and Peterson, 1986). According to Kais and Peterson (1986), one spray applied when needles are nearly half grown can control the disease. However, during wet years or in severely infected plantations, a second spray is required 3-4 weeks later. Kais (1975b) and Phelps *et al*. (1978) reported that 4-7 sprays over the 6-month critical period for infection (May-October) is necessary for the control of the disease in pine nurseries.

No information is available on the measures (cultural, chemical, etc) applied in pine nurseries, seed orchards and plantations in the PRA area for the management of other pests.

Due to the premature defoliation, the disease may also cause loss in the aesthetic value of shade and ornamental host pine trees.

Uncertainties regarding crop consequences

There are uncertainties around the consequences that brown-spot needle blight might have in the PRA area within the time horizon considered in this risk assessment (i.e.5 years) mainly due to the lack of:

(i) relevant studies on the susceptibility of native pine species growing in the PRA area to the infection by *M. dearnessii*
(ii) information on the virulence of *M. dearnessii* strains present in the PRA area
(iii) data on the effects of the disease on susceptible pine species grown in managed environments (pine nurseries/seed orchards/plantations) in the PRA area

Conclusions

- In USA, brown-spot needle blight affects a wide range of pine species, with the highest consequences on young trees of *P. palustris* (longleaf pine) and *P. sylvestris* (Scots pine). The disease affects only the needles causing blight, premature defoliation and stunting of longleaf pine seedlings. However, severe infections may result in repeated defoliations, seedlings death or in decrease of the annual growth of *P. palustris*. The disease has been reported to reduce the annual growth of southern pines by more than 0.453 million m^3 of timber.
- Due to premature needle loss, the disease makes pines in landscapes unsightly and pines in Christmas tree plantations unmarketable.
- In the PRA area, *M. dearnessii* has been reported from several EU-Member States to cause needle blight and premature defoliation on pine trees growing in nature reserves and urban sites (i.e. private and public gardens). No other consequences of the disease on the affected pine species have been reported in the PRA area and, so far, the disease has not been detected in pine nurseries/seed orchards/plantations.

Based on the above, it may be concluded that the consequences that *M. dearnessii* might have in the PRA area within the time horizon considered in this risk assessment (i.e. 5 years) are expected to be low to very low with a medium uncertainty. Nevertheless, the introduction into the PRA area of new, more virulent strains of the pathogen and/or the establishment of *M. dearnessii* to pine nurseries/seed orchards/plantations will most probably increase the potential consequences.

3.03: Potential consequences on crops and managed plants			
Rating	**Description** (if established in the endangered area, the pest ....(descriptions within categories provide guidance, not all descriptions need to be satisfied in each category)	**Justification summary**	**Probability Assignment** [1]
Very low	Under existing pest management regimes, the pest is likely to have **negligible or no impact** on a standing crop and/or stored products. Yield and/or quality losses would be **negligible and within the range of natural variation**.	In the PRA area, *M. dearnessii* affects only the needles causing premature defoliation of susceptible pines grown in natural reserves and urban sites	60%
Low	Under existing pest management regimes, the pest is likely to have **minimal impact** on a standing crop and/or stored products. Yield / quality losses would be **minimal.**	In the PRA, *M. dearnessii* affects only needles causing premature defoliation of susceptible pines grown in natural reserves and urban sites	40%
Medium	Under existing pest management regimes, the pest is likely to have a **minor to moderate impact** on a standing crop and / or stored products. Yield / quality losses would be **moderate.**		0%
High	Under existing pest management regimes, the pest is likely to have a **moderate to severe impact** on a standing crop and / or stored products. Thus the pest will not be effectively controlled by actions already applied against other pests by growers. Yield / quality losses would be **moderate to severe**.		0%
Very high	Under existing pest management regimes, the pest is likely to have a **severe impact** on a standing crop and / or stored products. Thus the pest will not be effectively controlled by actions already applied against other pests by growers. Yield / quality losses would be severe.		0%
		Check sum =	100%

[1] Spread your judgment according to your belief / evidence

3.04 Environmental Consequences

The assessment of the potential of a pest to cause environmental damage proceeds by considering the following factors:

- *can the introduction of the pest cause permanent (irreversible) significant, direct environmental impacts, e.g. reduced biodiversity, ecological disruption.*
- *can the pest have <u>direct</u> impacts on endangered/threatened species by infesting/infecting a plant listed in Annex II or IV of the EC Habitats Directive[7] or infesting / infecting a plant which is a key component of a habitat listed in Annex I of the EC Habitats Directive? If the pest attacks other species within the genus or other genera within the family, and preference/no preference tests have not been conducted with the listed plant and the pest, then the plant is assumed to be a host.*
- *Can the pest have <u>indirect</u> impacts on species that are listed in Annex II or IV of the EC Habitats Directive or on species that are key components of habitats listed in Annex I of the EC Habitats Directive?*
- *Would the introduction of the pest stimulate chemical or biological control programmes which would disrupt existing biological or integrated systems for control of other pests or have negative effects on the environment e.g. biodiversity (at various levels), reduce population sizes, or increase their fragmentation.*

Fill out table 3.04 by considering the likely magnitude of the above impacts, taking into account the extent of pest spread within the <u>endangered area</u> up to the time horizon of the assessment, and other factors such as the rate of pest population development and any threshold required for the pest to cause environmental harm in the environment.

Information / evidence: *Provide reasoning then give judgment*

In the areas of its present distribution, *M. dearnessii* affects only the needles of young susceptible pine species causing blight and premature defoliation, particularly of the lower branches. Defoliation has a rather negligible impact on pine natural stands, as the pathogen does not kill its hosts. However, in the Gulf States of the USA, brown-spot needle blight has a major impact on biodiversity, as the disease is considered to be the main limiting factor to the establishment of longleaf pine (*P. palustris*) in its natural range (Henry, 1954; Gibson, 1979; CABI/EPPO, 1997; Jewell, 1983).

In the PRA area, *M. dearnessii* has been reported to cause needle blight and premature defoliation of young pine trees mainly in urban sites, which are not considered as an ecologically sensitive environment. However, in Czech Republic (South Bohemia), the disease was detected on 10- to 60-year old *P. rotundata* trees grown in two nature conservation peat bog sites. According to Annex I of the EU Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora, bog woodlands are natural habitats (forests) hosting species of Community interest. However, as affected pine trees are

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[7] Council Directive 92/43/EEC (as amended) on the Conservation of natural habitats and of wild fauns and flora. Available at http://www.central2013.eu/fileadmin/user_upload/Downloads/Document_Centre/OP_Resources/HABITAT_DIRECTIVE_92-43-EEC.pdf

not killed by *M. dearnessii*, it is not expected that the disease will have any consequences on the biodiversity of these bog woodlands.

In the areas outside Europe (e.g. USA), brown-spot needle blight is successfully controlled in pine nurseries, seed orchards and plantations, by cultural measures, repeated applications of fungicide sprays and in the case of longleaf pine plantations, by prescribed fires (Phelps *et al*., 1978; Skilling and Nicholls, 1974; Kais, 1975b). So far, there are no reports on the occurrence of the disease in pine nurseries/seed orchards/plantations in the PRA area. Nevertheless, potential establishment of the pathogen in those managed environments may require specific chemical control programmes, which could negatively impact non-target organisms.

Uncertainties regarding environmental consequences

There are uncertainties around the environmental consequences of *M. dearnessii* in the PRA area, which are mainly due to the:

(i) lack of relevant studies on the susceptibility of the native pine species grown in the PRA area to the infection by *M. dearnessii,* and

(ii) unavailability of data on the distribution of pine species susceptible to *M. dearnessii* in the PRA area, and particularly in the natural habitats listed in Annex I of the Council Directive 92/43/EEC

Conclusions

- So far, *M. dearnessii* has no negative impact on the biodiversity in the PRA area, as (i) it causes only needle blight and premature defoliation of susceptible pine species grown in nature reserves and urban sites, and (ii) longleaf pine (*P. palustris*), which is the most seriously affected in the USA pine species, is not native to Europe.
- Potential establishment of the pathogen in pine nurseries/seed orchards/plantations might have a negative impact on the environment, as numerous fungicide applications will be required during the growing period to provide adequate protection of young pine seedlings.

Based on the above, it may be concluded that, in the PRA area and within the time horizon considered in this risk assessment (i.e. 5 years), *M. dearnessii* is likely to have low to medium environmental consequences with a medium uncertainty

3.04: Potential environmental consequences			
Rating	**Description**	**Justification summary**	**Probability Assignment** [1]
Very low	None of the above would occur; the pest is only able to establish on crops grown in protected cultivation such as glasshouses or shade houses. Nevertheless, it is assumed that introduction of a non-indigenous pest will have some environmental impact (by definition, introduction of a non-indigenous species affects biodiversity).		0%
Low	None of the above would occur; nevertheless the pest could	*M. dearnessii* does not kill its hosts, and *P.*	50%

	establish outdoors and it is assumed that introduction of a non-indigenous pest will have some environmental impact (by definition, introduction of a non-indigenous species affects biodiversity).	*palustris*, the most seriously affected pine species in the USA, is not native to Europe	
Medium	One of the above would occur. *However, if effects are relatively small, the potential consequences can be rated Low instead of Medium.*	Potential spread of *M. dearnessii* in pine nurseries/seed orchards/plantations in the PRA area might stimulate chemical control programmes with negative effects on the environment	50%
High	Two of the above would occur. *However, if effects are relatively small, the potential consequences can be rated Medium*		0%
Very high	Three or more of the above would occur. *However, if effects are relatively small, the potential consequences can be rated High*		0%
		Check sum =	100%

[1] Spread your judgment according to your belief / evidence

3.05 Potential impact

The potential impact is assessed assuming entry has occurred and takes into account the endangered area occupied at the given time horizon (3.02b) with consequences to crops (3.03) and the environment (3.04) within the endangered area.

Under the current EU legislation, the potential impact of *M. dearnessii* in the risk assessment area has been estimated by the BBN model to be medium (40% likelihood) to low (46% likelihood) with a medium uncertainty [Figs ii (a) & (b)]. This is rather in accordance with the assessor's judgment.

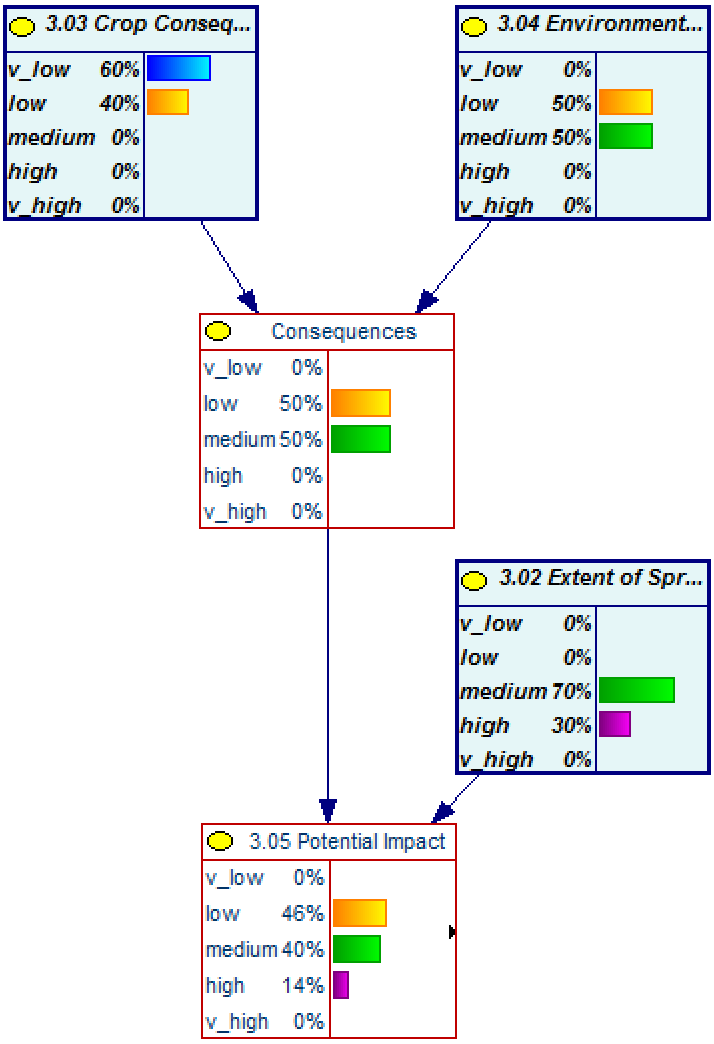

Figure ii (a). BBN model results for the potential impact of *Mycosphaerella dearnessii* in the risk assessment area, under the current EU legislation

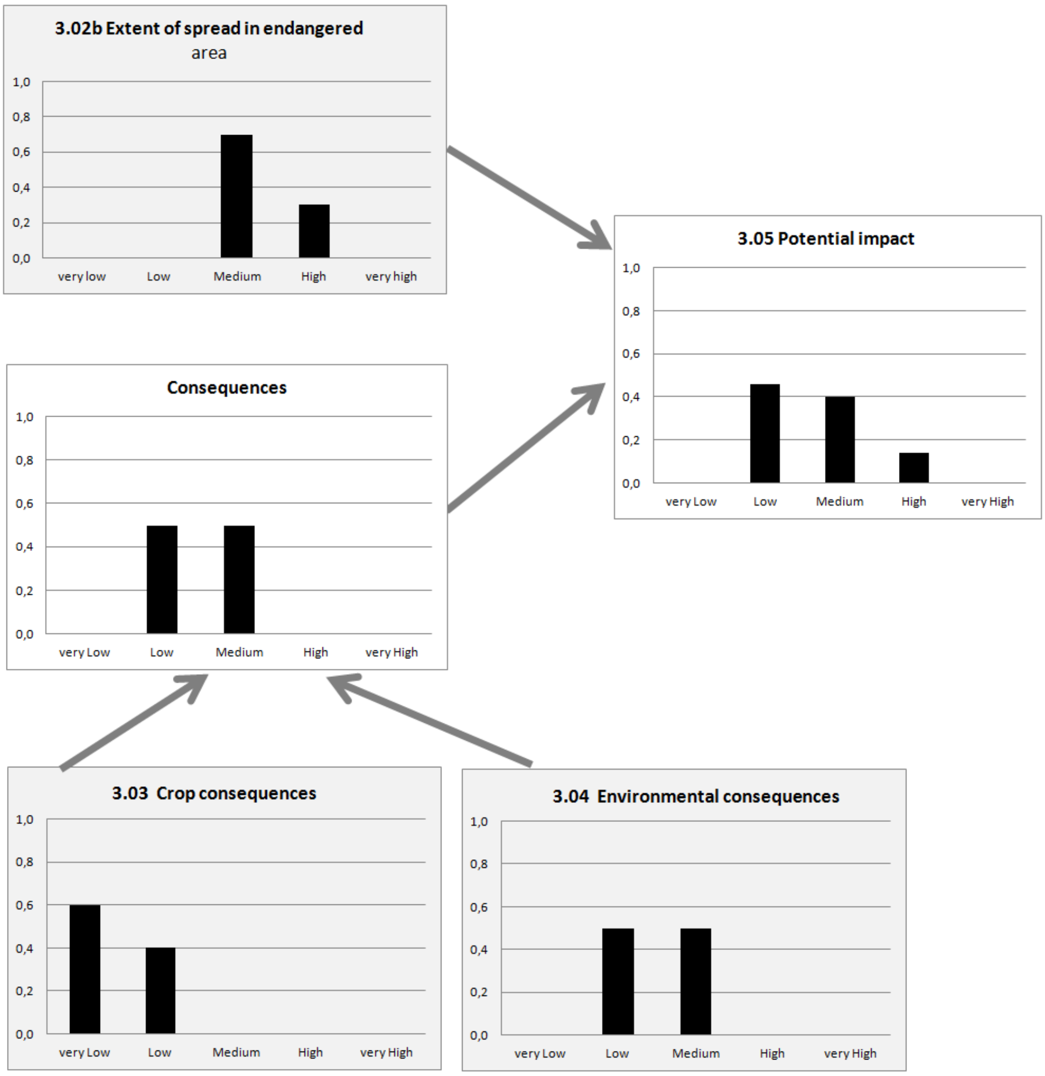

Figure ii (b): Graphical representation of potential consequences of *Mycosphaerella dearnessii* in the risk assessment area, under the current EU legislation, by combining the consequences of the pathogen's introduction with the area occupied by the pest at the time horizon (5 years) (Q3.02b).

Conclusions

3.06 Pest Risk

To assess the risk for a pest that has not yet entered the PRA area, the potential impact (3.05) which assumes entry has occurred, must be combined with likelihood of entry and transfer (2.08).

Under the current EU legislation, the risk posed by *M. dearnessii* in the risk assessment area has been estimated by the BBN model to be rather low (59% likelihood) to medium (26% likelihood) [Figs iii (a) & (b)] and it is in agreement with the assessor's judgment.

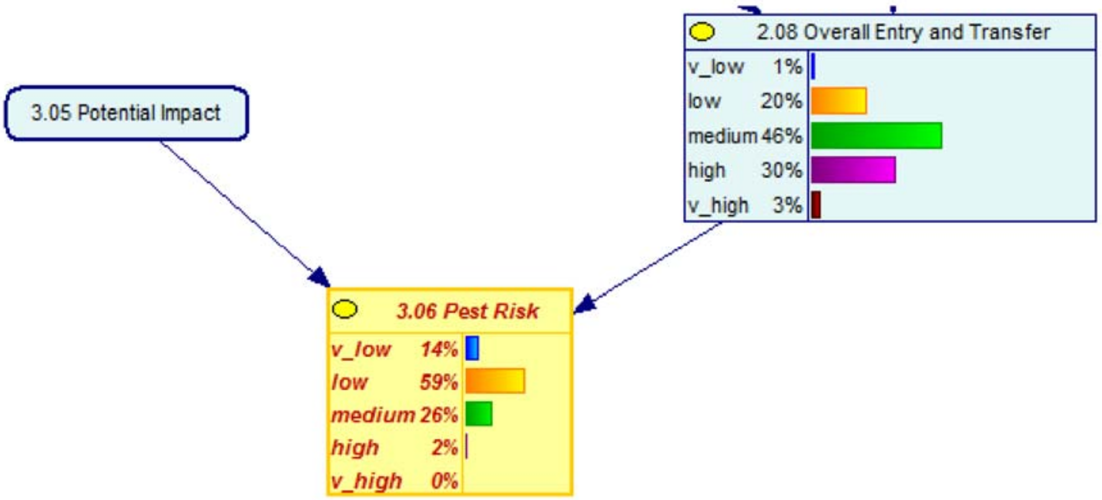

Figure iii (a). BBN model results for the risk posed by *Mycosphaerella dearnessii*, under the current EU legislation, by combining the potential impact (Q3.05) with the overall likelihood of entry and transfer(Q2.08)

Conclusions

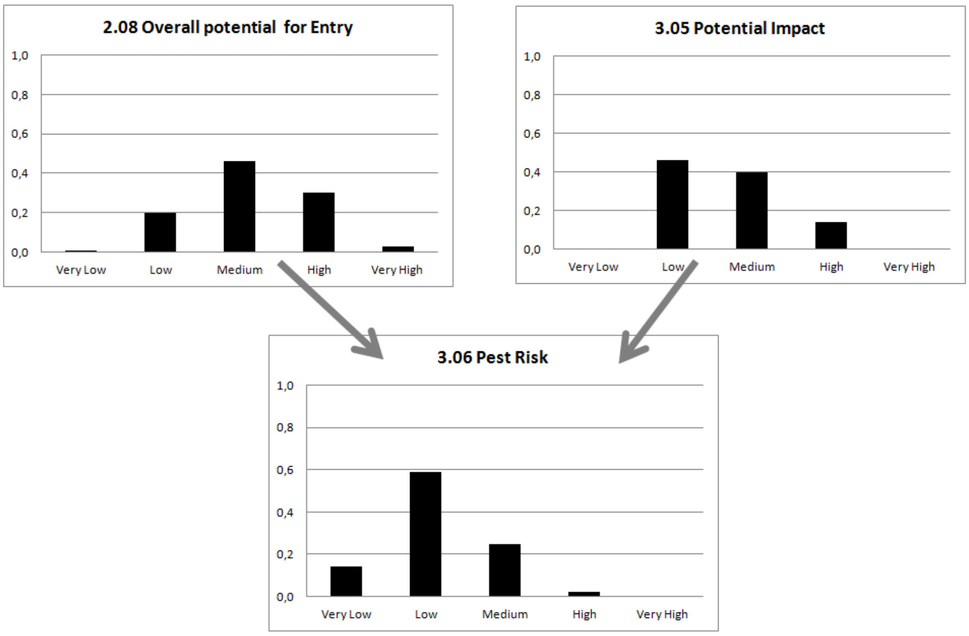

Figure iii (b): Graphical representation of Pest Risk (Q3.06), combining overall potential for *M. dearnessii* entry in the risk assessment area and transfer to susceptible hosts (Q2.08) with potential impact (Q3.05),under the current EU legislation

4.0 Uncertainties

Following EFSA Guidance (EFSA, 2010), to ensure transparency in risk assessment, uncertainties should be identified, characterized and documented within all risk assessments. This can show not only which aspects of an assessment are uncertain but the degree of uncertainty and can help identify where further work could usefully reduce uncertainty.

*The relative importance of uncertainties and their influence on the assessment outcome should be described. – **This can be done by changing the uncertainty associated with selected questions and reporting how such change impacts on subsequent pest risk.***

Table x: Summary of uncertainties identified and further work that could be undertaken to reduce uncertainties			
Section of risk assessment		**Uncertainties**	**Research that would reduce uncertainty**
2.0	Pathways	No	
2.01a	Pest associated	• Prevalence of the pathogen in nurseries and plantations in the infested areas • Efficacy of control measures applied	Studies on the efficacy of chemical treatments in controlling the pathogen
2.02a	Survive post harvest	Time required for symptom development (length of incubation period)	Studies on the effects of host age and environmental conditions on the length of incubation period
2.03a	Survive storage	Effect of low transport and storage temperatures on the survival of conidia	Studies on the effects of a range of temperatures on conidial germination and subsequent infection of pine hosts
2.04a	Survives measures	Time required for symptom development (length of incubation period)	Studies on the effects of host age and environmental conditions on the length of incubation period
2.05a	Quantity imported	Volume of host plants imported into the risk assessment area from Third countries	
2.06a	Transfer	Distance/height of *M. dearnessii* spore dispersal	Studies under simulated and/or field conditions on the dispersal potential of *M. dearnessii* conidia and ascospores by natural means (rain, wind-driven rain, wind)
3.01	Environmental suitability	Environmental conditions,	Studies on the effects of temperature on conidial

		particularly temperature range, favouring infection of pines by *M. dearnessii*	germination and subsequent infection of pine hosts
3.02	Extent of spread	• Volume of pine host plants for planting moved/traded in the risk assessment area • Distribution of susceptible hosts in the risk assessment area and type of distribution (continuous, fragmented)	
3.03	Crop consequences	• Level of susceptibility of pine species grown in the risk assessment area to infection by *M. dearnessii* • Virulence of *M. dearnessii* strains present in the infested areas	Studies on the susceptibility of pine species to infection Studies on the virulence of *M. dearnessii* strains present in the infested areas
3.04	Environmental consequences	Effects of *M. dearnessii* infection on pine hosts native to Europe	Studies on the susceptibility of pine species to infection

5.0 Conclusions

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Supporting documentation

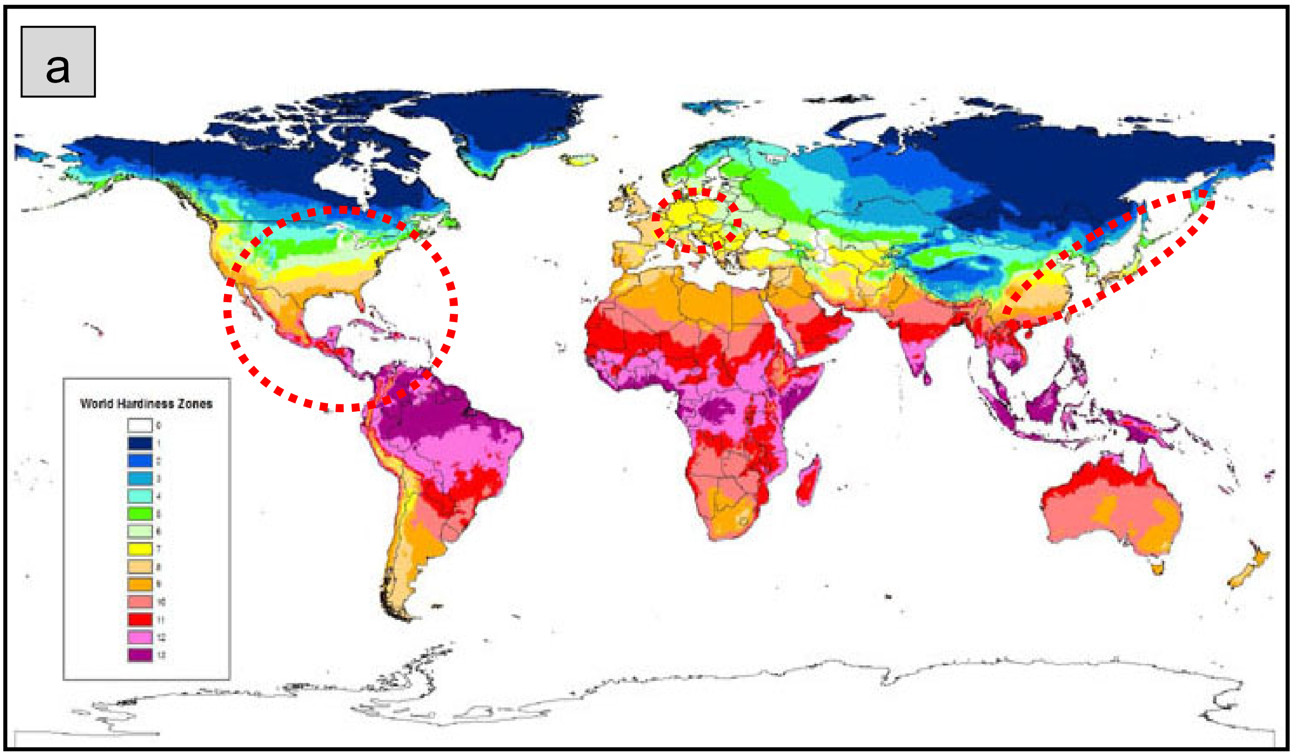
- Annex 1: Plant hardiness zones for the world and Europe
- Annex 2: Average temperatures (base 5°C) for the world and Europe
- Annex 3: Average temperatures (base 10°C) for the world and Europe

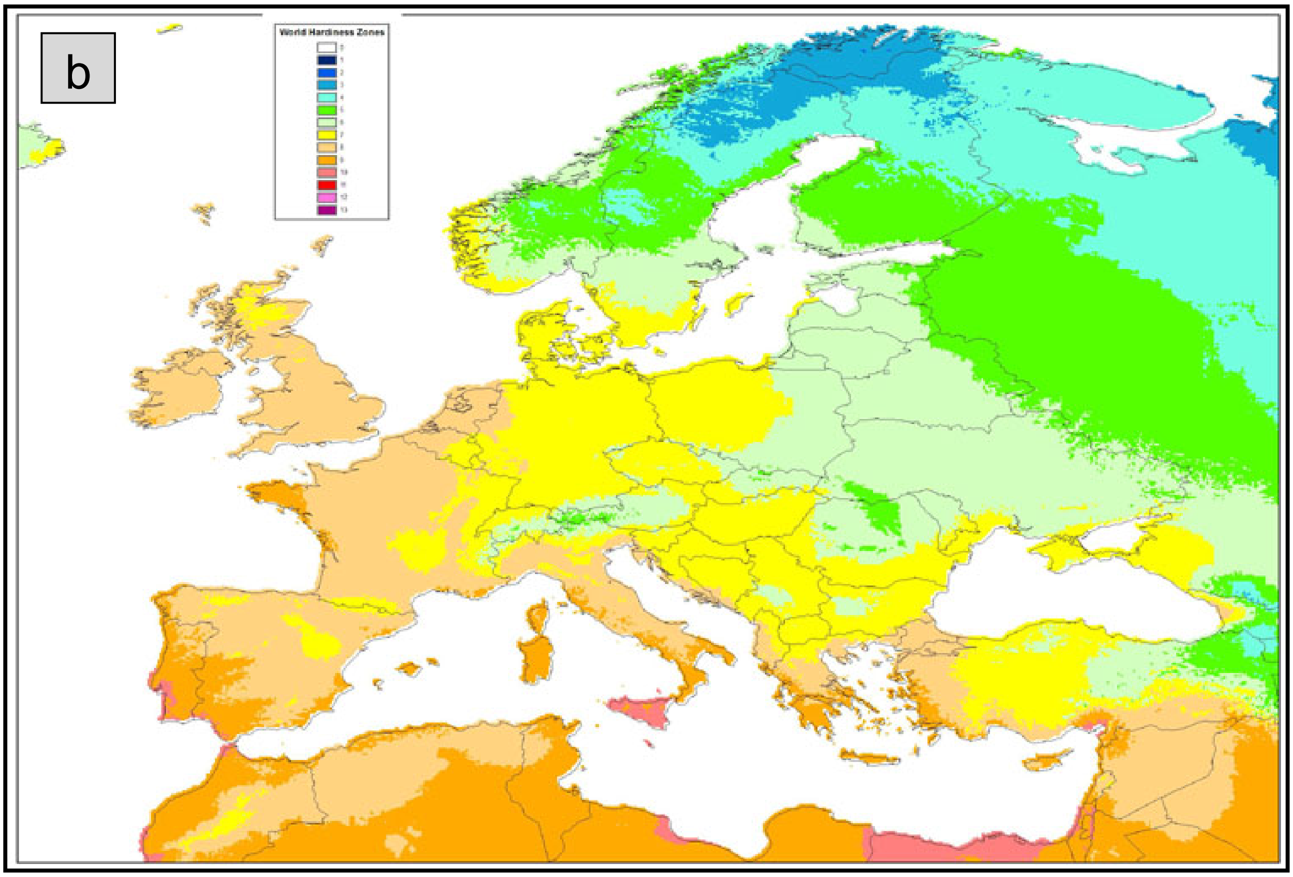
To inform decisions regarding Q 2.05 (import quantity) the table below shows EU imports of a small range of fruit and vegetables (and pineapple plants) for comparison.

Example EU import statistics of some fruit and vegetables and pineapple plants, 2008 – 2010
Source: Euro stat data http://epp.eurostat.ec.europa.eu/newxtweb/setupdimselection.do#
(tonnes)

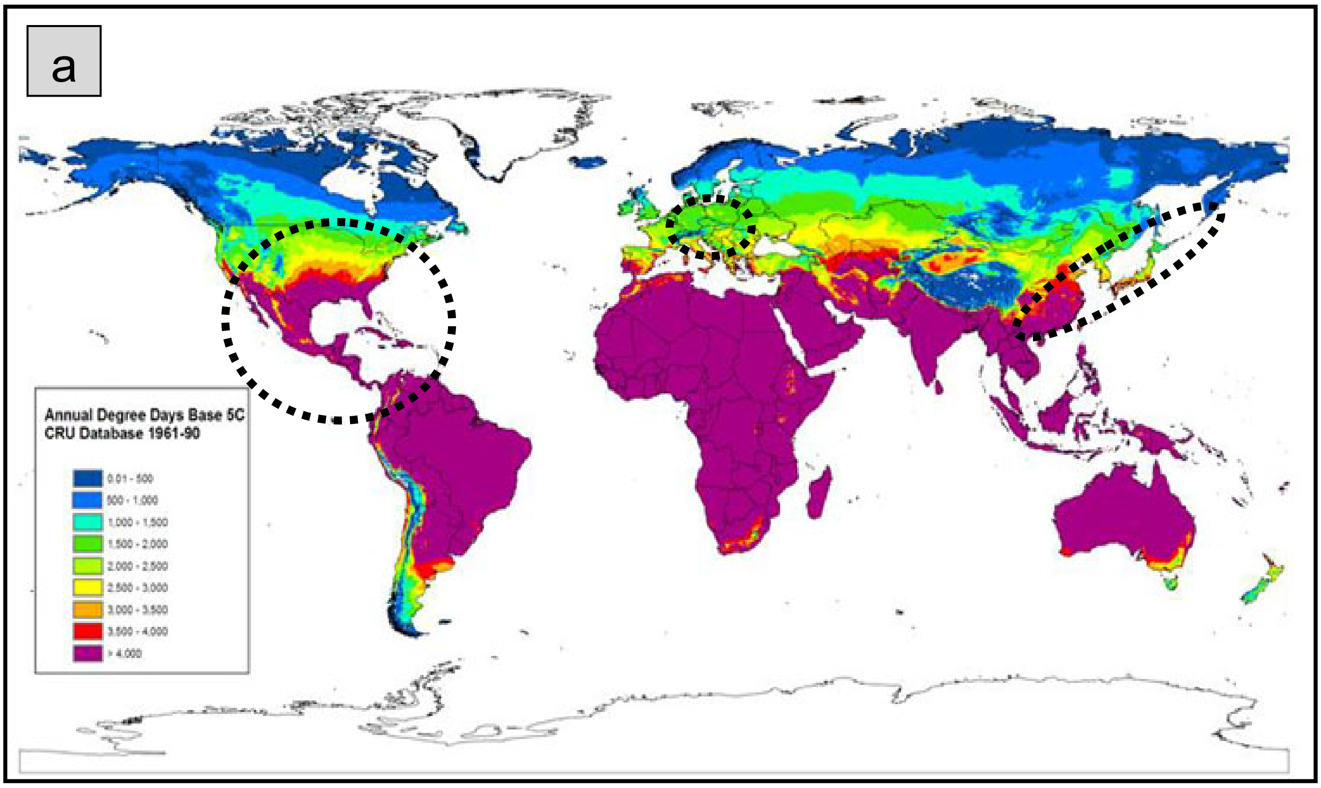
Commodity	**2008**	**2009**	**2010**	***3 year mean***	**Rating**
Fresh sweet oranges	1,034,024	844,591	945,744	*941,453*	High / very high
Table grapes	649,124	616,382	568,650	*611,385*	High
Fresh or chilled asparagus	32,476	35,200	37,081	*34,919*	Medium
Fresh figs	10,098	12,853	11,890	*11,614*	Medium
Quince	5,163	4,773	4,700	*4,879*	Medium
Fresh or chilled fennel	232	582	386	*400*	Low
Sloes	52	16	21	*30*	Very low
Pineapple plants	5	10	10	*8*	Very low

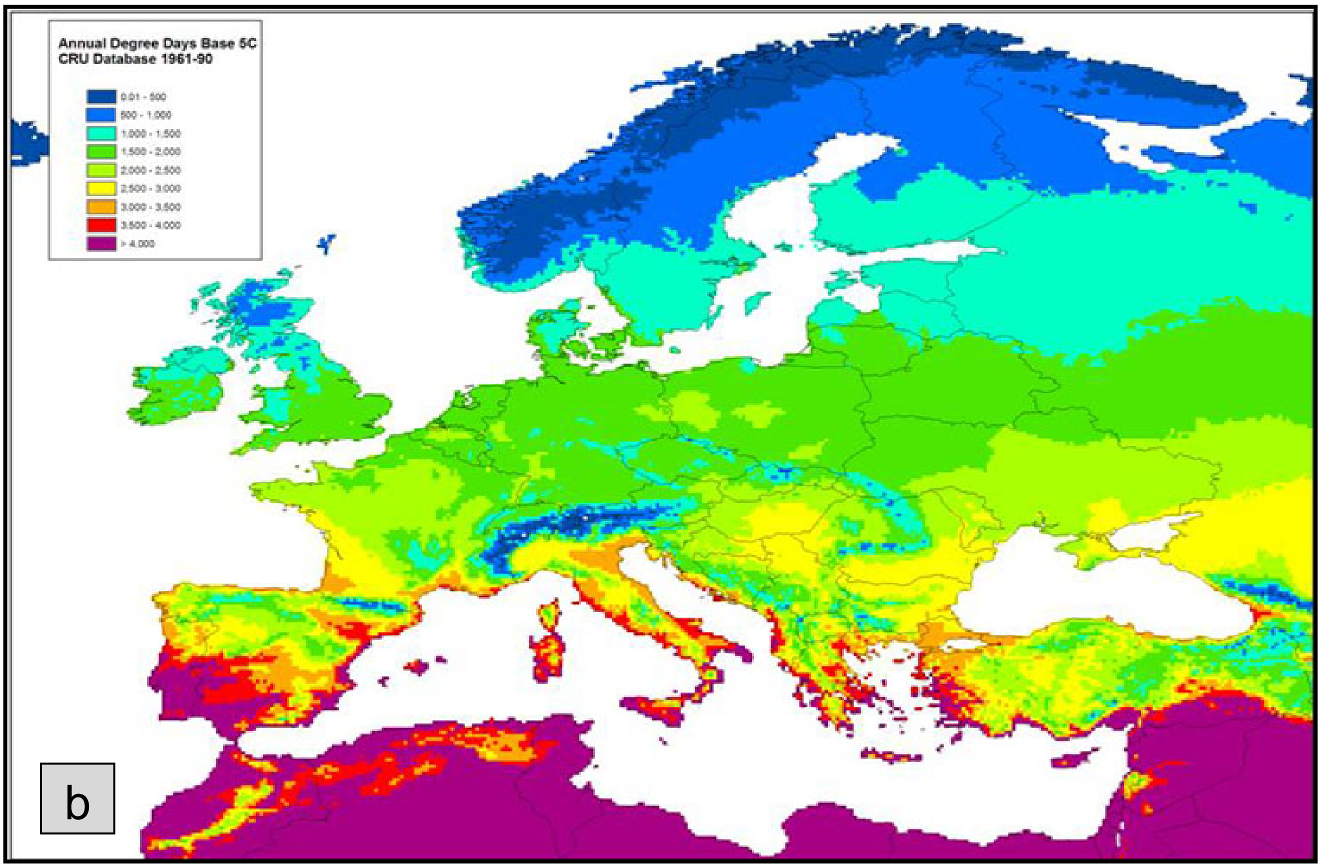
ANNEX 1. Plant hardiness zones in the world and Europe





ANNEX 2. Accumulated temperature base 5°C in the world and Europe





ANNEX 3. Accumulated temperature base 10°C in the world and Europe