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

Pest Risk Assessment of *Meloidogyne fallax*

Revised Test Method 4b[1]
Without risk reduction options in place

December 2011

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Acknowledgements: the authors would like to thank L.P.M. Molendijk (Applied Plant Research, WUR, the Netherlands) for useful comments and suggestions on a draft version of the summary of this document and G. Schrader (Julius Kühn-Institute, Germany) and R.P.J. Potting (Plant Protection Service, the Netherlands) for useful comments and suggestions on a draft version of the whole document.

[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

The purpose of this pest risk assessment was to evaluate the plant health risk associated with the False Columbia root-knot nematode *Meloidogyne fallax* Karssen within the framework of EFSA project CFP/EFSA/PLH/2009/01.

Pest biology (see Annex I for details)

- Identity of the pest: *Meloidogyne fallax* Karssen, 1996
- Life history: The nematode species *Meloidogyne fallax* is an obligate plant parasite. It is able to survive in the soil as eggs or J2 for more than half a year but population density declines substantially in the absence of a host plant. It can complete several life cycles during one growing season depending on the climate.
- Host range / habitat: *M. fallax* has a very wide host range among several plant families, including crop plants and common weed species and it has possibly more host plant species than presently known.
- Means of dispersal / spread: rot-knot nematodes in general, so also *M. fallax,* can move only very small distances by themselves. Only the second-stage juveniles (J2) and the males are able to move in soil and in plant tissue (< 1m). Horizontal movement is probably less than 0.5 m.

Time period considered by this assessment

A time horizon of 20 years was used during this assessment. Climate change was not taken into account. The endangered area may shift northwards when temperature would increase during the next 20 years but it was not analysed to which extent.

Geographic Distribution (see Annex I and VI for details)

North America:	Absent/not known to be present
South America:	Absent/not known to be present
Europe:	The Netherlands, Belgium, France, Germany, Switzerland, United Kingdom
Africa:	South Africa
Asia:	Absent/not known to be present
Oceania:	New Zealand, Australia

Pathways

The following pathways for entry from third countries and/or spread within the EU were identified:

1. Plants intended for planting of host plants with or without soil attached originating from areas where *M. fallax* is present. This pathway includes any propagation material except plants derived from tissue culture
    a. seed potatoes
    b. plants for planting of host plants other than seed potatoes
2. Plants intended for planting of non-host plants with soil attached originating from areas where *M. fallax* is present. This pathway includes any propagation material except plants derived from tissue culture
3. Tubers, bulbs and roots of host plants originating from areas where *M. fallax* is present and intended for consumption or processing
    a. waste water and any other waste product is purified/properly treated
    b. waste water is applied to agricultural fields and/or other waste products is not properly treated
4. Soil attached to or associated with tubers, bulbs and roots of host plants intended for consumption or processing originating from areas or fields where *M. fallax* is present
5. Soil attached to equipment, shoes and machinery (e.g. tractors, plowing machines, shoes, etc).
6. Soil as such
7. Travellers carrying one of the above mentioned products and/or soil samples
8. Irrigation (spread within and between fields)

9. Natural spread

Pathways 1-4, trade of plants and products that may be infested, are considered most relevant for spread over larger distances (e.g. between countries) and was assessed in detail for spread within the EU.

Summary of risk elements

Likelihood of entry from third countries
The likelihood of entry of *M. fallax* from third countries was not assessed in detail because of lack of information. It is unknown if plants or plant products of host plants that can be infected of infested with *M. fallax* are actually imported from areas where *M. fallax* is present (Vaalharts Valley in South Africa, certain regions in New Zealand and Australia). *M. fallax* is present in some vegetable growing greenhouses in Switzerland but there appears to be no risk of spread to other European countries. Soil as such from third countries is a potential pathway but is a closed pathway for countries where *M. fallax* is known to be present under the present EU-legislation (except Switzerland). The likelihood of entry of *M. fallax* from third countries was assessed low with a medium uncertainty. The uncertainty is medium because of uncertainty about the distribution of *M. fallax* and uncertainty about import of plants and products from third countries where *M. fallax* is known to be present.

Likelihood of spread with trade within the EU
The likelihood of spread with trade within the EU for the individual pathways was assessed as follows for pathways 1-4:

Pathway 1a, seed potatoes: high risk with a medium uncertainty. The likelihood of association is low but the quantity traded very high. The likelihood of transfer is very high.

Pathway 1b, plants for planting of hosts other than seed potatoes: high risk with a medium uncertainty. The likelihood of association is low but the quantity traded very high. The likelihood of transfer is very high.

Pathway 2, plants for planting of non-hosts with soil attached: low risk with high uncertainty. The likelihood of association is very low but the quantity traded may be (very) high. The likelihood of transfer is considered low to medium. The uncertainty is high: transfer with soil attached to non-hosts has never been reported. Moreover, *M. fallax* has a very wide host range and the volume of non-host species that are traded with soil may also be limited.

Pathway 3a, tubers, bulbs and roots of host plants intended for consumption or processing, waste properly treated: very low risk due to the very low likelihood of transfer. Low uncertainty.

Pathway 3a, tubers, bulbs and roots of host plants intended for consumption or processing, waste water applied to a field: medium risk with a medium uncertainty.

Note pathway 3 does not include the possibility that consumers use ware potatoes as seed potatoes. The likelihood of transfer in such a case would be very high. However, the likelihood of such an event "an infested ware potato is used by a consumer as seed potato" was assessed low.

Pathway 4, soil attached to products intended for consumption or processing: medium risk with a medium uncertainty. The likelihood of transfer is medium to high.

The overall likelihood of spread with trade of plants for planting and plant products was assessed as very high (very likely that *M. fallax* will be spread in at least one occasion per year). *M. fallax* is known to be present in several agricultural areas, it has a very wide host range, many host plants do not show (clearly visible) symptoms and the risk of spread though trade of plants or plant products is, therefore, very high.

Area suitable for establishment and endangered area

M. fallax has a very wide host range. Host plants are present in agricultural and non-agricultural areas throughout the EU. *M. fallax* may be able to establish in a large proportion, between 2/3 and 90% of its host area. The uncertainty is, however, high. There is uncertainty whether *M. fallax* can establish in northern (Scandinavia) and eastern Europe because the species has, thus far, only be found in areas with relatively mild winters (plant hardiness zones 8 or higher). *M. fallax* has mainly been reported from course textured soil and there is also uncertainty if *M. fallax* can establish in more fine textured soils.

The endangered area will probably be much smaller than the area suitable for establishment. The reason for this is that damage has mainly been reported for potato, carrot and black salsify and damage seems only to occur under certain conditions. The endangered area for *M .fallax* within the EU was assessed as follows:

- areas with a coarse soil texture (yellow areas on the soil map in Annex V with a sand content > 65%), and
- where the annual number of degree days (base 5˚C) is at least 1400, and
- where potato, carrot and/or black salsify are or can be grown with or without irrigation.

Within the areas with >65% sand, more or less endangered areas may be distinguished and the potential impact is expected to increase with the sand content of the soil.

The potential impact will increase with increasing DD_5 accumulation during the cropping period.

(Most) warm areas in southern Europe where potato, carrot and black salsify are grown during winter and early spring are probably outside the endangered area (low number of degree days during the growing season and unfavourable conditions for survival during summer).

Areas with an annual DD_5 between about 900 and 1400 DD_5 are considered as less-endangered areas but with a potential shift to the endangered area in warmer years.

Greenhouses growing host plants (e.g. production of tomatoes and lettuce) are also part of the endangered area (except plants grown in soilless culture).

Consequences

Outdoor crops

Within the endangered area as specified above, the presence of *M. fallax* will usually not lead to losses in yield volumes. The main impact of this nematode species is cosmetic damage (quality loss) in potato, carrot and black salsify which in the worst case can lead to complete rejection of the crop. On host crops other than potato, carrot and black salsify, *M. fallax* seems generally to have a minor or minimal impact. Rotation practices that are applied to control *Meloidogyne hapla,* a species which is fairly widespread in the EU, will likely not be effective against *M. fallax. M. fallax* can reproduce on many dicotyledon and monocotyledon species while *M. hapla* does not reproduce on most monocotyledons. Thus, locally or in certain regions major/high impacts may occur after introduction of *M. fallax*.

Indoor crops

It is uncertain to which extent *M. fallax* poses an additional risk to greenhouse crops as compared to *Meloidogyne* species that are already fairly widespread in greenhouses such as *M. hapla, M. incognita, M. arenaria* and *M. javanica*. It is assessed that the impact of *M. fallax* for greenhouse crops will be similar or lower than these commonly occurring *Meloidogyne* species. The characteristics which makes *M. fallax* an additional risk for outdoor crops, causing cosmetic damage to potato, carrot and black salsify and more difficult to control by crop rotation, do not hold for greenhouse crops. In temperate climates, (sub)tropical species may be more of a risk in heated greenhouses than *M. fallax*.

Environmental impact
The environmental impact is assessed to be low (medium uncertainty). Environmental impact may occur as a result of the use of nematicides against *M. fallax*.

Conclusion
The overall pest risk is assessed medium. *M. fallax* is expected to spread slowly. It has already been present in the EU at least since 1992 but probably much longer. The known distribution of *M. fallax* is still limited but *M. fallax* may have entered several areas in the EU already but either did not establish or has not been noticed because conditions are unfavourable for disease development. Locally or in certain regions, high impacts may occur due to complete crop rejections but the nematode species is not expected to have a high impact on the total production of potato, carrot and black salsify in the EU. The impact of *M. fallax* for greenhouse crops is assessed similar or lower than the impact of other *Meloidogyne* species present in greenhouses in Europe (high uncertainty).

Note that this assessment does not consider control measures which growers can take to reduce the impact by the nematode species. Such measures are presently for example taken by growers in Belgium and the Netherlands, e.g. avoidance of infested fields for the production of carrot and black salsify, adaptation of sowing date, choice of cultivar, crop rotation, use of nematicides etc.

Uncertainties
The major uncertainties are:
- Present distribution of *M. fallax* in Europe and other parts of the world. *M. fallax* may be more widespread than presently known.
- Survival in soil in the field, attached to products and in soil attached to non-hosts (especially as eggs)
- Effect of environmental conditions, temperature, rainfall and soil texture on establishment and consequences
- Limitations for establishment especially warm and dry periods, cold periods and fine soil textures. *M. fallax* is presently only known from areas with mild winters (hardiness zones 8 or higher) and it is uncertain if the species can establish in areas with colder winters in eastern and northern Europe.

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 *M. fallax* 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). *M. fallax* 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?

A pest risk assessment is available for the USA at http://www.aphis.usda.gov/plant_health/plant_pest_info/pest_detection/mini-pra.shtml (last access August 2011). No pest risk assessment of *M. fallax* is available for the EU.

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

- EPPO datasheet available at http://www.eppo.org/QUARANTINE/nematodes/Meloidogyne_fallax/MELGFA_ds.pdf (accessed August 2011)
- Datasheet in the CABI Crop Protection Compendium http://www.cabi.org/cpc/default.aspx?LoadModule=datasheet&dsID=33235&CompID=1&site=161&page=868
- An updated and comprehensive datasheet has been prepared with in the project Prima Phacie and is included in Annex I of this pest risk assessment.

(iii) Current regulatory status

What is the pest's status in the Plant Health Directive (Council Directive 2000/29/EC[4]) ?

[4] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32000L0029:EN:NOT

Listed in the directive's Annex IAII (Harmful organism known to occur in the EU and relevant for the entire EU), see Annex II of the present pest risk assessment.

(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	X	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

The time period considered was 20 years. Climate change was not taken into account except from a statement that the endangered area may shift further northwards when temperature would increase during the next 20 years. This long term was chosen because *Meloidogyne* spp. spread slowly. *M. fallax* has probably been present in the EU at least since 1992 (Karssen, 1996) and possibly much longer. It might even be native to Europe. The species still has not reached its potential area of distribution. A period of 20 years will still be too short for *M. fallax* to reach its potential area of distribution but it was considered unrealistic (too high uncertainty) to assess the impact over a period of more than 20 years. *M. fallax* will be spread over longer distances only by human assistance and the rate of the nematode spread will mainly be determined by human activities which are difficult to predict over longer periods.

1.6 Introductions or interceptions (reported from EU or elsewhere)

Europhyt (accessed 4th August 2011): no notifications of interceptions (oldest records of interceptions of pests in Europhyt are from 1994). *M. fallax* is a relatively newly described species and was reported for the first time from the Netherlands in 1996 (Karssen, 1996). The species was later recorded in several other countries (see "Distribution list" in Annex I). *M. fallax* may be more widespread than presently known since it may be present without causing clear external symptoms and the species may be confused with for example *M. chitwoodi* and *M. hapla*, the latter one having a worldwide distribution (CABI, 2007). In the UK, *M. fallax* was recently found in turf grass (NPPO of UK, July, 2011). The origin of *M. fallax* is unknown.

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 pests 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.

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).

List of relevant pathways:

1. Plants intended for planting of host plants with or without soil attached originating from areas where *M. fallax* is present. This pathway includes any propagation material except plants derived from tissue culture
    a. seed potatoes
    b. plants for planting of host plants other than seed potatoes
2. Plants intended for planting of non-host plants with soil attached originating from areas where *M. fallax* is present. This pathway includes any propagation material except plants derived from tissue culture
3. Tubers, bulbs and roots of host plants originating from areas where *M. fallax* is present and intended for consumption or processing
    c. waste water and any other waste product is purified/properly treated
    d. waste water is applied to agricultural fields and/or other waste products is not properly treated
4. Soil attached to or associated with tubers, bulbs and roots of host plants intended for consumption or processing originating from areas or fields where *M. fallax* is present
5. Soil attached to equipment, shoes and machinery (e.g. tractors, plowing machines, shoes, etc).
6. Soil as such
7. Travellers carrying one of the above mentioned products and/or soil samples
8. Irrigation (spread within and between fields)
9. Natural spread

Pathways 1 - 4 are considered to be the most important ones for long distance spread. Pathway 1 is split into 1a (seed potatoes) and 1b (plants for planting other than seed potatoes) because in the present EU-legislation (2000/29/EC) there are specific measures formulated for seed potatoes but not for other plants for planting (see Annex II). Pathway 4 includes long distance transport through soil attached to plant products after they have left the farm. Pathway 4 does not account for local spread within or between fields that may result from harvest of tubers, bulbs and roots that can be infested with *M. fallax.* Such kind of spread is part of pathway 5. Pathway 5 is especially relevant for local spread of the nematode within the country of origin. Pathway 6, import of "soil as such" is forbidden from most third countries, with the exception of continental Europe (excluding Turkey, Belarus, Moldavia, Russia and Ukraine), Egypt, Israel, Libya, Morocco and Tunisia (Directive 2000/29, Annex III, Part A, 14). Among these countries, *M. fallax* has been reported only from Switzerland in the past and recently the species has been detected again in the same 4 reported localities in greenhouses and heated tunnels (See Appendix VII). Pathway 7, travellers, could contribute to the spread of *M. fallax* but is probably much less relevant than for example commercial trade, pathways 1-4. Pathways 8 (irrigation) and 9 (natural spread) is like pathway 5 especially relevant for local spread and will be discussed in the spread section. Pathways 8 and 9 are not relevant for entry from third countries.

In this entry section, we consider both entry from third countries as well as spread within the EU for the following reasons:

- *M. fallax* is already present in some areas in the EU (Annex I and VI) and spread from these areas into areas that are not yet infested is considered more relevant than entry from outside the EU. The movement of plants, plant parts and soil within the EU from countries where *M.*

fallax is present, is much more frequent and concerns greater total volumes than import of these plants, products and materials from third countries where the pest is present.
- The origin of *M. fallax* is unknown. It has probably been present in the PRA area for at least several decades and might even be native to Europe (see Annex I).
- When considering risk reduction options, the options should not only be evaluated to prevent entry from outside the EU but also be evaluated for their efficacy to prevent spread within the EU and, therefore, a more detailed analysis of the pathways for spread is needed.

The probability of entry of *M. fallax* from third countries has not been assessed in detail because of lack of information. It is unknown if plants or plant products that may be infected or infested with *M. fallax* are actually imported from areas where *M. fallax* is present (Vaalharts Valley in South Africa, certain regions in New Zealand and Australia). *M. fallax* is present in some vegetable growing greenhouses in Switzerland but there appears to be no risk of spread to other European countries (Eder *et al*., 2010). Soil as such from third countries is a potential pathway but is under the present legislation (2000/29/EC) a closed pathway for most third countries including those where *M. fallax* is known to be present (except Switzerland). In general, the probability of entry of *M. fallax* from third countries has been assessed low with a medium uncertainty. The uncertainty is medium because of uncertainty about the distribution of *M. fallax* (see Annex I) and uncertainty about import of plants and products from third countries where *M. fallax* is known to be present.

Pathways 1-4 were analysed in detail for spread within the EU through trade of plants for planting and plant products (see Table below).

Note that *M. fallax* presently has a quarantine status in the EU and phytosanitary measures to prevent introduction and spread through import and trade of plant products are in place. **In the present risk assessment, we have assessed the likelihood of entry in case no phytosanitary measures against *M. fallax* would be in place (i.e. would not be listed as a quarantine organism).** The general prohibition of import of soil from third countries is not relevant for the detailed pathway-analyses because there are no restrictions of soil movement within the EU.

Note that in the entry part, the “origin” (see question 2.01) has been defined as those EU-countries where *M. fallax* has been found although the species is only known to be very locally present in some of these countries (France and Germany) or have not been found in agricultural areas (United Kingdom). However, there was too little information and too much uncertainty about the distribution of *M. fallax* in the EU to define more precisely those agricultural areas where *M. fallax* is present (see also Annex VI).

Pathway	Pathway name	Summary description of pathway
1a.	Seed potatoes	See above
1b.	Plants for planting hosts other than seed potatoes	
2.	Plants for planting non-hosts	
3a.	Tubers, bulbs and roots of host plants intended for consumption or processing, waste properly treated	
3b.	Tubers, bulbs and roots of host plants intended for consumption or processing, waste water applied to field	
4	Soil attached to plants intended for consumption	

Uncertainties (regarding pathways)

The main uncertainty concerns the distribution of *M. fallax* and hence the areas from which the nematode could be introduced (see Annex I for more details and references).

Pathway 1a: Seed potatoes

2.01-1a 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, specify whether these are being taken into account or not.

Information / evidence:
M. fallax is present in agricultural areas in at least four EU-countries (Annex VI). The species builds up high population levels in the presence of a host plant but its numbers decrease markedly during winter and under black fallow (i.e. fallow with weed control) (Annex I; Molendijk & Brommer, 1998). Crop rotation schemes are likely to decrease the population density of *M. fallax* when the host crop is alternated with a non-host crop. However the nematode species has a wide host range and some widely applied rotation schemes will not reduce the pest's population. For example, crop rotations used to control *M. hapla* in potato fields are not effective against *M. fallax* since this species can infest several crop plants usually grown in rotation with potato such as cereals (Annex I).

In the Netherlands, which is a major trader of seed potatoes, *M. fallax* has a more limited distribution than *M. chitwoodi* (Annex III, VI). The NPPO of the Netherlands has not found *M. fallax* on seed potatoes since 2008 despite annual surveys and inspections including testing of seed potatoes (Annex VI; Plant Protection Service, 2011). Totally, about 35,000 – 40,000 seed potato lots are produced in the Netherlands every year. In Belgium *M. fallax* has, thus far, not been found in seed potatoes despite inspections and testing (Annex VI). In the 2 other countries where *M. fallax* is known to be present in agricultural areas, Germany and France, *M. fallax* is only known from a few locations (Annex VI). Based on these figures, we assess that currently less than 1 out of ten thousand lots may be infested. However, the likelihood of association may increase in the absence of the current phytosanitary measures. Growers may presently avoid infested fields for the production of seed potatoes to prevent their crop to be rejected after testing which is part of the present measures (Annex II, VI). Therefore, we assess the likelihood of association roughly between 0.1 and 0.01%.

Uncertainties regarding likelihood of the pest being associated, spatially and temporally, with the pathway at origin
The uncertainty is medium. The present distribution of the pest is uncertain. The rating is partially based on the number of known findings (absence) on seed potatoes and the assumption is that the likelihood of association will increase when the current phytosanitary measures would be lifted.

Conclusions

2.01-1a: Likelihood of association with 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)	See above	40%
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)	See above	60%
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)		0%
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)		0%
Very High	> 10% (more than one in ten lots[2] of the commodity are likely to be contaminated / infested)		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.

2.02-1a Likelihood of surviving postharvest treatment / measures (before entry into risk assessment area)

Given that a proportion of lots/ consignments may be infested / contaminated, consider the proportion of contaminated lots that are likely to remain 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 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:

There is no effective post harvest treatment. Visibly infested seed potato lots may be rejected as part of a certification programme for seed potatoes. However, the pest can also be latently present or with very few symptoms. Note that the risk is assessed in absence of any phytosanitary measures against the pest.

Uncertainties regarding likelihood of the pest surviving postharvest treatment/ measures (before entry into risk assessment area)

Low uncertainty.

Conclusions

2.02-1a: Likelihood that an infested commodity remains infested after existing post harvest treatments			
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 commodity are likely to be contaminated / infested)		0%
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)		0%
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)		0%
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)		0%
Very High	> 10% (more than one in ten lots[2] of the commodity are likely to be contaminated / infested)	See above	100%
		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.

2.03-1a 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 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:

M. fallax can be present as eggs in egg masses and as adults (females) inside the tubers.

In general, *Meloidogyne* species are frequently found in planting material moving in trade. For example, Kurppa (1985) found *Meloidogyne* spp. in 81 out of 670 plant stocks of nursery plants which had been imported into Finland. *M. fallax* is known to survive in tubers for at least several months.

In conclusion, it is very likely that *M. fallax* will survive conditions that are suitable to transport of store seed potatoes.

Uncertainties regarding likelihood of the pest surviving storage and transport

Low uncertainty

Conclusions

2.03-1a: 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 commodity are likely to be contaminated / infested)		0%
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)		0%
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)		0%
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)		0%
Very High	> 10% (more than one in ten lots[2] of the commodity are likely to be contaminated / infested)	See above	100%
		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.

2.04-1a 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 because they survive existing phytosanitary procedures e.g. they are not detected at entry and/ or they 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:

In this paper, the risk is assessed without official measures in place against *M. fallax.* Other phytosanitary procedures currently applied (e.g. against other pests) are not effective.

Symptomatic potato tubers can be detected during routine visual inspection (e.g. as part of quality inspections). However, potato tubers can be infested without showing external symptoms (Karssen, 2002; Karssen and Moens, 2006). Moreover, the detection efficiency is also affected by the sample size. For these reasons, it is considered very likely with a low uncertainty that the pest will survive existing pest management procedures.

Uncertainties regarding likelihood of the pest surviving current phytosanitary procedures

Low uncertainty

Conclusions

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 commodity are likely to be contaminated / infested)		0%
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)		0%
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)		0%
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)		0%
Very High	> 10% (more than one in ten lots[2] of the commodity are likely to be contaminated / infested)	Risk assessed without measures in place	100%
	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.

2.05-1a Quantity of commodity imported annually

Quantity of commodity imported annually: The likelihood that a pest will be introduced 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 3 level scale and provide some reasoning to support use of the scale.

Information / evidence: *Provide reasoning then give judgment*

The annual volume of seed potatoes traded within the EU and originating from countries where *M. fallax* is known to be present is about 450,000 – 500,000 tonnes (Annex III; Table 1.A.1). Note that the distribution of *M. fallax* is (rather) limited in these countries which is taken into account in the answer to question 2.01 (likelihood of association with the pathway at origin).

Uncertainties regarding the quantity of commodity imported annually

The uncertainty is low.

Conclusions

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- from EU countries)				
Rating	**Tonnes imported into PRA area (per year)**	**Number of containers (per year)**	**Justification summary**	**Probability Assignment** [1]
Very low	< 10	<1		0%
Low	10 - 100	1- 10 containers		0%
Medium	100 -1,000	10 - 100 containers		0%
High	1,000 - 10,000	100 – 1,000 containers		0%
Very high	> 10,000	> 1,000 containers	Annex III, Table 1.A.1	100%
			Check sum =	100%

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

2.06-1a Likelihood of transfer via pathway

Consider the likelihood that the pest will be distributed and subsequently 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.

Also consider the likelihood that sufficient numbers of 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.

Information / evidence:
The pathway is a host plant that will finally be planted in soil. Runia & Korthals (2004) have shown experimentally that soil became infested after planting of seed potatoes infected with the closely related *M. chitwoodi* and also that the subsequent crop became infected. The probability of transfer is, therefore, rated very likely with a low uncertainty.

Uncertainties regarding likelihood of transfer
Low uncertainty.

Conclusions

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)		0%
Low	Between 0.01% and 0.1% (between one in ten thousand and one in one thousand contaminated lots will provide transfer opportunities)		0%
Medium	Between 0.1% - 1% (between one in one thousand and one in one hundred contaminated lots will provide transfer opportunities)		0%
High	Between 1% and 10% (between one in one hundred and one in ten contaminated lots will provide transfer opportunities)		0%
Very high	> 10% (more than one in ten contaminated lots will provide transfer opportunities)	Transfer shown for the closely related species *M.chitwoodi*	100%
	Check sum =		100%

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

2.07a Likelhood of entry and transfer via pathway 1a

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(1a) to 2.05(1a), that relate to likelihood of entry is combined with score for likelihood of transfer 2.06(a) using a BBN to provide an assessment of potential for entry and transfer for the pathway and is shown in Fig. 1. It suggests that the potential for entry and transfer via pathway 1a “seed potatoes” is high which is in correspondence with the assessors’ view. The likelihood of association is assessed to be low but the overall risk is high due to the very large volume associated with this pathway.

Uncertainties regarding likelihood of entry and transfer

The main uncertainty is the present area of distribution of *M. fallax* and hence the likelihood of association of *M. fallax* with seed potatoes.

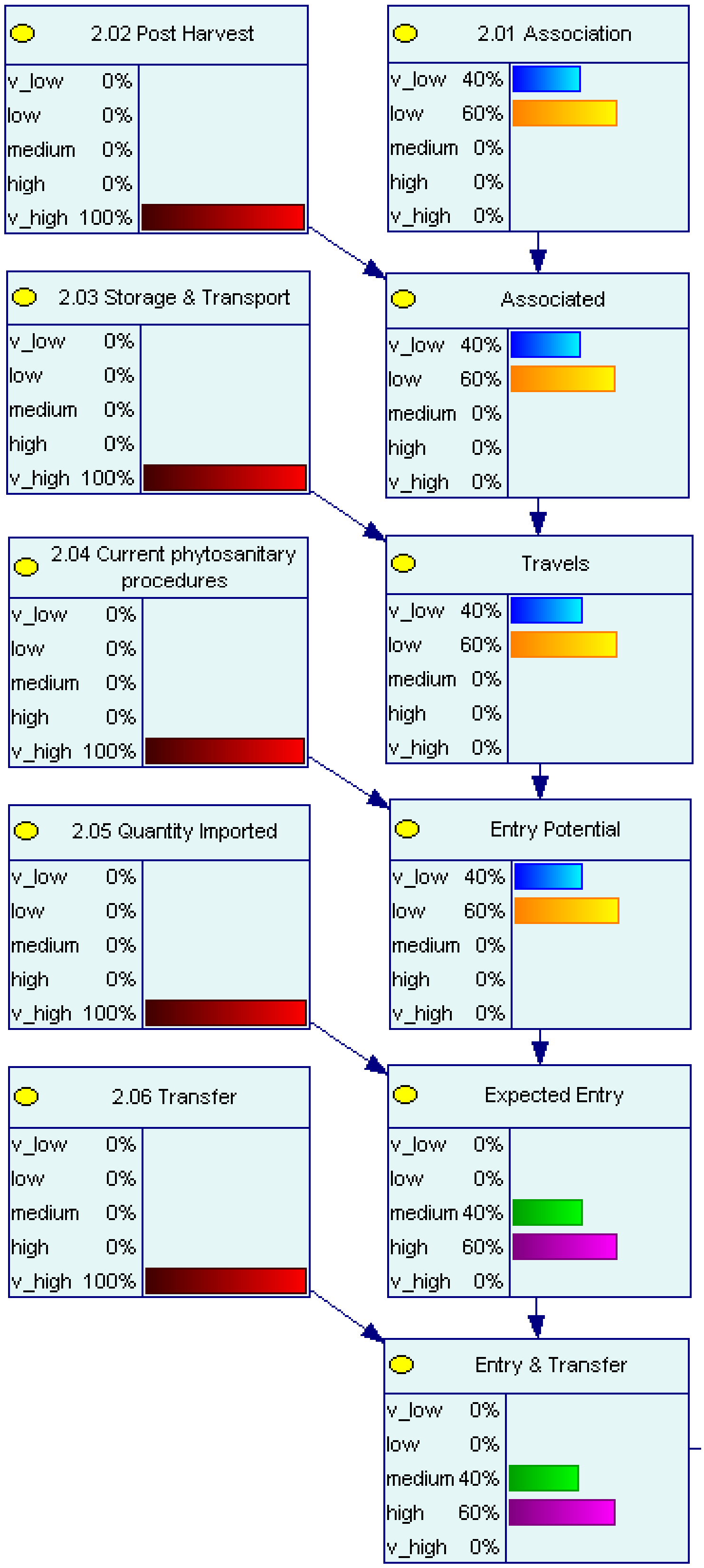

Figure 1: Graphical representation of combining scores for questions 2.01 to 2.06, using a BBN to give the likelihood of entry and transfer of *Meloidogyne fallax* on pathway 1a, trade of seed potatoes.

Pathway 1b: Plants for planting of hosts other than seed potatoes

2.01-1b 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, specify whether these are being taken into account or not.

Information / evidence:
M. fallax has a very wide host range and can be spread through trade of plants of many plant species (Annex I). *M. fallax* is fairly widespread in some vegetable producing areas in Belgium (Annex VI). However, *M. fallax* seems to have a limited distribution in areas where propagation material and tree nursery products are being produced (Elberse & Visser, 2008; see also the answer to question 2.01a). In the Netherlands, *M. fallax* has not been reported on plants for planting at least since 2008 and has been found much less frequently than the closely related species *M. chitwoodi* (Annex VI). However, *M. fallax* can be present in plants without clear symptoms and plants for planting other than seed potatoes are presently not tested for presence of *M. fallax.* Therefore, we assess the likelihood of association roughly between 0.1 and 0.01%.

Uncertainties regarding likelihood of the pest being associated with the pathway at origin
The uncertainty is medium. The present distribution of the pest is uncertain. *M. fallax* can be present in plants without clear symptoms and plants for planting other than seed potatoes are presently not tested for presence of *M. fallax* (except if its presence would be suspected).

2.01-1b: Likelihood of association with 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)	see above	40%
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)	see above	60%
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)		0%
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)		0%
Very High	> 10% (more than one in ten lots[2] of the commodity are likely to be contaminated / infested)		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.

2.02-1b Likelihood of surviving postharvest treatment / measures (before entry into risk assessment area)

Given that a proportion of lots/ consignments may be infested / contaminated, consider the proportion of contaminated lots that are likely to remain 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 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:

There is no effective post harvest treatment. Visual inspection is not sufficient. The pest can also be latently present or with very few symptoms. Note that the risk is assessed in absence of any phytosanitary measures against the pest.

Uncertainties regarding likelihood of the pest surviving postharvest treatment/ measures (before entry into risk assessment area)

Low uncertainty

Conclusions

2.02-1b: Likelihood that an infested commodity remains infested after existing post harvest treatments			
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 commodity are likely to be contaminated / infested)		0%
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)		0%
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)		0%
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)		0%
Very High	> 10% (more than one in ten lots[2] of the commodity are likely to be contaminated / infested)	No effective treatment	100%
		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.

2.03-1b 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 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:

M. fallax can be present as eggs in egg masses adhering to roots or inside tubers and bulbs and as adults (females), egg masses or juveniles inside plant material. Flower bulbs (e.g. tulip) and tubers (e. g. dahlia) are normally sold free from roots, but can still harbour nematodes inside the bulb or tuber, depending on the plant species and cultivar (Den Nijs *et al*., 2004).

In general, *Meloidogyne* species are frequently found in planting material moving in trade. For example, Kurppa (1985) found *Meloidogyne* spp. in 81 out of 670 plant stocks of nursery plants which had been imported into Finland.

In conclusion: it is very likely that *M. fallax* will survive conditions that are suitable to transport or store plants for planting. The uncertainty of this assessment is low.

Uncertainties regarding likelihood of the pest surviving storage and transport.

Low uncertainty

Conclusions

2.03-1b: 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 commodity are likely to be contaminated / infested)		0%
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)		0%
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)		0%
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)		0%
Very High	> 10% (more than one in ten lots[2] of the commodity are likely to be contaminated / infested)	See above	100%
		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.

2.04-1b 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 because they survive existing phytosanitary procedures e.g. they are not detected at entry and/ or they 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:

See the answer to question 2.04-1a.

Symptomatic plants can be detected during routine visual inspection (e.g. as part of quality inspections), as root knots are easily recognizable. However, hosts may be heavily infested without showing external symptoms (Annex I). Moreover, usually a sample of plants is examined, and especially when only low percentages of plants are infested there is always the chance that these plants are not part of the sample. When the planting material is traded with adhering soil/media, the soil/media is usually not examined for the presence of juveniles or egg masses. For these reasons, it is considered very likely with a low uncertainty that the pest will survive existing pest management procedures.

Uncertainties regarding likelihood of the pest surviving current phytosanitary procedures

Low uncertainty

Conclusions

2.04-1b: 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 commodity are likely to be contaminated / infested)		0%
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)		0%
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)		0%
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)		0%
Very High	> 10% (more than one in ten lots[2] of the commodity are likely to be contaminated / infested)	Risk assessed without measures in place	100%
	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.

2.05-1b Quantity of commodity imported annually

Quantity of commodity imported annually: The likelihood that a pest will be introduced 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 3 level scale and provide some reasoning to support use of the scale.

Information / evidence:

There is a large trade volume of dormant bulbs, corms, trees and shrubs from EU-countries where *M. fallax* is known to be present (Annex III: several hundreds of tonnes). More than 60% of this trade volume is from the Netherlands and Belgium where *M. fallax* seems to be more widespread than in the other countries. It is not known which proportion accounts for host plants of *M. fallax*. However, given its large host plant range the traded volume of host plants will probably more than 10,000 tonnes per year (rating: very high).

Uncertainties regarding the quantity of commodity imported annually

Low uncertainty: the trade volume is certainly more than 10,000 tonnes (Annex III) .

Conclusions

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- from EU countries)				
Rating	**Tonnes imported into PRA area (per year)**	**Number of containers (per year)**	**Justification summary**	**Probability Assignment** [1]
Very low	< 10	<1		0%
Low	10 - 100	1- 10 containers		0%
Medium	100 -1,000	10 - 100 containers		0%
High	1,000 - 10,000	100 – 1,000 containers		0%
Very high	> 10,000	> 1,000 containers	Annex III	100%
			Check sum =	100%

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

2.06-1b Likelihood of transfer via pathway

Consider the likelihood that the pest will be distributed and subsequently 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.

Also consider the likelihood that sufficient numbers of 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.

Information / evidence:
Planting material will be planted in soil usually shortly after arrival at the final destination. See also pathway 1a.

Uncertainties regarding likelihood of transfer
Low uncertainty.

Conclusions

2.06-1b: 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)		0%
Low	Between 0.01% and 0.1% (between one in ten thousand and one in one thousand contaminated lots will provide transfer opportunities)		0%
Medium	Between 0.1% - 1% (between one in one thousand and one in one hundred contaminated lots will provide transfer opportunities)		0%
High	Between 1% and 10% (between one in one hundred and one in ten contaminated lots will provide transfer opportunities)		0%
Very high	> 10% (more than one in ten contaminated lots will provide transfer opportunities)	See above	100%
	Check sum =		100%

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

2.07-1b Likelhood of entry and transfer via pathway 1b
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(1b) to 2.05(1b), that relate to likelihood of entry is combined with score for likelihood of transfer 2.06(a) using a BBN to provide an assessment of potential for entry and transfer for the pathway and is shown in Fig. 2. It suggests that the potential for entry and transfer via pathway 1b “plants for planting of host plants other than seed potatoes” is high which is in correspondence with the assessors’ view. The likelihood of association is assessed to be low but the overall risk is high due to the very large volume associated with this pathway.

Uncertainties regarding likelihood of entry and transfer
The uncertainty is the present area of distribution of *M. fallax* and hence the probability of association of *M. fallax* with plants for planting of host plants.

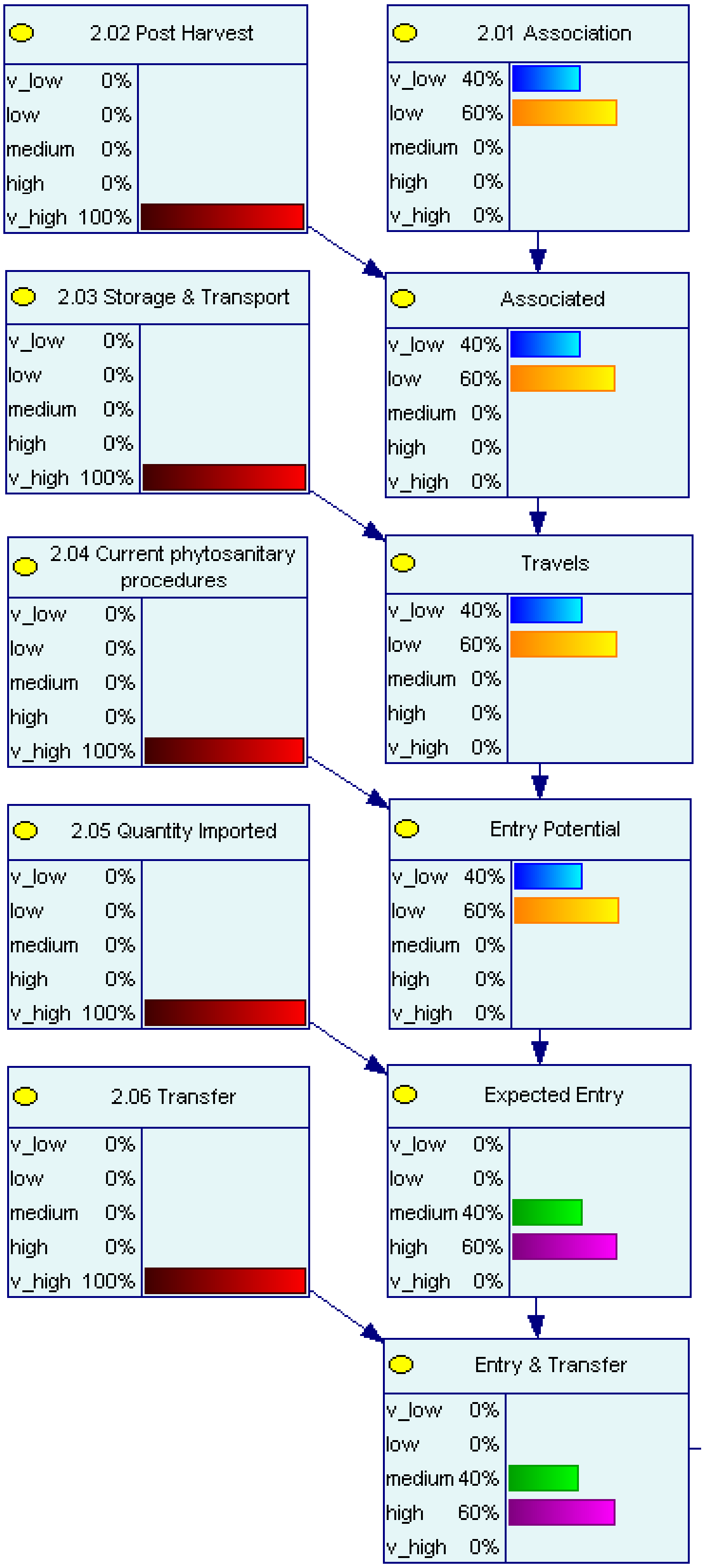

Figure 2: Graphical representation of combining scores for questions 2.01 to 2.06, using a BBN to give the likelihood of entry and transfer of *Meloidogyne fallax* on pathway 1b, trade of plants for planting of host plants other than seed potatoes

Pathway 2: Plants for planting of non-host plants with soil

Note: *M. fallax* has a very wide host range and many host plant species may not have been identified (Annex I). Den Nijs *et al*. (2004) tested the host plant status of various species and cultivars. Some species or cultivars were not found infested but this does not prove that these are non-host plants. On some plant species, *M. fallax* multiplies poorly which makes it difficult to differentiate between non-hosts and poor-hosts. Host plant status can also vary among genotypes within a species (Den Nijs *et al*., 2004).Thus, with the present knowledge it is not possible to provide a (full) list of non-host plants. Here, we assess the potential of non-host plants with soil attached to act as a pathway for *M. fallax* without identifying these non-host plants.

2.01-2 Likelihood of the pest being associated, spatially and temporally, with the pathway at origin

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, specify whether these are being taken into account or not.

Information / evidence:

In the absence of a host plant, *M. fallax* populations will decline rapidly in soil (Molendijk & Brommer, 1998). It is, however, unknown, how long *M. fallax* can survive in soil. More studies are known on survival of populations of the closely related species *M. chitwoodi* in the absence of a host plant (Been *et al.*, 2007; Pinkerton *et al.*, 1991; Wesemael & Moens, 2008a). In one of these studies, *M. chitwoodi* could still be detected one year after harvest of potatoes (Been *et al.*, 2007). It is unknown if *M. fallax* is a better or poorer survivor than *M. chitwoodi* in soil. Assuming a similar survival rate, we assess a very low likelihood of association (see also the risk assessment of *M. chitwoodi*). The percentage of infested commodities will certainly be lower than for pathway 1b (which was already rated as “low” (see above).

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

Low uncertainty about the rating level.

Conclusions

2.01-2: Likelihood of association with 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)	See above	100%
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)		0%
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)		0%
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)		0%
Very High	> 10% (more than one in ten lots[2] of the commodity are likely to be contaminated / infested)		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.

2.02-2 Likelihood of surviving postharvest treatment / measures (before entry into risk assessment area)

Given that a proportion of lots/ consignments may be infested / contaminated, consider the proportion of contaminated lots that are likely to remain 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 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:
There is no effective post harvest treatment. Visual inspection is not sufficient. Testing of soil samples would be required which is currently not carried out.

Uncertainties regarding likelihood of the pest surviving postharvest treatment/ measures (before entry into risk assessment area)
Low uncertainty

Conclusions

2.02-2: Likelihood that an infested commodity remains infested after existing post harvest treatments			
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 commodity are likely to be contaminated / infested)		0%
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)		0%
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)		0%
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)		0%
Very High	> 10% (more than one in ten lots[2] of the commodity are likely to be contaminated / infested)	See above	100%
		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.

2.03-2 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 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:

If *M. fallax* is present in the soil attached to or associated with a non-host plant it will most likely be in the J2 stage (males are usually rare, see Annex I), but eggs may also be present. Eggs are produced in host plant tissue but may also be present on the surface of host plant tissue. If remnants of host plants roots are present in the soil, the soil may also contain eggs of *M. fallax.* Information on survival and infectivity of *M. fallax* J2s and eggs after storage or transportation in soil or exposure to dry conditions is limited to the data gathered by Kok & de Heij (2004) and Aslam (2010):

<u>J2</u>

Juveniles of *M. fallax* survived for at least 300 days in moist sand kept at 5° or 10°C. When temperatures were between 10˚ and 25°C, they survived for 140 days. Juveniles kept at 5°C were able to infect host plants after storage for more than 300 days. Infectivity decreased with increasing temperature: juveniles kept at 20-25 °C could infect plants during 61 days, they remained infective for 140 days at 15˚C, 218 days at 10˚C and more than 300 days at 5˚C (Kok & de Heij, 2004).

Aslam (2010) studied survival of J2s at different relative humidities (RH) at 25˚C. At a RH of 33% and 59% 0% of J2s had survived after exposure for 15 minutes. At a RH of 98%, survival was 100% after 60 minutes. Less than 20% survived 76% RH for 15 minutes and survival was 0% after 30 minutes.

In conclusion, infective J2 populations will likely rapidly decrease under dry conditions but can survive many weeks in moist soil.

<u>Eggs</u>

Kok & de Heij found that eggs of *M. fallax* survived fewer days than juveniles in sand: 188 days at 10°C down to 34 days at 25°C. Infectivity of juveniles hatched from the eggs was not tested. It should, however, be noted that survival of eggs in this study may have been underestimated since eggs might survive due to anhydrobiosis and inhibition of hatching (e.g. Braasch *et al*, 1996) and the gelatinous matrix of the egg mass keeps the eggs together and protects them against environmental extremes (Moens *et al*., 2009).

Results from Tiilikkala *et al*. (1988) indicated that *M. hapla* survived in the egg stage in Finland in peat outdoors and that a part of the population remained in a diapause and survived 2 winters. No such studies are known for *M. fallax.*

In conclusion, there is a high uncertainty of the ability of eggs to survive dry conditions and if eggs could go into a diapause and survive over prolonged period of times.

Conclusion

It is concluded that if *M. fallax* juveniles (and eggs) are present in soil attached to non-host plants and the soil is kept moist, they will likely survive transport and storage at least for a few months at temperatures up to at least 25˚C (no data available for higher temperatures).

Uncertainties regarding likelihood of the pest surviving storage and transport

Low uncertainty

2.03-2: 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 commodity are likely to be contaminated / infested)		0%
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)		0%
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)		0%
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)		10%
Very High	> 10% (more than one in ten lots[2] of the commodity are likely to be contaminated / infested)	See above	90%
		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.

2.04-2 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 because they survive existing phytosanitary procedures e.g. they are not detected at entry and/ or they 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:
Soil attached to plants is not tested for presence of *Meloidogyne* spp. (plants moving within the EU). The risk of entry/spread is assessed without the current phytosanitary measures against the pest.

Uncertainties regarding likelihood of the pest surviving current phytosanitary procedures
Low uncertainty

Conclusions

2.04-2: 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 commodity are likely to be contaminated / infested)		0%
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)		0%
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)		0%
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)		0%
Very High	> 10% (more than one in ten lots[2] of the commodity are likely to be contaminated / infested)	See above	100%
	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.

2.05-2 Quantity of commodity imported annually

Quantity of commodity imported annually: The likelihood that a pest will be introduced 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 3 level scale and provide some reasoning to support use of the scale.

Information / evidence:
See pathway 1b. We assess a volume of more than 10,000 tonnes

Uncertainties regarding the quantity of commodity imported annually
Medium uncertainty: uncertainty about the host range of *M. fallax* and, therefore, the trade volume of non-hosts (see also pathway 1b).

Conclusions

2.05-2 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	< 10	<1		0%
Low	10 - 100	1- 10 containers		5%
Medium	100 -1,000	10 - 100 containers		15%
High	1,000 - 10,000	100 – 1,000 containers		30%
Very high	> 10,000	> 1,000 containers	See above	50%
			Check sum =	100%

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

2.06-2 Likelihood of transfer via pathway 2

Consider the likelihood that the pest will be distributed and subsequently 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.

Also consider the likelihood that sufficient numbers of 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.

Information / evidence:
Plants (non-hosts) will finally be planted in soil and population decline will continue in the absence of a host plant. In principle soil is a suitable environment for survival although soil with heavier texture may be less suitable for survival and establishment (Runia & Korthals, 2004). Dry and warm conditions also negatively affect survival (Aslam, 2010; Kok & de Heij, 2004). There are wild and crop host plant species and transfer depends on the probability that the nematode will come into contact with a host plant before it has lost its infectivity.

J2's can only move over very short distances in soil (horizontally probably much less than 0.5 m) and *M. fallax* can only come into contact with a host plant when the non-host plant is in very close proximity. The likelihood that this will happen and J2's will reach a non-host before they have lost their infectivity is rated as low to medium (transfer might happen in one in ten thousand to one in hundred cases).

Uncertainties regarding likelihood of transfer
The uncertainty is high. Transfer from infested soil moved with a non-host plant has thus far not been reported.

Conclusions

2.06-2: 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)		10%
Low	Between 0.01% and 0.1% (between one in ten thousand and one in one thousand contaminated lots will provide transfer opportunities)		35%
Medium	Between 0.1% - 1% (between one in one thousand and one in one hundred contaminated lots will provide transfer opportunities)	See above	40%
High	Between 1% and 10% (between one in one hundred and one in ten contaminated lots will provide transfer opportunities)		15%
Very high	> 10% (more than one in ten contaminated lots will provide transfer opportunities)		0%
	Check sum =		100%

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

2.07-2 Likelhood of entry and transfer via pathway 2

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 likelihood of association is assessed to be very low, the volume medium - very high (high uncertainty). Transfer was assessed as low – medium. The result of combining scores to individual questions 2.01(2) to 2.05(2), that relate to likelihood of entry is combined with score for likelihood of transfer 2.06(a) using a BBN to provide an assessment of potential for entry and transfer for the pathway and is shown in Figure 3. It suggests that the potential for entry and transfer via pathway 2 “plants for planting of non-host plants with soil attached” is low to medium. The assessors assess the potential for entry and transfer via pathway 2 as low because of the very low likelihood of association of *M. fallax* in the rhizosphere of a non-host plant.

Uncertainties regarding likelihood of entry and transfer

The main uncertainties relate to:

- The likelihood of association: it is unknown how long *M. fallax* will survive in soil in absence of a host plant and could be associated with soil attached to a non-host plant.
- The volume traded: *M. fallax* has a very wide host range and hence the list of non-hosts is highly uncertain.
- The likelihood of transfer from soil attached to a non-host to a host plant

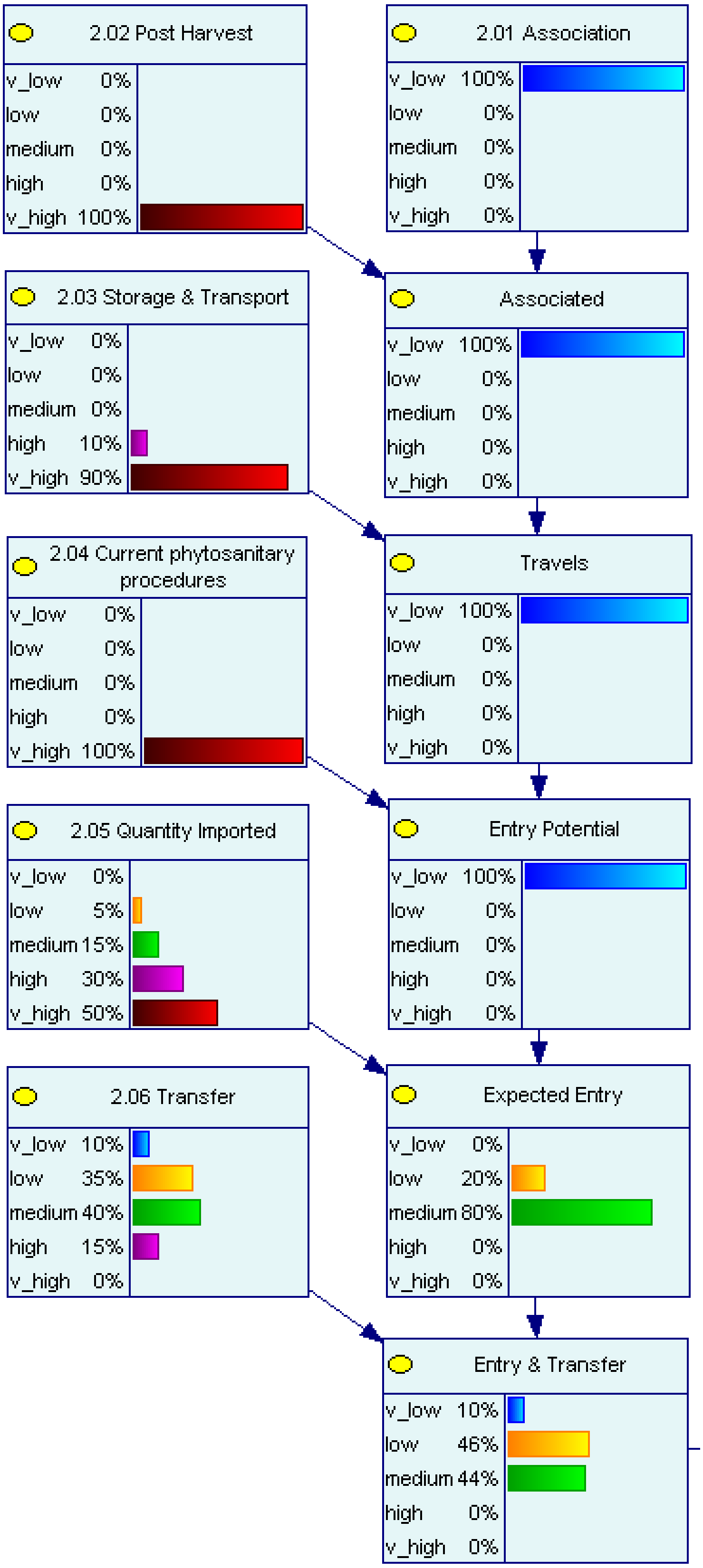

Figure 3: Graphical representation of combining scores for questions 2.01 to 2.06, using a BBN to give the likelihood of entry and transfer on pathway 2 of *Meloidogyne fallax*, trade of plants for planting of non-host plants with soil attached

Pathway 3: Tubers, bulbs and roots of host plants intended for consumption or processing

2.01-3 Likelihood of the pest being associated, spatially and temporally, with the pathway at origin
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, specify whether these are being taken into account or not.

Information / evidence:
There is a large trade volume of tubers, bulbs and roots of host plants from EU-countries where *M. fallax* has been found (Annex III). *M. fallax* appears to have a limited distribution in these countries apart from certain regions in Belgium and possibly the Netherlands (see Annex VI for details). It is, therefore, assessed that less than one in thousands lots are infested (low).

Uncertainties regarding likelihood of the pest being associated with the pathway at origin
Medium uncertainty. The present distribution of the pest is uncertain. It is uncertain what part of the trade volume (Annex III) originate from fields or areas where *M. fallax* is present.

Conclusions

2.01-3: Likelihood of association with 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)	see above	40%
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)	see above	60%
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)		0%
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)		0%
Very High	> 10% (more than one in ten lots[2] of the commodity are likely to be contaminated / infested)		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.

2.02-3 Likelihood of surviving postharvest treatment / measures (before entry into risk assessment area)

Given that a proportion of lots/ consignments may be infested / contaminated, consider the proportion of contaminated lots that are likely to remain 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 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:

There is no effective postharvest treatment. Part of the soil will be removed before transport during handling at the producer's place. This will not affect *M. fallax* inside the tubers and roots. Some eggs present on the surface may be removed. More than one out of ten individuals is expected to survive.

Uncertainties regarding likelihood of the pest surviving postharvest treatment/ measures (before entry into risk assessment area)

Low uncertainty

Conclusions

2.02-3: Likelihood that an infested commodity remains infested after existing post harvest treatments			
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 commodity are likely to be contaminated / infested)		0%
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)		0%
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)		0%
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)		0%
Very High	> 10% (more than one in ten lots[2] of the commodity are likely to be contaminated / infested)	See above	100%
		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.

2.03-3 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 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:

It takes no longer than one week to transport ware and starch potato, black salsify, carrots and any other products which can harbour *M. fallax* within the EU. Some products are cleaned from soil before transport which perhaps reduces the number of adhering egg masses but does not influence juveniles and females in tubers and roots. The pest will most likely survive in more than one in ten lots.

Uncertainties regarding likelihood of the pest surviving storage and transport

Low uncertainty

2.03-3: 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 commodity are likely to be contaminated / infested)		0%
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)		0%
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)		0%
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)		0%
Very High	> 10% (more than one in ten lots[2] of the commodity are likely to be contaminated / infested)	See above	100%
		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.

2.04-3 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 because they survive existing phytosanitary procedures e.g. they are not detected at entry and/ or they 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:
A high survival percentage is expected since products are not tested for presence of *Meloidogyne* spp. Heavily infested products may be rejected by industry. The risk is assessed with no phytosanitary measures in place.

Uncertainties regarding likelihood of the pest surviving current phytosanitary procedures
Low uncertainty

Conclusions

2.04-3: 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 commodity are likely to be contaminated / infested)		0%
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)		0%
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)		0%
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)		0%
Very High	> 10% (more than one in ten lots[2] of the commodity are likely to be contaminated / infested)	See above	100%
	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.

2.05-3 Quantity of commodity imported annually

Quantity of commodity imported annually: The likelihood that a pest will be introduced 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 3 level scale and provide some reasoning to support use of the scale.

Information / evidence:

Trade volume of ware potato, starch potato, salsify, turnip and carrots from EU countries where *M. fallax* is present to other EU countries is about 4.6 mln tonnes per year (Annex III; Table 2.A.1-4).

Uncertainties regarding the quantity of commodity imported annually

Low uncertainty.

2.05-3 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	< 10	<1		0%
Low	10 - 100	1- 10 containers		0%
Medium	100 -1,000	10 - 100 containers		0%
High	1,000 - 10,000	100 – 1,000 containers		0%
Very high	> 10,000	> 1,000 containers	Trade volumes in Annex III	100%
			Check sum =	100%

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

2.06-3 Likelihood of transfer via pathway

Consider the likelihood that the pest will be distributed and subsequently 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.

Also consider the likelihood that sufficient numbers of 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.

Information / evidence:
Tubers and roots intended for consumption will often be cleaned, packed or processed before being sold to the end-consumer. Waste products (e.g. potato peels) will be composted or are used as animal feed and usually not come into contact with a living host plant. Waste water can contain eggs and J2s hatching from the eggs or present in the soil adhering to the plant products and released into the water during the washing process. *M. fallax* can survive in clean water for 10 weeks at 20˚C and longer at lower temperatures (results of experiment conducted within the framework of Prima Phacie). Data are lacking about survival in waste water but *M. fallax* is expected to survive for at least several weeks. In the Netherlands waste water is purified following standard procedures including fermentation and filtering through sand. It is unlikely that *Meloidogyne* eggs and juveniles will survive these treatments. However, this is not the case in each EU-country. If the waste water is applied to fields there may be a high probability (1 – 10%) for the pest to transfer to a suitable host because of the wide host range of *M. fallax.* In experiments, plants in pots are often inoculated by adding aqueous suspensions of eggs and/or juveniles to the soil which show that application of infested water can lead to infection of a host plant.

In cases where consumers use infested ware potatoes as seed potatoes, the probability of transfer would be very high. The likelihood of such an event “an infested ware potato is used by a consumer as seed potato” is, however, assessed “low”. This pathway is not analysed in detail in this risk assessment because of lack of figures (% of ware potatoes used as seed potatoes) but the pathway poses a risk of introduction and spread of *M. fallax*.

Uncertainties regarding likelihood of transfer
High uncertainty in cases where waste water is applied to a field (pathway 3b). *M .fallax* can probably survive in waste water for several weeks but less certain is how long *M. fallax* remains infective in waste water. There are no data which show successful transfer from waste water to a host plant under practical conditions.

Pathway 3a: waste water (and any other waste material) is properly treated

2.06-3a: 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)	*M. fallax* will be eliminated from the waste	80%
Low	Between 0.01% and 0.1% (between one in ten thousand and one in one thousand contaminated lots will provide transfer opportunities)		20%
Medium	Between 0.1% - 1% (between one in one thousand and one in one hundred contaminated lots will provide transfer opportunities)		0%
High	Between 1% and 10% (between one in one hundred and one in ten contaminated lots will provide transfer opportunities)		0%
Very high	> 10% (more than one in ten contaminated lots will provide transfer opportunities)		0%
	Check sum =		100%

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

Pathway 3b: waste water is applied to a field

2.06-3b: 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)		5%
Low	Between 0.01% and 0.1% (between one in ten thousand and one in one thousand contaminated lots will provide transfer opportunities)		15%
Medium	Between 0.1% - 1% (between one in one thousand and one in one hundred contaminated lots will provide transfer opportunities)		30%
High	Between 1% and 10% (between one in one hundred and one in ten contaminated lots will provide transfer opportunities)	*M. fallax* can come into contact with a host through waste water	40%
Very high	> 10% (more than one in ten contaminated lots will provide transfer opportunities)		10%
	Check sum =		100%

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

2.07-3 Likelhood of entry and transfer via pathway 3a and 3b
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.

<u>Pathway 3a</u>
The result of combining scores to individual questions 2.01(3a) to 2.05(3a), that relate to likelihood of entry is combined with score for likelihood of transfer 2.06(3a) using a BBN to provide an assessment of potential for entry and transfer for the pathway and is shown in Figure 4. It suggests that the potential for entry and transfer via pathway 3a “tubers, bulbs and roots of host plants intended for consumption or processing, waste properly treated” is very low which is in correspondence with the assessors’ view.

When waste water and any other waste material that may be infested with *M. fallax* is treated properly (e.g. heated, composted or burnt), the likelihood of entry and transfer with plant products intended for consumption or processing is assessed as very low. Note that the likelihood of transfer will be very high in case ware potatoes would be used as seed potatoes by consumers. The likelihood that a ware potato which is used by a consumer as seed potato is infested with *M. fallax* is, however, assessed to be low.

Note that movement and/or loss of infested soil during harvesting or transport of plant products, which can lead to spread of *M. fallax*, were not included in this pathway. Such events will especially lead to local spread within an agricultural area and are discussed in the spread section of this risk assessment.

<u>Pathway 3b</u>
The result of combining scores to individual questions 2.01(3b) to 2.05(3b), that relate to likelihood of entry is combined with score for likelihood of transfer 2.06(3b) using a BBN to provide an assessment of potential for entry and transfer for the pathway and is shown in Figure 5. It suggests that the potential for entry and transfer via pathway 3b “tubers, bulbs and roots of host plants intended for consumption, waste water applied to a field” is medium which is in correspondence with the assessors’ view.

Uncertainties regarding likelihood of entry and transfer
(Summarise uncertainties from 2.01 to 2.06)
The main uncertainty relates to the likelihood of transfer from the waste water to a host plant. It is unknown how waste water is treated or applied to fields in the different EU countries. Transfer through waste water has thus far not been shown

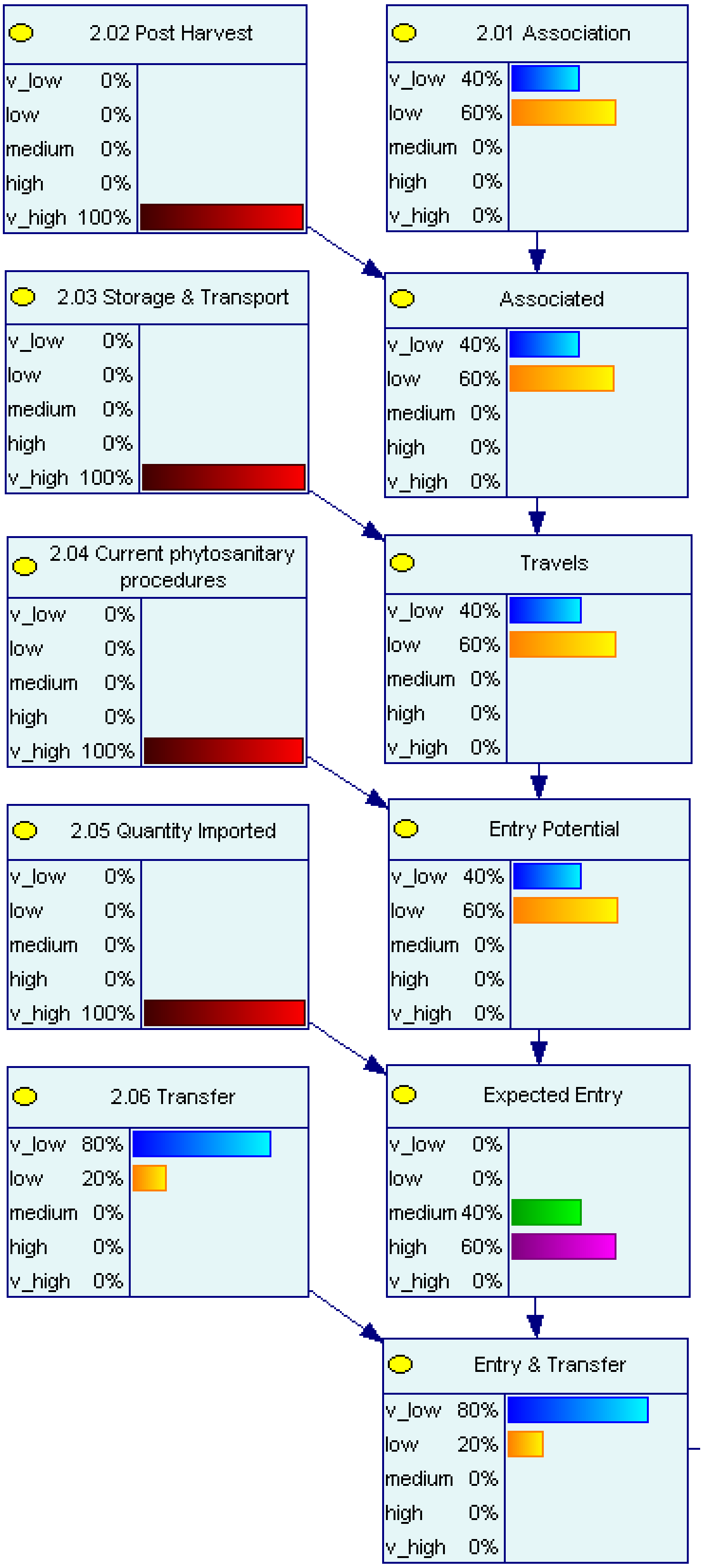

Figure 4: Graphical representation of combining scores for questions 2.01 to 2.06, using a BBN to give the likelihood of entry and transfer on pathway 3a, trade of tubers, bulbs and roots intended for consumption or processing, waste materials properly treated (this pathway does not include the possibility of using ware potatoes as seed potatoes by consumers).

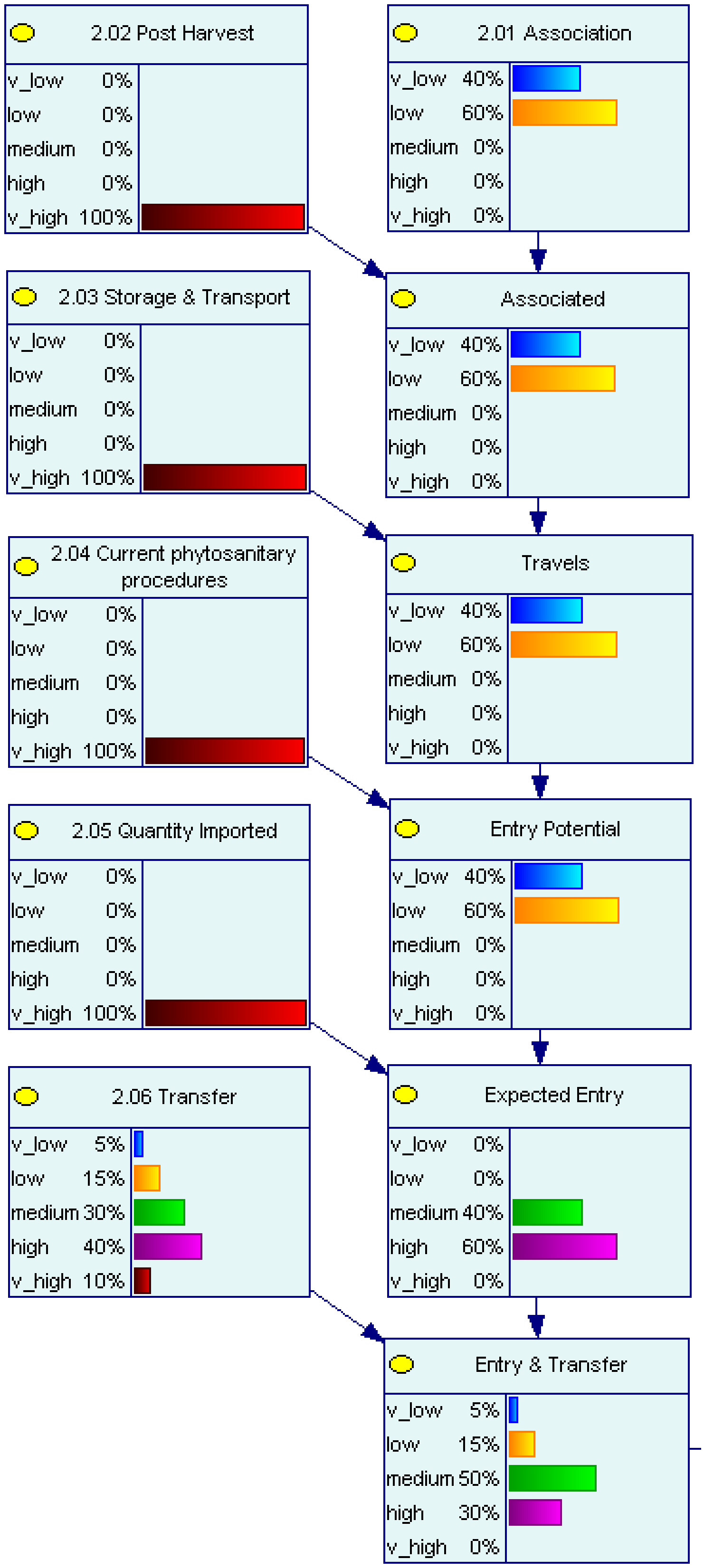

Figure 5: Graphical representation of combining scores for questions 2.01 to 2.06, using a BBN to give the likelihood of entry and transfer on pathway 3b, trade of tubers, bulbs and roots intended for consumption, waste water applied to a field (this pathway does not include the possibility of using ware potatoes as seed potatoes by consumers).

Pathway 4: (Soil attached to plants intended for consumption or processing)

2.01-4 Likelihood of the pest being associated, spatially and temporally, with the pathway at origin

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, specify whether these are being taken into account or not.

Information / evidence:

Large amounts of soil may be removed from the field during harvest of the products (Ruysschaert *et al*., 2007, 2007a, 2007b). Most of this soil will remain at the company and returned to the field where it originated from or may be left on other fields in the same region. Smaller amounts of soil e.g. (0-5% w/w) may remain attached to the product after harvest. According to the Rules for Inter-European Trade in Potatoes (RUCIP, 2006):

- ware potatoes should be "practically clean", i.e. a tolerance of 1% of earth adhering to the tubers is allowed,
- industrial potatoes for processing into products for human consumption should be free of earth "according to agreement between the parties"
- industrial potatoes for the production of alcohol or animal feed stuffs should be free of earth with a tolerance for waste (including earth) of 2%
- all root vegetables like turnip and salsify can bear even more soil on them

In practice these percentages may be higher.

The percentage of lots with adhering soil originating from an infested field is assessed less than 0.1% (see pathway 3).

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

Medium uncertainty. The present distribution of the pest is uncertain. It is uncertain what part of the trade volume (Annex III) originate from fields or areas where *M. fallax* is present.

2.01-4: Likelihood of association with 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)	see above	40%
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)	see above	60%
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)		0%
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)		0%
Very High	> 10% (more than one in ten lots[2] of the commodity are likely to be contaminated / infested)		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.

2.02-4 Likelihood of surviving postharvest treatment / measures (before entry into risk assessment area)

Given that a proportion of lots/ consignments may be infested / contaminated, consider the proportion of contaminated lots that are likely to remain 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 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:

Risk is assessed with no phytosanitary measures against *M. fallax* in place. There are no other treatments that will reduce the likelihood of surviving (treatments that reduce the amount of soil are already taken into account when assessing the volume of this pathway (see question 2.05-5).

Uncertainties regarding likelihood of the pest surviving postharvest treatment/ measures (before entry into risk assessment area)

Low uncertainty

Conclusions

2.02-4: Likelihood that an infested commodity remains infested after existing post harvest treatments			
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 commodity are likely to be contaminated / infested)		0%
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)		0%
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)		0%
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)		0%
Very High	> 10% (more than one in ten lots[2] of the commodity are likely to be contaminated / infested)	See above	100%
		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.

2.03-4 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 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:

Small amounts of soil are attached that can easily dry out during transport and storage. Egg masses released into the waste soil during harvest, washing etc. may better survive transport and storage than juveniles. The closely related species *M. chitwoodi* has been found in waste soil in France (Annex VI) but data are lacking about the percentage of J2s and eggs that survive and the infectivity of *M. chitwoodi* in the waste soil. Also, soil may be stored for several months or even more than a year near the processing factory before it is disposed. Therefore, we assess the likelihood of remaining infested roughly between 0.1% and 10%.

Uncertainties regarding likelihood of the pest surviving storage and transport

High uncertainty. The closely related species *M. chitwoodi* has been found in waste soil in France (Annex VI) but it is uncertain which percentage of juveniles and eggs will survive. It will also very much depend on storage time which may vary largely.

Conclusions

2.03-4: 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 commodity are likely to be contaminated / infested)		0%
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)		0%
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)		30%
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)	See above	50%
Very High	> 10% (more than one in ten lots[2] of the commodity are likely to be contaminated / infested)		20%
		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.

2.04-4 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 because they survive existing phytosanitary procedures e.g. they are not detected at entry and/ or they 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:

Risk is assessed in absence of phytosanitary measures against *M. fallax* (see also the note on page 12)..

Uncertainties regarding likelihood of the pest surviving current phytosanitary procedures

Low uncertainty.

Conclusions

2.04-4: 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 commodity are likely to be contaminated / infested)		0%
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)		0%
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)		0%
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)		0%
Very High	> 10% (more than one in ten lots[2] of the commodity are likely to be contaminated / infested)	Risk assessed in absence of phytosanitary measures	100%
	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.

2.05-4 Quantity of commodity imported annually

Quantity of commodity imported annually: The likelihood that a pest will be introduced 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 3 level scale and provide some reasoning to support use of the scale.

Information / evidence: Provide reasoning then give judgment

The weight limit for waste (earth, whether adhering or not, and foreign bodies) in EU trade of potatoes established in the EU (RUCIP, 2006) is 1% of the weight of the product for new potatoes and ware potatoes and 2% for industrial potatoes destined for the production of alcohol or animal feed stuffs. For industrial potatoes for processing into products for human consumption, the tolerance limit by weight is set according to an agreement between the trading parties. In practice the amount of soil adhering to the potatoes may be higher in some cases, up to 3-5%. The Netherlands and Belgium trade about 1.2 – 1.4 million tones potatoes per year which means that about 10,000 to 30,000 tonnes of soil is moved with the trade of ware and industrial potatoes from these countries to other EU-countries (see also Annex III). Soil may also be moved between countries with other plant products from host plants of *M. fallax* (e.g. carrots and black salsify).

Uncertainties regarding the quantity of commodity imported annually

Low uncertainty about the rating level for the quantity moved within the PRA area.

Conclusions

2.05-4 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	< 10	<1		0%
Low	10 - 100	1- 10 containers		0%
Medium	100 -1,000	10 - 100 containers		0%
High	1,000 - 10,000	100 – 1,000 containers		0%
Very high	> 10,000	> 1,000 containers	See above	100%
			Check sum =	100%

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

2.06-4 Likelihood of transfer via pathway

Consider the likelihood that the pest will be distributed and subsequently 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. Also consider the likelihood that sufficient numbers of 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.

Information / evidence:
Soil will be removed from the product and stored for a while near the processing industry. In the Netherlands, the final destination of the soil can be variable: meadows, agricultural or non-agricultural destinations (information obtained from the processing industry in the Netherlands). In each of these cases soil can come into contact with a host plant suitable for reproduction but the likelihood that this will occur is lowest when it is used for non-agricultural purposes, e,g, landfill. J2s of *M. fallax* cannot move over large distances and soil containing the nematode should be placed close to a host plant, probably within several decimetres of roots/tubers of the host plant.

We assess that roughly between 1 and 10% of the soil may come into contact with roots or tubers of host plants in such a way that, if *Meloidogyne* would be present, it could infest a host plant. This percentage is very uncertain and may also be higher or lower since data are lacking about the exact destination of the soil in the various EU-countries. The time of the year that soil is spread on a field will largely influence the probability of transfer. When the soil is applied on an agricultural field in the autumn the soil may only come into contact next spring when the population has declined further.

Uncertainties regarding likelihood of transfer
High uncertainty: estimation of likelihood of transfer is quite speculative.

2.06-4: Likelihood pest will transfer in sufficient numbers to a host			
Rating	**Description** (likelihood of pest transfer is ....)	**Justification summary**	**Probability Assignment**
Very low	< 0.01% (less than one in ten thousand contaminated lots will provide transfer opportunities)		5%
Low	Between 0.01% and 0.1% (between one in ten thousand and one in one thousand contaminated lots will provide transfer opportunities)		15%
Medium	Between 0.1% - 1% (between one in one thousand and one in one hundred contaminated lots will provide transfer opportunities)		30%
High	Between 1% and 10% (between one in one hundred and one in ten contaminated lots will provide transfer opportunities)	*M.fallax* can come into contact with host through waste soil	40%
Very high	> 10% (more than one in ten contaminated lots will provide transfer opportunities)		10%
	Check sum =		100%

2.07-4 Likelihood of entry and transfer via pathway 4
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(4) to 2.05(4), that relate to likelihood of entry is combined with score for likelihood of transfer 2.06(4) using a BBN to provide an assessment of potential for entry and transfer for the pathway and is shown in Figure 6. It suggests that the potential for entry and transfer via pathway 4 “soil attached to plant products intended for consumption or processing” is medium which is in correspondence with the assessors’ view.

The likelihood of association was assessed to be very low but the total volume very high which resulted in a medium risk of spread with soil associated with plant products intended for processing and consumption.

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

The main uncertainty is related to the likelihood of transfer. The related species *M. chitwoodi* has been found in waste soil in France (Annex VII). It is, therefore, also considered likely that *M. fallax* can be present in waste soil from plant products originating from a field infested with the nematode species. However, it is uncertain in how many cases transfer of *M. chitwoodi* and *M. fallax* from the waste soil to a host plant would be successful.

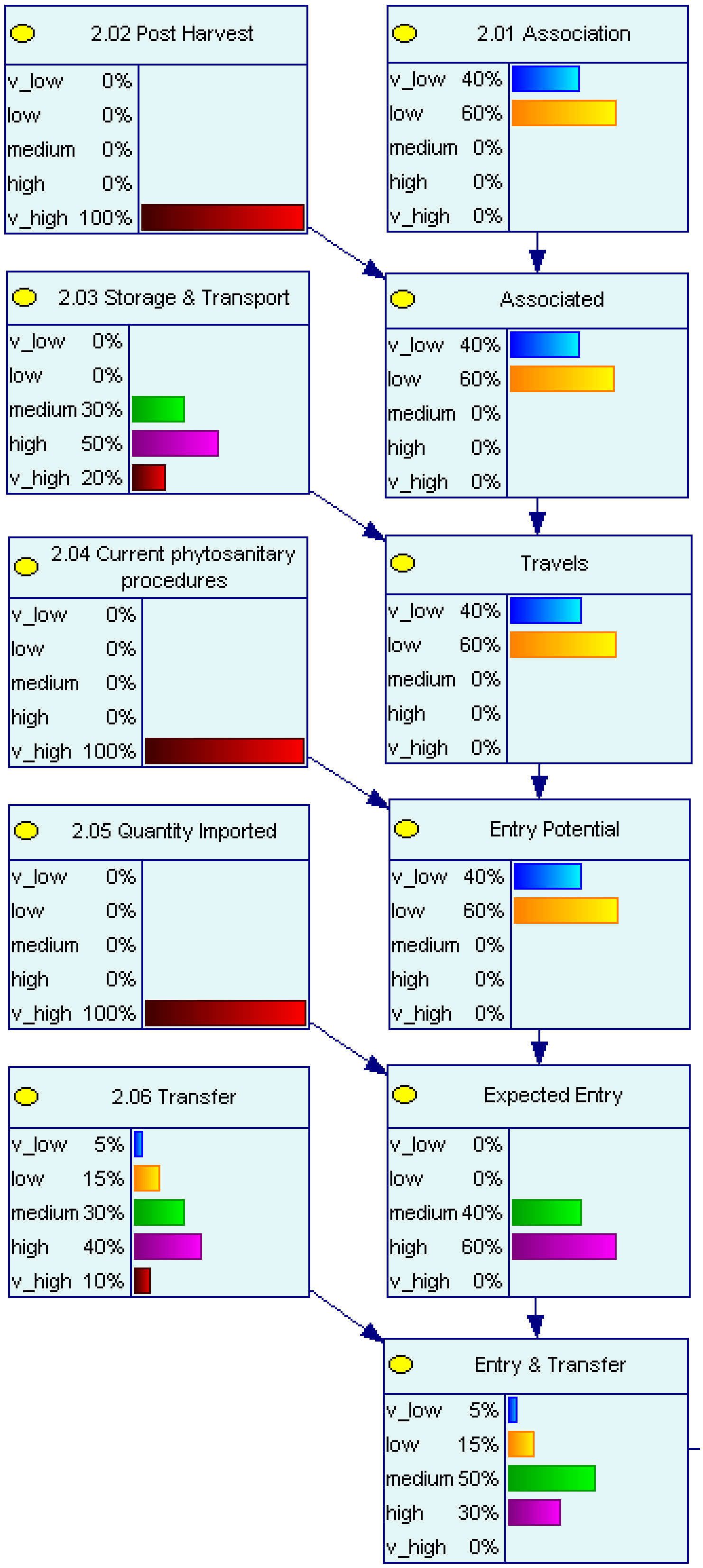

Figure 6: Graphical representation of combining scores for questions 2.01 to 2.06, using a BBN to give the likelihood of entry and transfer of *M. fallax* on pathway 4, soil attached to plant products intended for consumption or processing.

2.08 Likelihood of entry and transfer via all pathways assessed

The overall likelihood of entry and transfer (in this analysis the likelihood of spread within the EU by trade) was assessed very high according to the BBN-model (Fig. 7) which is in correspondence with the assessors' view. It was assessed to be very likely that *M. fallax* will be spread in at least one occasion per year by trade of plants for planting and/or plant products.

Uncertainties regarding likelihood of entry and transfer via all pathways combined

(Summarise uncertainties 2.08a, 2.08b, 2.08c etc.)

The main uncertainty relates to the present distribution of *M. fallax* and hence the likelihood of association with plants for planting and plant products. Other uncertainties concern the likelihood of transfer with waste products (soil and water) from the processing industry and the likelihood of entry and transfer with plants for planting of non-host plants.

Conclusions

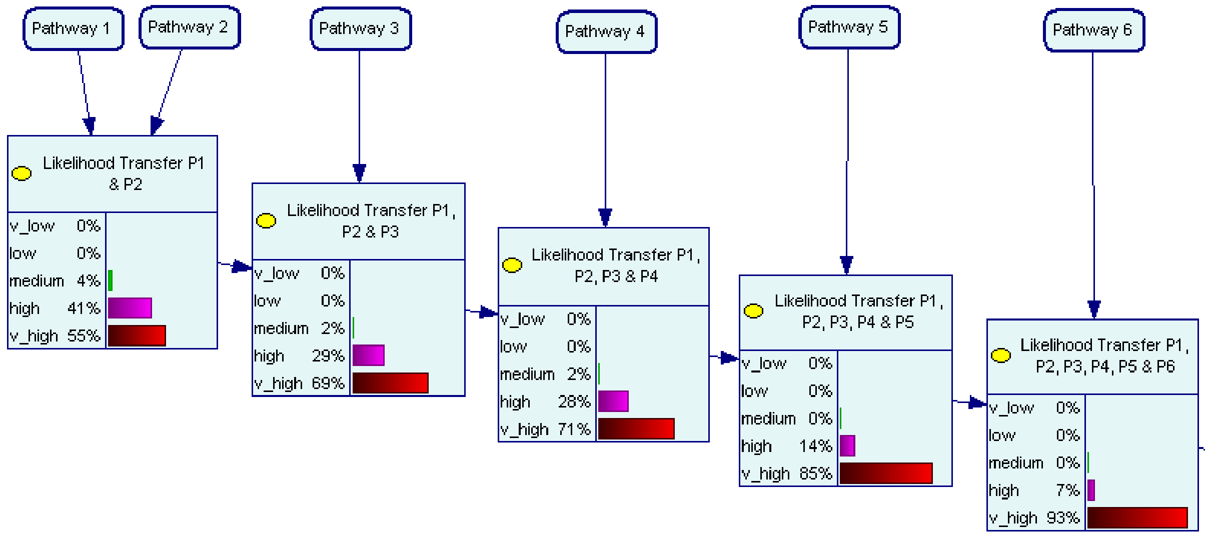

Figure 7: Graphical representation of combining results from 2.08 for all pathways: overall likelihood of spread of *M. fallax* with trade of plants for planting and plant products in the EU

3.00 Potential for pest establishment[5] 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).

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).

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 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

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

whose presence in the area will result in harmful consequences to cultivated and managed plants[6] 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.

M. fallax has a very wide host range (Annex I). Hosts, including crop plants, trees and weeds, are present throughout the risk assessment area. The area of potential distribution and the endangered area are discussed in detail in Annex V. Both areas are assessed to be largely similar to those for *Meloidogyne chitwoodi* but with much more uncertainty.

M. fallax may be able to establish in a large part of its host area (between 2/3 and 90%). Factors that may limit its establishment are: warm and/or dry conditions in absence of a host plant, (medium) fine soil textures and cold climates. Management practices will also influence the establishment potential. The establishment potential will increase with the number of days per year that a host plant is present.

The endangered area is assessed to be much smaller than the area of potential distribution because significant damage may only occur under certain conditions (coarse textured soil and accumulated DD_5 above about 1400, see for details Annex V).

Greenhouses (e.g. production of vegetables such as tomato and lettuce) are also part of the endangered area.

Uncertainties regarding environmental suitability and endangered area

The assessment is mainly based on knowledge of the related species *M. chitwoodi* because little information is available about the ecology of *M. fallax*. The major unknowns regarding the environmental suitability are:

- the base temperature for development of *M. fallax*
- the temperature sum needed for damage to occur
- the minimum temperature for survival
- the maximum temperature in relation to time for survival
- its ability to survive dry conditions especially as egg masses is not well known
- survival studies in soil and with different stages (egg masse, juveniles) are lacking

[6] 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.

- the influence of soil texture on establishment and damage

In the Netherlands, *M. fallax* has a much more limited distribution than *M. chitwoodi* although it has probably been present for several decades already, thus before it received a quarantine status (Annex VI). The reason for this difference in distribution between *M. fallax* and *M. chitwoodi* is unknown. In Germany, *M. fallax* has been found on symptomatic potato tubers in the autumn of 1994. In later surveys, *M. fallax* could not be detected any more (Annex VI). Either, *M. fallax* has disappeared from the field and was not able to establish or is present at very low population densities and, therefore, difficult to detect. These observations add to the uncertainty about the establishment potential of *M. fallax.*

Conclusions

3.01: Environmental suitability				
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%	15%
Low	Between 10% and 1/3 of host area		0%	45%
Medium	Between 1/3 and 2/3 of host area	Dry warm periods without host and cold climates may hinder establishment	30%	30%
High	Between 2/3 and 90% of host area	Climate and soil texture suitable in large part of EU.	55%	10%
Very high	More than 90% of host area		15%	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 other 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[7]. Fill out table 3.02 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. Also note the endangered area occupied at the time horizon.

The table is 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

Reproductive potential. Meloidogyne fallax reproduces mostly parthenogenetically, but also sexual reproduction occurs (Van der Beek & Karssen, 1997). A relatively large offspring is produced: up to a 1000 eggs per female are possible. One to a few generations can be produced per year, depending on temperature and availability and status of a host plant. In continuous optimum conditions of warm temperatures (e.g. 600 degree-days base 5˚C per month) one generation can be produced per month (Aslam, 2010). This is at most, and not realistic, about 10 to 12 generations per year. In temperate climates, 2 to 3 generations per year can be produced in the field. When compared to some fungi or even bacteria, reproduction is not high because the number of generations per year is restricted: one to a few. However, through the wide variety of host plants, new generations can be formed almost every year (on crops and weeds),.

Spread rate. Natural spread rate of *Meloidogyne fallax* is low (<1 m) and spread is basically confined to passive movement with soil, water or infected plant parts (roots, tubers, bulbs,...). This movement can happen over large distances and usually involves human activities, e.g. between countries through trade of infested plants (see the entry section of this risk assessment), between fields through agricultural practices. The nematode has no vectors. Dispersal by wind is not known, but water runoff from contaminated fields or waste water from processing plants can distribute *M. fallax* if fields or crops are contaminated (see Annex I: datasheet).

Thus, the nematode may be spread over large distances through human assistance but the infested area will probably increase slowly. Within the time horizon considered, 20 years (see 1.5), it is assessed that *M. fallax* may have spread to less than 10% of its potential area of establishment (this 10% does not include the area in the EU where it has already established). Once introduced into an

[7] 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 inhibi spread (risk reduction options) in place.*

area, the rate of spread will generally increase with the number of fields that is infested (chance that infested soil or infected plants are moved increases with the percentage of infested fields).

The extent of spread is expected to be similar for the area suitable for establishment and the endangered area. Natural spread rate is not expected to be different in the 2 areas nor the likelihood of spread by human assistance.

Uncertainties regarding extent of spread
The main uncertainty is that it is not known exactly where *M. fallax* is present at this moment. *M. fallax* may have entered several areas in the EU already but either did not establish or has not been noticed because conditions are unfavourable for disease development. The more widespread *M. fallax* is already present the more rapidly it will spread through movement of infected plants, infested soil etc.

The species was described only recently (1996) so its spread cannot be traced back to give an idea of how fast this has occurred (see also Annex I). Also the uncertainties regarding its establishment potential and limits of the endangered areas as indicated above (question 3.01) add to the uncertainties about the extent of spread.

Conclusions

3.02a: Extent of spread (area suitable for establishment)			
Rating	**Within the time horizon considered the pest is likely to have spread to ...**[2]	**Justification summary**	**Probability that given area will be occupied at time horizon**[1]
Very low	Less than 10% of the area suitable for establishment	Restricted natural spread capacity	50%
Low	Between 10% and 1/3 of the area suitable for establishment	Present distribution uncertain and spread rate increases with % infested fields	35%
Medium	Between 1/3 and 2/3 of the area suitable for establishment		15%
High	Between 2/3 and 90% of the area suitable for establishment		0%
Very high	More than 90% of the area suitable for establishment		0%
	Check sum =		100%

3.02b: Extent of spread (endangered area)			
Rating	**Within the time horizon considered the pest is likely to have spread to ...**[2]	**Justification summary**	**Probability that given area will be occupied at time horizon**[1]
Very low	Less than 10% of the endangered area	See 3.02a	50%
Low	Between 10% and 1/3 of the endangered area	See 3.02a	35%
Medium	Between 1/3 and 2/3 of the endangered area		15%
High	Between 2/3 and 90% of the endangered area		0%
Very high	More than 90% of the endangered area		0%
	Check sum =		100%

[1] Spread your judgment according to your belief / evidence
[2] This does not include the area in the EU where *M. fallax* has already established

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*
In Annexes V and VII, the impacts of *M. fallax* and the related species *M. chitwoodi* are discussed in detail including the effect of climate, soil type and cropping practices. Here we give a short summary.

M. fallax has a very wide host range (Annex I) but there are few reports which demonstrate the impact of *M. fallax* on yield or quality of plant products. The nematode species has been reported to be of economic importance on potato, black salsify and carrot in the Netherlands but limited data are available on yield losses in practice (Brommer & Molendijk, 2001; Rouwette *et al*., 2006; see also Annex VI). Similar to *M. chitwoodi*, this species does generally not cause total yield reduction but can cause quality damage. The impact appears to be more severe on course textured soils than in fine textured soils and during longer (warmer) growing seasons. The impact will also be more severe in cropping systems with a high frequency of host plants with long growing seasons.

Nobbs *et al.* (2001) have reported quality damage on potatoes in Australia but no information was given if damage had led to marketable yield losses. Much more information is available for *M. chitwoodi* for which marketable yield losses have been reported from the USA (Annex VI). Both species are very similar in their biology and we assess, therefore, a similar impact on potato for both species. On carrot, marketable yield reduction by *M. fallax* has been reported. Its impact on carrot can be reduced by postponement of sowing date and cultivar choice (Annex V; De Temmerman, 2009). Only at high population densities of *M. fallax* (>1000 Juveniles/100 g soil) gross yield of carrot may be reduced though quality damage occurs at lower densities (Molendijk & Brommer, 1998). There are no data of (marketable) yield losses for black salsify but damaged roots have been reported from for example France (Annex VI).

On host crops other than potato, carrot and black salsify, *M. fallax* seems generally to have a minor or minimal impact. On strawberry for example, no plant growth reduction has been reported (Van der Sommen et al., 2005). The number of nematodes extracted suggested that strawberry is a good host but no or few galls, depending on cultivar, caused by root-knot nematodes were observed (Van der Sommen *et al*., 2005). Anonymous (2011) suggests that *M. chitwoodi* can cause yield losses in some crops, for example sugar beet, pea and *Gladiolus* spp. but no published data on yield losses could be found in these crops. Santo & Ponti (1985) tested various pea cultivars under greenhouse conditions and the growth of only one cultivar was adversely affected.

In conclusion, the main impact of *M. fallax* is its ability to cause cosmetic damage to potatoes, carrots and black salsify which may lead to a lower marketable yield or even complete crop rejection. The amount of (quality) damage depends largely on local conditions (soil texture, climate, irrigation and crop rotation practices) but also on tolerance/resistance level of the cultivar used. We assess, therefore, a low to high impact depending on the local conditions. For those areas that are within the most endangered area (sandy soils on which potato, carrot and/or black salsify are grown in combination with many cropping days of host plants during the year) the impact will be high/major in accordance with the rating guidance (see below). Farmers may have to change their cropping practices to control the pest and fields that are (heavily) infested will not be suitable to grow carrots, black salsify and ware potatoes. Note that in general, *M. fallax* is like *M. chitwoodi* not assessed to be a high impact pest for potato in the EU. Both species have probably been present for many decades in Europe without causing major problems in potato. For carrot, the potential impact may be higher than for potato because carrots are generally grown on sandy soils. Damage on summer-grown carrots can be reduced by postponement of sowing (Molendijk & Brommer, 1998). For black salsify the impact may be higher for potato and carrot because black salsify has a long growing season which cannot be shortened to reduce damage.

Indoor crops
M. fallax has been reported from vegetable producing greenhouses in several countries (Annex VI). It is uncertain to which extent *M. fallax* poses an additional risk to greenhouse crops as compared to *Meloidogyne* species that are already fairly widespread in greenhouses such as *M. hapla, M. incognita* and *M. javanica*. There is hardly any information on the impact of *M. fallax* on greenhouse crops. On tomato, the related species *M. chitwoodi* reproduces well and reduces root weight (Santo & O'Bannon 1982; Hafez & Sundararaj 1999b). Reduction in foliar weights due to attack by *M. chitwoodi* have been described as well (Hafez & Sundararaj 1999). Effects on fruit yield have not been reported. Van der Wurf *et al.* (2010) found *M. fallax* in one organic greenhouse out of 20 organic greenhouses sampled in the Netherlands. *M. fallax* was present in low numbers compared to other *Meloidogyne* species and the authors stated that *M. incognita* is causing the largest problem in organic greenhouses growing vegetables. Wobalem & Viaene (2005) investigated the presence of plant parasitic nematodes in 10 vegetable producing greenhouses in Flanders (Belgium). Five of these greenhouses used a conventional growing system and the other 5 an organic system. *Meloidogyne* spp. were most abundant and present at 8 of the 10 sites. *M. hapla* was the most prevalent species in organic greenhouses and *M. arenaria* and *M. javanica* were more prevalent in the conventional greenhouses. *M. fallax* was found at one site, an organic greenhouse. Outdoors, *M. fallax* is especially a problem due its ability to cause cosmetic damage in potato, carrot and black salsify (e.g. Brommer & Molendijk, 2001) and because of its very wide host range including both dicotyledons and monocotyledons which makes it very difficult to control by crop rotation. In greenhouses, potato, carrot and black salsify are (usually) not grown and crop rotations schemes (if any) applied in greenhouse will also be favour other *Meloidogyne* species. Therefore, it is assessed that the impact of *M. fallax* for greenhouse crops will be similar or lower (high uncertainty) than the impact of *Meloidogyne* spp. that are already fairly widespread in greenhouses in the EU.

Uncertainties regarding crop consequences

The uncertainty is high because of lack of information on cropping practices in the different agricultural areas in the EU in combination with soil texture and climate. There is also uncertainty under which condition damage can be expected. *M. fallax* causes potentially more damage in course textured than in fine textured soils. Detailed information on the effect of soil texture is, however, lacking. It is, therefore, not possible to indicate more precisely in what kind of soils damage and economic impact can be expected.

There is also uncertainty about the potential impact of *M. fallax* in greenhouse crops. The species has been found in greenhouses in several countries but there are no data on yield losses.

Conclusions

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**.		0
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.**		10%
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.**		30%
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**.	Cropping practices will have to be adapted to avoid moderate to severe economic losses due to cosmetic damage	50%
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.		10%
		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 direct impacts on endangered/threatened species by infesting/infecting a plant listed in Annex II or IV of the EC Habitats Directive[8] 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 indirect 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 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 the pest to cause environmental harm in the environment.

Information / evidence: Provide reasoning then give judgment
Meloidogyne fallax is a polyphagous nematode with a very wide host range (Santo *et al*., 1980; O'Bannon et al. 1982; Annex I). Host plants reported are mainly confined to agricultural and horticultural fields in temperate areas. Some weeds and trees have, however, also been reported as host plants (Zoon & De Heij, 2004; Annex I). No reports are, however, available about possible environmental impact due to this pest. *M. fallax* is mainly known because of its ability to cause cosmetic damage to potato, carrot and black salsify and not because of its effect on plant growth in general. The origin of *M. fallax* is unknown. The species might even be native to Europe.

According to this information, *M. fallax* is not considered either to cause significant direct environmental impacts, or to have impacts on endangered/ threatened species.

However, nematicides are likely to be used against this pest as part of control strategies. Growers can use soil fumigants and non-fumigant nematicides. Soil fumigants have a large impact on the soil fauna since it kills many organisms present in the soil. It may also pollute the ground water quality. According to the Dutch "Centre for Agriculture and Environment" metam sodium and dazomet have a high toxicological impact on soil and ground water (http://milieumeetlat.nl). Soil fumigants are not included in the list of active substances in the EU (http://ec.europa.eu/food/plant/protection/evaluation/database_act_subs_en.htm; website accessed 14/01/2011). In some EU-countries, metam sodium may be used as an "essential use" until 2014. Dazomet had been voluntarily withdrawn and should therefore be withdrawn from sale and use as of

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[8] 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

31 December 2011 at the latest (EC decision no. 2008/934/EC). New soil fumigants might, however, be included in the future. Non-fumigant nematicides have been registered and their impact on the environment can also be substantial. Therefore, several precautions need to be taken to minimize negative side effects when applying these agents (http://www.ctb.agro.nl).

The introduction of *M. fallax* may lead to an increased use of (non-fumigant) nematicides in the endangered area. Nematicides are, however, already applied and when label instructions are followed, side effects should be low. Therefore, we assess a low environmental impact

Uncertainties regarding environmental consequences
There is some uncertainty because *M. fallax* has been found and described only less than 20 years ago and studies on direct environmental impacts are not available.

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 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).	Direct environmental impact not demonstrated	90%
Medium	One of the above would occur. *However, if effects are relatively small, the potential consequences can be rated Low instead of Medium.*	Possible side effects due to pesticides	10%
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 (3.02) with consequences to crops (3.03) and the environment (3.04) within the endangered area.

The potential environmental impact was assessed to be low. The only impact expected is due to side effects of nematicides which may be used by farmers after introduction of *M. fallax*.

The potential impact for agriculture will depend on many factors including management practices (e.g. crop rotation and irrigation), climate and soil type. It is, therefore difficult to assess the impact in the various agricultural areas in the EU. The potential impact may also increase or decrease with change of management practices. The highest impact is expected in areas with sandy soils and warm growing seasons with frequent rainfall and/or irrigation and where host plants are present during many days per year on the field (Annex V). Locally or in certain areas (very) high impacts may occur due to complete rejection of affected crops (mainly potato, carrot and black salsify).

M. fallax will spread slowly and is expected to have occupied only a small proportion (less than 10%) of the endangered area after 20 years (outside the area where it is already present). The potential impact at time horizon of 20 years was, therefore assessed medium with a high uncertainty (Fig. 8).

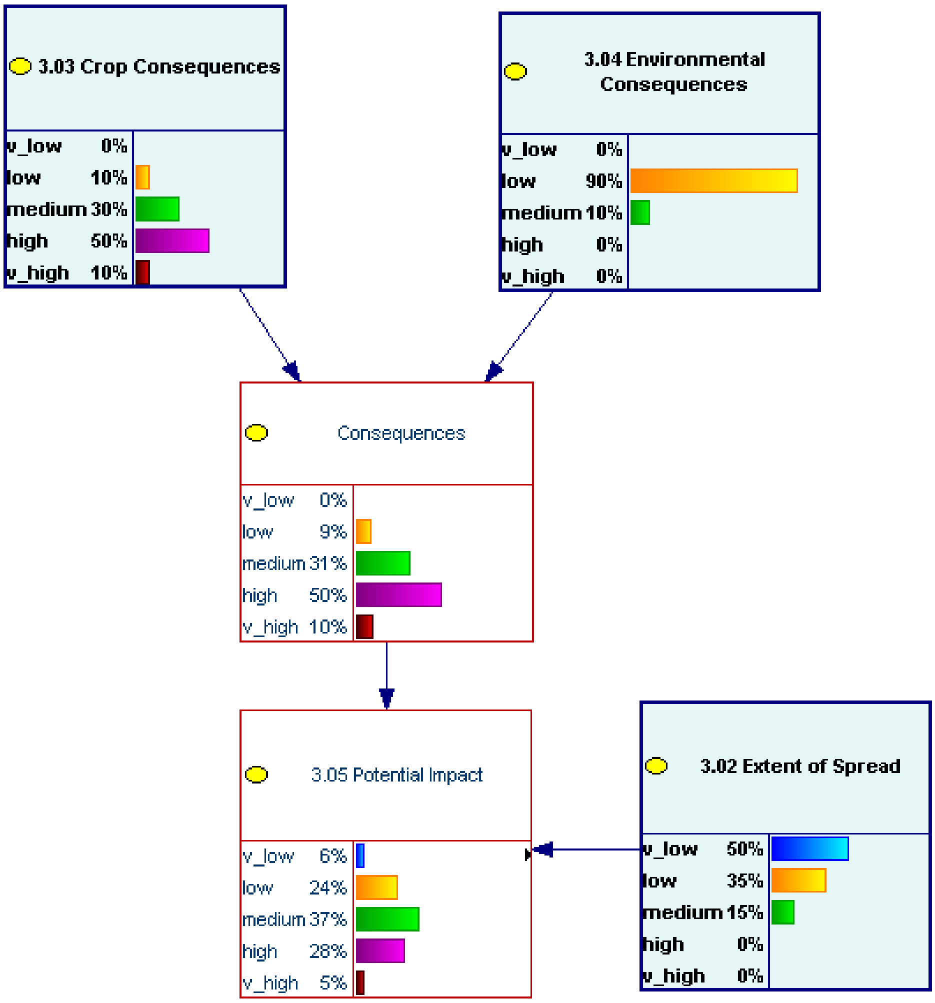

Figure 8: Graphical representation of potential impact of *Meloidogyne fallax*, combining consequences of pest introduction with the area occupied by the pest at the time horizon of 20 years.

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).

The pest risk was assessed medium with a high uncertainty at a time horizon of 20 years (Fig. 9). The likelihood of spread in the EU is high. However, the infested area is expected to increase slowly due to the low natural spread rate capacity. Locally high impacts may occur and complete crops (potato, carrot and/or black salsify) may be rejected due to cosmetic damage by the pest. In many areas, where conditions are less favourable for disease development, *M. fallax* may be able to establish but its impact is expected to be low or medium. *M. fallax* is expected to spread slowly. It has already been present in the EU at least since 1992 but probably much longer. The known distribution of *M. fallax* is still limited but *M. fallax* may have entered several areas in the EU already but either did not establish or has not been noticed because conditions are unfavourable for disease development. Thus, locally or in certain regions, high impacts may occur due to complete crop rejections but the nematode species is not expected to have a high impact on the total production of potato, carrot and black salsify in the EU. The impact of *M. fallax* for greenhouse crops is assessed similar or lower than the impact of other Meloidogyne species present in greenhouses in Europe (high uncertainty).

Note that the endangered area seems relatively small. *M. fallax* may be able to establish in a large proportion of its host area but may only cause significant damage in certain areas and under certain conditions. *M. fallax* was for example found near Hamburg in 1994 but could, thereafter not be detected any more (Annex VI). The species might already be present in a larger area at very low densities without causing significant damage to crops. Also note that this assessment does not consider control measures which growers can take to reduce the impact by the nematode species. Such measures are presently for example taken by growers in Belgium and the Netherlands, e.g. avoidance of infested fields for the production of carrots and black salsify, adaptation of sowing date, choice of cultivar, crop rotation, use of nematicides etc.

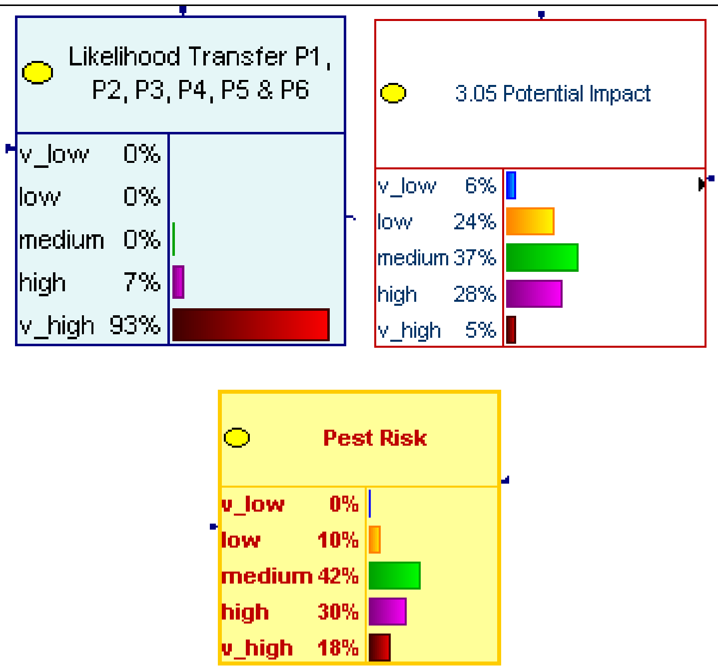

Figure 9: Graphical representation of Pest Risk of *Meloidogyne fallax* (3.06), combining overall potential for pest entry and transfer (2.08) with potential impact (3.05).

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.***

The main uncertainties are the present distribution of *M. fallax* in the EU, the conditions under which *M. fallax* can establish and the conditions under which it causes significant damage. Uncertainties are discussed in more detail in Annex IX.

Table: Summary of MAIN 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		
2.01	Pest associated	Present distribution Population decline in absence of a host crop	Survey. Experiments on survival in soil in absence of host plant
2.02	Survive post harvest		
2.03	Survive storage	Survival in soil attached to products and non-hosts	Survival experiments especially for eggs
2.04	Survives measures		
2.05	Quantity imported		
2.06	Transfer	Transfer from soil attached to non-hosts and waste products	Transfer experiments after infested soil has been stored for different time periods. Experiments to determine the transfer potential of waste water from processing industry.
3.01	Environmental suitability	Effect of temperature and soil texture	Experiments on survival at low and high temperatures in absence of hosts. Influence of soil texture on establishment.
3.02	Extent of spread	Present distribution	Survey
3.03	Crop consequences	Conditions under which economic damage occurs	Experiments to determine effect of temperature and soil texture on damage potential.
3.04	Environmental consequences		

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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