European and Mediterranean Plant Protection Organization
Organisation Européenne et Méditerranéenne pour la Protection des Plantes

Guidelines on Pest Risk Analysis
Lignes directrices pour l'analyse du risque phytosanitaire

Decision-Support Scheme for an Express Pest Risk Analysis

> The EPPO Working Party on Phytosanitary Regulations approved in 2020 that a version of EPPO Standard PM 5/5 with additional guidance should be made available via the EPPO website and that a corrigendum is published in the EPPO Bulletin to update outdated information. The present document includes modifications published in the corrigendum in 2020 as well as the additional guidance developed.

Specific scope: This standard provides a simplified scheme for the rapid production of pest risk analyses.

Specific approval and amendment: 2012-09
Additional guidance developed in 2020 and updated in 2021, 2022 and 2023.

Introduction
The EPPO Standards on Pest Risk Analysis (PRA) are intended to be used by National Plant Protection Organizations (NPPOs), in their capacity as bodies responsible for the establishment of phytosanitary regulations and the application of phytosanitary measures while respecting the requirements of the International Plant Protection Convention, ISPM 1 *Phytosanitary principles for the protection of plants and the application of phytosanitary measures in international trade* and ISPM 11 *Pest Risk Analyses for Quarantine Pests*. They are also used by the technical bodies of EPPO to formulate recommendations on phytosanitary measures to the NPPOs. In this framework EPPO has developed different Standards to be used in different circumstances. PM 5/2 was developed to provide a simplified PRA scheme to be used when an unfamiliar pest is detected in an imported consignment, in order to decide whether phytosanitary action is needed. PM 5/3 is based on ISPM no. 11 and provides detailed instructions for the following steps of PRA for quarantine pests: initiation, pest categorization, probability of introduction and spread, assessment of potential economic consequences and pest risk management.
This standard provides a simplified scheme for undertaking a rapid PRA to determine whether an organism has the characteristics of a quarantine pest, and if appropriate, to identify potential management options. Its use is particularly suitable to support recommendation of phytosanitary measures for an emerging pest. This scheme may also be used in the framework of a pathway-initiated PRA to evaluate individual pests likely to be carried by this pathway. In the case of an express PRA initiated by an outbreak, risk managers should also use the information provided to consider actions to be taken internally (such as establishing surveillance to confirm the status of the pest in the country).

An EPPO Standard on "*Generic elements for contingency plans*" (PM 9/10) describing essential elements for an emergency response for a pest outbreak or a suspected pest outbreak was adopted in 2009. In addition, a decision-support scheme for prioritizing action during outbreaks is under development to decide on measures to be applied in an outbreak area.

It is important that all steps of the Express PRA should be documented, indicating how each decision was reached and on what information it was based. The assessor may stop the assessment at any point if the evidence provided is sufficient to reach a conclusion on the pest risk.

[In addition, it should be noted that, as requested by the EPPO Working Party on Phytosanitary Regulations, a version of PM 5/5 with additional guidance for users has been prepared by the EPPO Secretariat]. The additional guidance is based on the EPPO Standard PM 5/3 *Decision-support scheme for quarantine pests*, and guidance developed in the framework of the EU funded project PRATIQUE (enhancements of pest risk analysis techniques) as well as the experience of EPPO Expert Working Groups performing Pest Risk Analysis.
The text is available both as a .pdf file and a Microsoft Word file and guidance for each question is in the form of hyperlinks.

Summary[1] of the Express Pest Risk Analysis for "*pest name*"			
PRA area: *specify the PRA area being assessed*			
Describe the endangered area: *(see question 14)*			
Main conclusions *Overall assessment of risk: (Copy your answer from section 15).* *Phytosanitary Measures: indicate whether the pest should be recommended for immediate action in the PRA area. Summarize your answer from section 16.* *Note: If the assessment shows that phytosanitary measures are not required for your country but there are indications that other EPPO countries are at higher risk, mention it.*			
Phytosanitary risk for the <u>*endangered area*</u> *(Individual ratings for likelihood of entry and establishment, and for magnitude of spread and impact are provided in the document*)	High ☐	Moderate ☐	Low ☐
Level of uncertainty of assessment *(see section 17 for the justification of the rating. Individual ratings of uncertainty of entry, establishment, spread and impact are provided in the document)*	High ☐	Moderate ☐	Low ☐
Other recommendations: • *Inform EPPO or IPPC or EU* • *Inform industry, other stakeholders* • *State whether a detailed PRA is needed to reduce level of uncertainty (if so, state which parts of the PRA should be focused on)* • *Specify if surveys are recommended to confirm the pest status* • *State what additional work/research could help making a decision*			

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[1] The summary should be elaborated once the analysis is completed

Express Pest Risk Analysis:

…………..

(*Pest name*)

Prepared by: *Name and affiliation of the assessor(s). Contact details.*
Date - *more guidance*

Stage 1. Initiation

Reason for performing the PRA: *(e.g. interceptions, outbreak)* – *more guidance*

PRA area: *specify the PRA area being assessed* – *more guidance*

Stage 2. Pest risk assessment

1. Taxonomy e.g. Genus, Species/Subspecies, Authority, Family, Order, Kingdom. – *more guidance*

Include information on strains and populations, etc. if relevant, and synonyms if appropriate.

2. Pest overview – *more guidance*

Summarize:

- *The life cycle (e.g. length of life cycle, location of different life stages, temperature thresholds, humidity requirements) and other relevant information (damage should be described in section 12). If a datasheet is available, this section should only include the basic information. If available place illustrations of the pest and the symptoms caused in Appendix 1.*

- *Host plants (for pests)/habitats (for invasive plants) (more detail should be provided in section 7)*
- *Symptoms.*
- *Detection and identification (note if a diagnostic protocol is available). State if and how the pest can be trapped.*

3. Is the pest a vector? – *more guidance*   **Yes** ☐   **No** ☐

If the pest is a vector, which organism(s) is (are) transmitted and does it (do they) occur in the PRA area?

4. Is a vector needed for pest entry or spread?   **Yes** ☐   **No** ☐

more guidance

If a vector is needed, which organism(s) serves as a vector and does it (do they) occur in the PRA area? Consider both the pest and the vector in the assessment.

5. Regulatory status of the pest – *more guidance*

Is the pest already regulated by any NPPO, or recommended for regulation by any RPPO? (Assessors can check this by reference to EPPO Global Database, RPPO and IPPC websites in addition to normal search mechanisms).

6. Distribution – *more guidance*

Continent	*Distribution (list countries, or provide a general indication, e.g. present in West Africa)*	*Provide comments on the pest status in the different countries where it occurs e.g. widespread, native, introduced….)*	*Reference*
Africa			
America			
Asia			
Europe			
Oceania			

Information on distribution may be retrieved from EPPO Global Database (https://gd.eppo.int/), CABI maps, etc.

Comments on distribution: *(e.g. if known, please comment on the area of origin, how the pest has spread and on any evidence of increasing range / frequency of introductions).*

7. Host plants /habitats* and their distribution in the PRA area – *more guidance*

If the host range is large, you may group plants (e.g. deciduous trees, or at the family level, e.g. Brassicaceae, Rosaceae), and/or focus on those occurring in the PRA area. When appropriate, the difference of susceptibility between hosts should be noted. If there are many habitats, focus on those occurring in the PRA area. Reference to FAOSTAT and EUROSTAT may help assess distribution of host plants.

Host Scientific name (common name) / *habitats**	Presence in PRA area (Yes/No)	Comments (e.g. total area, major/minor crop in the PRA area, *major/minor habitats**)	*Reference*

*Specify habitat for invasive plants, host plants for other pests.

8. Pathways for entry – *more guidance*

Which pathways are possible and how important are they for the probability of entry?

Examples of pathways are:

- *Plants for planting*
  - plants for planting (except seeds, bulbs and tubers) with or without soil attached
  - bulbs or tubers
  - seeds
- *Plant parts and plant products*
  - cut flowers or branches
  - cut trees
  - fruits or vegetables
  - grain
  - pollen
  - stored plant products
- *Wood and wood products*
  - non-squared wood
  - squared wood
  - bark
  - wood packaging material
  - chips, firewood, waste wood…
- *Natural spread*
- *Other possible pathways*
  - other packaging material
  - soil/growing medium as such
  - conveyance and machinery
  - passengers
  - hitchhiking
  - plant waste
  - manufactured plant products
  - intentional introduction (e.g. scientific purposes)

Possible pathways *(in order of importance)*	Short description explaining why it is considered as a pathway	Pathway prohibited in the PRA area? Yes/No	Pest already intercepted on the pathway? Yes/No

Rating of the likelihood of entry	*Low* ☐	*Moderate* ☐	*High* ☐
Rating of uncertainty	*Low* ☐	*Moderate* ☐	*High* ☐

9. Likelihood of establishment outdoors in the PRA area – *more guidance*

Consider in particular the presence of host plants/habitats and climatic suitability and describe the area where establishment is most likely (area of potential establishment). Reference to maps such as Köppen-Geiger climate zones, day degrees and hardiness zones may help assess the likelihood of establishment (see e.g.https://www.eppo.int/media/uploaded_images/RESOURCES/special_projects/03_rating_guidance_for_climatic_suitability.pdf)

Rating of the likelihood of establishment outdoors	*Low* ☐	*Moderate* ☐	*High* ☐
Rating of uncertainty	*Low* ☐	*Moderate* ☐	*High* ☐

10. Likelihood of establishment in protected conditions in the PRA area – *more guidance*

Consider the presence of host plants within protected cultivation (e.g. glasshouses, shade houses) and describe the area of potential establishment. For invasive plants consider if protected conditions are a suitable habitat.

Rating of the likelihood of establishment in protected conditions	*Low* ☐	*Moderate* ☐	*High* ☐
Rating of uncertainty	*Low* ☐	*Moderate* ☐	*High* ☐

11. Spread in the PRA area – *more guidance*

- *Natural spread*
- *Human assisted spread*

Briefly describe each mode of spread (e.g. natural flight of invertebrate pests, wind dispersal, carried within plants or plant products, carried with traded commodities), and indicate the rate or distance of spread.

If possible, consider how long it would take for the pest to spread widely within the area of potential establishment if no phytosanitary measures are taken. If no specific data are available, compare with similar organisms.

Rating of the magnitude of spread	*Low* ☐	*Moderate* ☐	*High* ☐
Rating of uncertainty	*Low* ☐	*Moderate* ☐	*High* ☐

12. Impact in the current area of distribution – *more guidance*

Briefly describe the economic, ecological/environmental and social impacts in the current area of distribution.
Briefly describe the existing control measures applied against the pest.

Rating of the magnitude of impact in the current area of distribution	*Low* ☐	*Moderate* ☐	*High* ☐
Rating of uncertainty	*Low* ☐	*Moderate* ☐	*High* ☐

The rating chosen should be based on the highest type of impact.

13. Potential impact in the PRA area – *more guidance*

Consider whether impacts in the area of potential establishment will be similar to that in areas already infested, taking into account availability of plant protection products, natural enemies, cultural practices, etc.in the area of potential establishment. Consider other consequences (e.g. export loss) if applicable.

Will impacts be largely the same as in the current area of distribution? Yes /No

If No

Rating of the magnitude of impact in the area of potential establishment	*Low* ☐	*Moderate* ☐	*High* ☐
Rating of uncertainty	*Low* ☐	*Moderate* ☐	*High* ☐

14. Identification of the endangered area – *more guidance*

Define the endangered area (see definition in ISPM 5): describe in which part of the area of potential establishment significant impact is expected.

15. Overall assessment of risk – *more guidance*

*Summarize the likelihood of entry, establishment, spread and possible impact without phytosanitary measure. **An overall rating should be given in the summary part which is placed at the beginning of the Express PRA.***
Then consider whether phytosanitary measures are necessary.
If the assessment shows that phytosanitary measures are not required for your country but there are indications that other EPPO countries are at higher risk, mention it.

Stage 3. Pest risk management

16. Phytosanitary measures – *more guidance*

Describe potential measures for relevant pathways and their expected effectiveness on preventing introduction (entry & establishment) and / or spread. If possible, specify prospects of eradication or containment in case of an outbreak. Indicate effectiveness and feasibility of the measures.

As described in PM 5/3 possible options for phytosanitary measures include
Options at the place of production
> Detection of the pest at the place of production by inspection or testing
> Prevention of infestation of the commodity at the place of production (treatment, resistant cultivars, growing the crop in specified conditions, harvest at certain times of the year or growth stages, production in a certification scheme)
> Establishment and maintenance of pest freedom of a crop, place of production or area

Options after harvest, at pre-clearance or during transport
> Detection of the pest in consignments by inspection or testing
> Removal of the pest from the consignment by treatment or other phytosanitary procedures (remove certain parts of the plant or plant product, handling and packing methods, specific conditions or treatments during transport)

Options that can be implemented after entry of consignments
> Detection during post-entry quarantine
> Consider whether consignments that may be infested be accepted without risk for certain end uses, limited distribution in the PRA area, or limited periods of entry, and can such limitations be applied in practice

Prohibition
Surveillance, eradication, containment

17. Uncertainty – *more guidance*

List and describe the main sources of uncertainty within the risk assessment and risk management.
State whether a detailed PRA is needed to reduce key aspects of uncertainty (if so state which parts of the PRA should be focused on). Comment on what work would be needed to address uncertainties (e.g. for distribution the need for surveys, produce epidemiological data…)

18. Remarks – *more guidance*

Add any other relevant information or recommendations. For example, when phytosanitary measures are not considered appropriate, recommendations for the development of other control strategies can be made (e.g. Integrated Pest Management, certification schemes).

Once the analysis has been completed, a summary should be prepared
(see the summary box at the beginning of the Express PRA)

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19. REFERENCES – *more guidance*
Provide references cited above (see Instructions for authors to the EPPO Bulletin.)
When referring to websites, include the web address and date accessed.

Appendix 1. Relevant illustrative pictures (for information)

Photo 1 (pest)	Photo 2 (e.g. symptoms)
Source/ copyright owner	Source/ copyright owner

Guidance document
for the drafting of a PRA according to the Express PRA scheme (EPPO Standard PM 5/5)

This document has been assembled by the EPPO Secretariat under a mandate given by the EPPO Working Party on Phytosanitary Regulations. It aims at providing more guidance to help assessors using the Express PRA scheme (EPPO Standard PM 5/5) and to improve consistency. Guidance included comes from the EPPO PRA scheme (EPPO Standard PM 5/3), CAPRA and from experience when performing detailed PRAs at EPPO level.

Express Pest Risk Analysis:
Note the pest name, the name and affiliation of the assessor(s) (with contact details), the date when the PRA was conducted as well as dates when the PRA was reviewed or amended if relevant.

Stage 1. Initiation

The aim of the initiation stage is to identify the pest which is of phytosanitary concern and should be considered for risk analysis in relation to the identified PRA area.
This version of the EPPO scheme is only for pest-initiated PRA. For pathway-initiated PRAs each pest should be evaluated separately in an independent session. The system does not allow an overall conclusion for a pathway-initiated analysis.

Reason for performing the PRA:
The PRA may be initiated for one of several reasons, the most common being:

PRA initiated by the identification of a pest:
- an established infestation or an incursion of a pest has been discovered in the PRA area;
- a pest has been detected in an imported consignment;
- a pest has been identified as a risk by scientific research;
- a pest has invaded a new area, other than the PRA area;
- a pest is reported to be more damaging in a new area than its area of origin;
- a pest is observed to be detected more frequently in international trade;
- a request is made for the intentional import of a pest;
- a previous PRA is being re-evaluated;
- an organism has been identified as a vector for other pests.

In some cases, a PRA may be initiated as above for an organism which is not known to be a pest, but whose pest potential in the PRA area needs to be evaluated.

PRA initiated by the identification of a pathway:
- international trade is initiated in a commodity not previously imported into the country, or a commodity from a new area or new country of origin;
- new plant species are imported for breeding or research purposes;
- a pathway other than a commodity import is identified (natural spread, packing material, mail, garbage, passenger baggage, etc).
- a Systems Approach or other management change is proposed for an international trade

In such cases, a list of pests likely to be associated with the pathway should be generated and preferably prioritized, based on pest distribution, pest status and expert judgment.

PRA initiated by the review or revision of a policy:
- phytosanitary regulations are being revised, e.g. following a national decision or new information on treatments or processes;
- a proposal made by another country or by an international organization (RPPO, FAO) is assessed;
- a dispute arises on phytosanitary measures.

Remark: The pest, or a very similar pest, may have been subjected to the PRA process before, nationally or internationally. This may partly or entirely replace the need for a new PRA.

PRA area:
The PRA area being assessed should be specified and precisely described. The PRA area can be a complete country, several countries, or part(s) of one or several countries.
These areas do not need to be contiguous. PRA performed in the EPPO framework are performed for a PRA area covering all EPPO member countries.

Stage 2. Pest risk assessment

Essential information used in the assessment should be mentioned in the PRA or references given. In general, such information is first referred to in sections 1 to 7.

It is suggested to begin by checking whether a PRA already exists on the pest e.g. by searching on the EPPO platform on PRAs.

It should be noted that some EPPO countries have adopted a similar scheme without ratings. The Express PRA scheme (EPPO Standard PM 5/5) includes a three-level scale rating. Based on practical experience when performing detailed PRAs at EPPO level and following the recommendation from the EPPO PRA core members, endorsed by the Working Party on Phytosanitary Regulations in 2016, the Express PRA scheme is now used at EPPO level with ratings using a 5-level scale. Rating of uncertainty is based on a three-level scale.

1. Taxonomy

The following information could be indicated: Domain, Kingdom, Phylum, Class, Order, Family, Genus, Species/Subspecies, Authority.

Additional information on subfamilies, sections, strains, populations, etc. may be indicated if relevant, and synonyms if appropriate, as well as common names often used in the literature.

The taxonomic unit for the pest is generally the species. The use of a higher or lower taxonomic level should be supported by a scientifically sound rationale. In the case of levels below the species, this should include evidence demonstrating that factors such as differences in virulence, host range or vector relationships are significant enough to affect phytosanitary status. Implications of listing below (sub)species level are detailed in section 16 *Phytosanitary measures*.

Any uncertainties on the taxonomy of the pest should be noted (e.g. whether some information indicate there may be subspecies or cryptic species).

Suggested subheadings:

>Taxonomic classification.
>Synonyms.
>Common names.

>Return to EPPO Standard PM 5/5

2. Pest overview

This section is aimed at summarizing:

- The morphology
- The life cycle (e.g. length of life cycle, location of different life stages, temperature thresholds, humidity requirements; other biotic or abiotic factors that are important for the life cycle; capacity for dispersal).
- Main host plants (for pests)/habitats (for invasive plants) (more detail should be provided in section 7).
- Symptoms and nature of the damage (but impact should be described in section 12).
- Detection and identification (note if a diagnostic protocol is available). State if and how the pest can be trapped.
- Other relevant information: It is useful that all biological or ecological information that is used later in the PRA is at least summarized or referred to in this section.

If an up to date EPPO datasheet or another document summarizing this information (e.g. CABI datasheet) is already available, this section should only include the basic information and refer to this document. If available, place illustrations of the pest and the symptoms caused in Appendix 1 (see EPPO Standard PM 5/5).

If the causal agent of particular symptoms has not yet been fully identified, it should have been shown to produce consistent symptoms and to be transmissible.

Suggested subheadings:

2.1 Morphology

2.2 Life cycle

2.3 Temperature (or climatic) requirements

2.4 Dispersal capacity

2.5 Nature of the damage

2.6 Detection and identification methods

>Return to EPPO Standard PM 5/5

3. Is the pest a vector?

If the pest is a vector, it should be indicated, as well as which organism(s) is (are) transmitted and whether it does (or they do) occur in the PRA area.

If the PRA relates to both a pest and its vector, mention if the vector is known to transmit other organisms.

>Return to EPPO Standard PM 5/5

4. Is a vector needed for pest entry or spread?

If a vector is needed, organism(s) which serves as a vector should be indicated as well as whether it (they) does (do) occur in the PRA area. Both the pest and the vector will be considered in the assessment.

If a vector is the only natural means by which the pest can spread and when it is absent from the PRA area, a separate PRA to determine the risk of introduction of the vector may be needed; or the vector can be assessed in the same PRA, if this is possible (e.g. vector of only the pest considered, similar pathways, distribution, hosts etc.).

>Return to EPPO Standard PM 5/5

5. Regulatory status of the pest

In this section, it should be indicated whether the pest is already regulated by any NPPO or recommended for regulation by any RPPO.

Suggested sources:
Assessors can check this by reference to EPPO Global Database, RPPOs and IPPC websites in addition to usual search mechanisms. In addition, it may be useful to consult the WTO/SPS website.
Remark: List of quarantine pests in EPPO Global Database are updated a) for EPPO countries, when the EPPO Secretariat is informed of a revision; b) for non-EPPO countries, on a case-by-case basis and not on a regular basis. As a consequence, these lists are not always up-to-date. Up-to-date lists are normally available on the IPPC website.

6. Distribution

In this section, countries (or regions e.g. West Africa) where the pests occur (see below) should be listed, with additional information on the pest status in these countries (e.g. if known, please comment on the area where the pest is endemic, indicate whether it is widespread, native or introduced, how the pest has spread and on any evidence of increasing range / frequency of introductions etc.). Appropriate references should be included.

Distribution maps can be added.

It may be useful to state uncertainties as well as any doubtful or invalid records.

Definitions and remarks:

A pest record is documented evidence that indicates the presence or absence of a specific pest at a particular location and certain time, within an area, usually a country, under described circumstances. Pest records are used in conjunction with other information for the determination of the status of the given pest in the area (ISPM 8).

A pest is present if records indicate that it is indigenous or introduced (ISPM 8). This includes organisms which have been introduced intentionally and which are not subject to containment (notably cultivated plants). Organisms present for scientific purposes under adequate confinement (e.g. in botanic gardens) are not included.

If a pest is already present in the PRA area, it should be assessed whether it is already widely distributed or not.

- A quarantine pest may be *'present but not widely distributed*', this means that the pest has not reached the limits of its potential area of distribution either in the field or in protected conditions; it is not limited to its present distribution by climatic conditions or host-plant distribution. There should be evidence that, without phytosanitary measures, the pest would be capable of additional spread. If the pest is present but not widely distributed in the PRA area, it may already be under official control, with the aim of eradication or containment. If it is not already under official control and if the conclusion of this PRA is that it should be regulated as a quarantine pest, then the pest should also be placed under official control.
- If the pest is already '*present and widely distributed*' in the PRA area, it does not fulfil the minimum requirements for being regulated as a quarantine pest in this area (see definition of '*quarantine pest*' in ISPM 5).

Pest status is considered transient when a pest is present, but establishment is not expected to occur based on technical evaluation (ISPM 8).

Suggested table:

Based on practical experience when performing EPPO PRAs, it is suggested to use the slighty revised table below (in Table 1, continents are classified as in EPPO Global Database).

Table 1. Distribution of the pest

Continent	*Distribution (list countries, or provide a general indication, e.g. present in West Africa)*	*Comments (If relevant, provide comments on the pest status in the different countries where it occurs e.g. widespread, native, introduced….)*	*Reference*
Africa			
North America			
Central America and the Caribbean			

Continent	Distribution (list countries, or provide a general indication, e.g. present in West Africa)	Comments (If relevant, provide comments on the pest status in the different countries where it occurs e.g. widespread, native, introduced….)	Reference
South America			15
Asia			
Europe			
Oceania			

Suggested sources:

Information on distribution may be retrieved from EPPO Global Database, CABI maps, the EPPO platform on PRAs, etc. Search for recent literature may allow to find new records that update the information given in EPPO Global Database or CABI maps.

>Return to EPPO Standard PM 5/5

7. Host plants /habitats and their distribution in the PRA area

It may be useful to first provide a short summary of the host range (e.g. are they all from one family, many families, woody plants versus herbaceous, etc.), before detailing and describing host plants and/or habitats in a table. If the host range is large, plants may be grouped (e.g. deciduous trees, or at the family level, e.g. Brassicaceae, Rosaceae), and/or focus on those occurring in the PRA area. When appropriate, the difference of susceptibility between hosts should be noted. If there are many habitats, focus on those occurring in the PRA area. The distribution of host plants in the PRA area can be considered in section 9.

The taxonomic level at which hosts are considered should normally be the species. The use of higher or lower taxonomic levels should be scientifically justified. The pest should be able to complete its life cycle or multiply on the hosts considered. Some other plant species might also prove to be suitable hosts in the absence of the known host species. If the PRA is conducted on a pest which is indirectly injurious to plants through effects on other organisms, these organisms should also be present in the PRA area. It may be useful to consider associations with key-stone or dominant species of plants. For intentionally introduced plants, indicate the unintended habitats.

It can be justified to list separately (or at the end of the table) the hosts that have been recorded only in experimental conditions.

Note any uncertainties about hosts. For example: if there is one herbaceous host amongst only woody plants; or if it is unclear if a host is a true host, or only adults have been recorded feeding on a plant.

It is preferable to list separately doubtful host species and explain e.g. why these host species were considered erroneous.

Suggested table:
When performing a detailed PRA, the EPPO secretariat found very convenient to use the following tables (Table 2 for invasive plants and Table 3 for other pests).

Table 2. Habitats and their distribution in the PRA area (for invasive plants)

Habitats	Presence in PRA area (Yes/No/Not known).	Comments	*Reference for habitat*
Habitat 1	Yes/No/Not known. Consider mentioning elements relating to the habitat in the PRA area that may be important for the rest of the assessment:	In terms of presence (e.g. total area, major/minor habitats in the PRA area) Whether the habitat has specific conservation status *References for these comments can be added there.*	*Reference for the invasive plant being present in this habitat*
Habitat 2			
…			

Table 3. Host plants and their distribution in the PRA area (for pests other than invasive plants)

Host Scientific name (common name)	Presence in PRA area (Yes/No/Not known).	Comments	*Reference for host status*
Host 1	Yes/No/Not known. Consider mentioning elements relating to the host in the PRA area that may be important for the rest of the assessment:	In terms of presence/cultivation (e.g. total area, major/minor crop in the PRA area) In terms of biology (e.g. '*preferred host*' vs. '*incidental*', '*alternate*' if the pest needs distinct hosts to complete its life cycle,	

Host Scientific name (common name)	Presence in PRA area (Yes/No/Not known).	Comments	*Reference for host status*
	- whether the plant is cultivated or present in the wild. Mention '*as ornamental*' if the host is only known to be present as ornamental - whether the plant is mostly/only used indoors etc. *References for the use as ornamentals can be added there.*	'*wild/weed*', '*indicator*', '*artificial*' when only in inoculation studies or under laboratory conditions (no records of infection in the field or the environment), indicate when the plant only host a specific development stage of the pest) This column can also contain any element important for the PRA, e.g. where the host range of a pest vary between countries, in which country it has been reported as a host. *References for these comments can be added there.*	*Reference for the host status*
Host 2			
…			

Suggested subheadings (to put after the table):
        Experimental hosts
        Uncertainties
        Doubtful hosts

Suggested sources:
Reference to FAOSTAT, EUROSTAT and other databases (e.g. IUCN red list, EUFORGEN, CAPRA maps) may help assess the presence of host plants in the PRA area.

Habitats may be considered according to the EUNIS habitat types or CORINE land cover classification.

>Return to EPPO Standard PM 5/5

8. Pathways for entry

Depending on the availability of information, and the time to perform the PRA, there may be more or less information given on the pathways. Minimal information should consist in the listing of possible pathways, a short description why it is considered as a pathway, information whether this pathway is prohibited in the PRA area and information on interceptions (e.g. EUROPHYT, EPPO Reporting Service). This should allow to conclude how important are these pathways important for the probability of entry.

It is common practice when performing PRAs to group pathways of similar commodities (e.g. seeds of host plants) except if there is a very good reason to do otherwise (e.g. clear difference in host status of different genus or species).

Definitions and remarks

Pathway is defined in the Glossary as '*any means that allows the entry or spread of a pest*' [FAO, 1990; revised FAO, 1995]. Pathways can be identified principally in relation to the geographical distribution, host range of the pest and the type of commodity that may carry life stages of the pest. Consignments of plants and plant products moving in international trade are the principal pathways of concern and existing patterns of such trade will, to a substantial extent, determine which pathways are relevant. Other pathways such as other types of commodities, packing materials, persons, baggage, mail, conveyances and the exchange of scientific material should be considered where appropriate. Entry by natural means should also be assessed, as natural spread is likely to reduce the effectiveness of phytosanitary measures. A list of possible commodities/pathways is provided in Figure 1 with elements of definition in Table 5.

Closed pathways may also be considered, as the pests identified may support existing phytosanitary measures. Furthermore, some pathways may be closed by phytosanitary measures which might be withdrawn at a future date. In such cases, the risk assessment may need to be continued. Data on detections in imported consignments may indicate the ability of a pest to be associated with a pathway.

If the PRA is being conducted on a pest that is intentionally imported, e.g. a plant for planting or a biological control agent, and this is the only pathway of entry, an assessment of its entry potential is not required. However, it is still important to record the volume, frequency and distribution of imports. If other pathways of entry also exist, these should be assessed following standard procedures. Spread from the intended habitat to the unintended habitat which is an important judgement for intentionally imported plants is covered by section 11. But the transfer into the habitat should be considered in the pathway section.

Relevant pathways are those with which the pest has a possibility of being associated (in a suitable life stage), on which it has the possibility of survival, and from which it has the possibility of transfer to a suitable host. Make a note of any obvious pathways that are impossible and record the reasons (For the sake of completeness, it may be useful to check the commodity tree available in Figure 1).

Select from the relevant pathways, using expert judgement, those which appear most important. If these pathways involve different origins and end uses, it is sufficient to consider only the realistic worst-case pathways. The information on pathways may be gathered for each relevant pathway in turn, as appropriate, starting with the most important pathway.

Additional considerations are given within the suggested table below.

Suggested subheadings:

> 8.1 Pathways investigated in detail.
>
> > *Suggested tables may be used to investigate pathways more in detail*
>
> 8.2 Unlikely pathways: very low likelihood of entry
> > *Pathways with a very low likelihood of entry should be listed here. It is useful to provide a rationale for the very low likelihood.*
> 8.3 Overall rating of the likelihood of entry

Suggested categories of pathways with elements of definitions (where necessary):

Examples of pathways are given in EPPO Standard PM 5/5. However, after a review of all risk management options recommended in individual EPPO PRAs and PM 8 Commodity-specific phytosanitary measures Standards, a more comprehensive commodity tree of pathways has been developed by the EPPO Secretariat and is given in Figure 1. Elements of definition (where necessary) are suggested in Table 5. This commodity tree of pathways is adapted from an excel file compiling all risk management measures recommended by EPPO in EPPO PRA documents. This excel file also provides examples of pathways by pests (the excel

file is available for NPPOs of EPPO member countries or other authorized organisations at the following link: EPPO compilation of phytosanitary measures recommended in PRAs).

- *Plants for planting*
  - plants with roots
    - plants in growing medium
    - bare-rooted
  - cuttings/bud
    - rooted
    - unrooted
  - seeds
  - Bulbs, corms, tubers, rhizomes
  - Tissue cultures
  - Pollen
- *Fruits*
  - fruit (except nuts)
  - nuts
    - conifer nuts and cones
    - fresh nuts
- *Underground fresh plant parts*
  - with green parts
  - without green parts
- *Above-ground fresh plant parts*
  - cut flowers
  - cut branches
    - Christmas tree
    - cut green part of palms
    - other cut branches
  - cut foliage
  - leaf vegetables (incl. herbs)
  - others
- *Stored products/dried plant parts*
  - grain
  - others
- *Soil/growing medium*

- *Wood*
  - round wood (with or without bark)
  - sawn wood (with or without bark)
  - wood chips, processing wood residues, hogwood,
- *Bark*
- *Wood packaging material*
- *Furniture and articles entirely or partly made of raw wood or bark*
- *Natural spread*
- *Travellers*
  - *luggage*
  - *clothes and footwear*
  - *leisure equipment*
  - *others*
- *Animals*
  - *livestock*
  - *pets and ornamental use*
  - *others*
- *Manufactured/processed commodities (other than wood)*
  - *non-organic*
  - *made from plant material (other than wood)*
- *Packaging (other than WPM)*
- *Conveyances, vehicles and equipment*
  - *containers*
  - *vehicles driven across borders*
  - *used machinery*
  - *used vehicles*
  - *used equipment/tools*
  - *others*
- *International mail items*
- *Hitchhiking*

Figure 1. Commodity tree presenting possible categories of pathways to be used in the PRA

Suggested tables:

A first table format to assess pathways for entry is given in EPPO Standard PM 5/5. When performing detailed PRAs, the EPPO secretariat found very convenient to use the following table format. Additional guidance is included in the table and coming mainly from EPPO Standard PM 5/3.

Table 4. Table format to assess pathways for entry when performing a detailed PRA (content is based on EPPO Standard PM 5/3 with additions based on experience when performing EPPO PRAs).

Pathway	Pathway 1
Coverage	The pathway should be clearly defined.
Pathway prohibited in the PRA area?	Yes/No. Give references.
Pathway subject to phytosanitary measures, including inspection at import?	Pre-shipment phytosanitary measures already in place that may be efficient against the pest should also be considered. Note that practices may change over time.
Pest already intercepted?	To show if the pest has already been observed to move on the pathway. This does not necessarily relate to the PRA area, but may be wider. Give references to any known interception reports of the pest. e.g. national databases, europhyt, EPPO Reporting Service, publications from outside the EPO region. **Links:** Europhyt, EPPO platform on PRAs
Most likely stages that may be associated	Consider association of the life stages with the pathway.
Plants covered	List species considered in this pathway (possibly cross-referring to section 7) and how the plant species impact the association with the pest.

Pathway	Pathway 1
Important factors for association with the pathway	Association with the pathway at the point(s) of origin takes into account: - the biology of the pest (e.g. life stage, seasonal timing. For plants: access of seeds or other propagules to commodities, containers or conveyances) - the current management conditions (consider the concentration of the pest on the pathway in the country of origin and the influence of practices, such as plant protection product application (including herbicides for plants), use of specific cultivars, removal of substandard produce, kiln-drying of wood, cultural methods, sorting and cleaning of commodities. Pre-shipment phytosanitary measures already in place that may be efficient against the pest should be considered. Note that practices may change over time). The likelihood of detecting the organism during inspection or testing at the point(s) of origin will depend on a number of factors including: o ease of detection of the life stages that are likely to be present. Some stages are more readily detected than others, for example insect adults may be more obvious than eggs, growing plants may be more obvious than seeds or bulbs etc o location of the organism on the commodity - surface feeders may be more readily detected than internal feeders; o symptom expression - many diseases may be latent for long periods, at certain times of the year, or may be without symptoms in some hosts or cultivars and virulent in others; o distinctiveness of symptoms - the symptoms might resemble those of other organisms or sources of damage such as mechanical or cold injury; o the intensity of the sampling and inspection regimes; o accessibility of the consignment for inspection; o distinguishing the organism from similar organisms
Survival during transport and storage	Consideration should be given to: o speed and conditions of transport (including treatments performed during transport); o vulnerability of the life-stages likely to be transported (for plants viability of seeds or other propagules, for all pests tolerance of low or elevated temperatures); o whether the life cycle is of sufficient duration to extend beyond time in transit. Detection data can be used to indicate the ability of a pest to survive in transit. Mention whether the pest could multiply/increase during transport or storage.
Trade	Volume and frequency of movement along the pathway should be estimated on the basis of quantities of the traded commodity, packing materials, persons, baggage, mail and conveyances, on a yearly basis. Any limitations on the availability of data can be specified **Links:** Eurostat, FAO Stat
Transfer to a host	Transfer is the dispersal mechanism that allows movement from a pathway to a suitable host (ISPM 11). The probability of transfer from the pathway to a suitable host or habitat should be considered. Factors to consider include: o innate dispersal mechanisms or the need for vectors o the likelihood that the pest might find suitable hosts and habitats, considering the distribution of the commodity throughout the PRA area. The more scattered the destinations, the more likely it is that the pest might find suitable hosts and habitats. o the likelihood that the pest will arrive during the months of the year most appropriate for establishment. Introduction at many different times of the year will increase the probability that entry of the pest will occur at a life stage of the organism or the host suitable for establishment. o the intended use of the commodity (e.g. processing, consumption, planting, disposal of waste, by-products) and how it can affect the transfer of the pest to a suitable host or habitat Some uses are associated with much higher probability of introduction (e.g. planting) than others (e.g. processing). Consider whether the intended use of the commodity would destroy the pest or whether the processing, planting or disposal might be done in the vicinity of suitable hosts or habitats.
Likelihood of entry and uncertainty (ratings: e.g. very low, low, moderate, high, very high)	When performing detailed PRAs, the EPPO Secretariat found very convenient to rate individually each pathway (here 'Pathway 1'). As recommended by the Panel on Phytosanitary Measures in 2021-10, when limited trade data is available or when the pest has a limited distribution in a country making it difficult to evaluate the amount of trade from this area, it is recommended to rate the likelihood of entry mainly based on the information on association, survival during transport and transfer. The lack of information on trade should be flagged and be reflected in the uncertainty.

Pathway	Pathway 1
	As performed in EPPO PRAs, the likelihood of entry can be expressed on a five-level scale (very low, low, moderate, high, very high) with an uncertainty on a three-level scale (low, moderate, high). Reasons for the uncertainty rate (when moderate or high) can be recorded.
	If this section considered a broad pathway, but the information above indicates a different likelihood and uncertainty for different commodities (including types of commodity and species) or origins, several sub-pathways can be rated here.
	Users can refer to PRAs of similar pests which may guide for ratings (e.g. using the EPPO platform on PRAs)

Rating of the overall likelihood of entry and uncertainty

The Express PRA scheme (EPPO Standard PM 5/5) includes a three-level rating scale for the likelihood of entry. Based on practical experience when performing detailed PRAs at EPPO level and following the recommendation of the EPPO PRA core members, endorsed by the Working Party on Phytosanitary Regulations in 2016, the Express PRA scheme is now used at EPPO level with ratings using a 5-level scale. Users can refer to PRAs of similar pests which may guide for ratings (e.g. using the EPPO platform on PRAs). Rating of uncertainty is based on a three-level scale. Guidance on the rating of uncertainties is available as a remark in section 17 of this guidance.

Overall rating of the likelihood of entry combining the assessments from the individual pathways considered:

Rating of the overall likelihood of entry	*Very low* ☐	*Low* ☐	*Moderate* ☐	*High* ☐	*Very high* ☐
Rating of uncertainty			*Low* ☐	*Moderate* ☐	*High* ☐

Reasons for the uncertainty rating, especially when moderate or high, can be recorded.

>Return to EPPO Standard PM 5/5

Table 5. Suggested categories of pathways with elements of definitions (where necessary), as used by the EPPO Secretariat.

Pathway 1st level	Elements of definition	Pathway 2nd level	Elements of definition	Pathway 3rd level	Elements of definition
Wood		**Round wood**	-Incl. firewood	**Round wood with bark**	
			-ISPM 5. Wood not sawn longitudinally, carrying its natural rounded surface, with or without bark		
			-may include branches, stumps and roots		
				Round wood without bark	
		Sawn wood	-ISPM 5. Wood sawn longitudinally, with or without its natural rounded surface with or without bark	**Sawn wood with bark**	
				Sawn wood without bark	
		Wood chips, processing wood residues, hogwood	EPPO study:		
			Wood chips. wood with or without bark in the form of pieces with a definable particle size produced by mechanical treatment with sharp tools		
			Processing wood residues. parts of wood and bark that are left after the process of transforming round wood into sawn wood and further transformation of sawn wood		
			Hogwood. wood with or without bark in the form of pieces of varying particle size and shape, produced by crushing with blunt tools such as rollers, hammers or flails		
Bark	On its own, i.e. isolated bark as a commodity				
	Note: deleted from ISPM 5 (2018). PM 8/2(3): "bark separated from wood (ISPM5). Bark may contain pieces of wood with it."				
Wood packaging material	ISPM 5. Wood or wood products (excluding paper products) used in supporting, protecting or carrying a commodity (includes dunnage)				
Furniture and articles entirely or partly made of raw wood or bark	With or without bark				
	ISPM 5. Raw wood = Wood which has not undergone processing or treatment 2002]				
	Includes any objects made of wood and bark, incl. construction kits and decorative items, also boxes/crates (if not covered under wood packaging material)				

Pathway 1st level	Elements of definition	Pathway 2nd level	Elements of definition	Pathway 3rd level	Elements of definition
Plants for planting	Note: all types of plants for planting are covered in the subcategories. The category 'other' is not needed -ISPM 5. Plants intended to remain planted, to be planted or replanted - note that pollen intended for pollination is included in this category.	**Plants with roots**	-Except cuttings	**Plants in growing medium**	In pots, bags etc.
			-With or without growing medium- also covers Christmas trees with roots and soil (others under 'cut green plant parts')		Incl. bonsais
			- also covers herbs with roots and growing medium		
				Bare-rooted plants	
		Cuttings/budwood	Includes also scion wood	**Rooted cuttings**	
				Unrooted cuttings	
		Seeds			
		Bulbs, corms, tubers, rhizomes	Incl. seed potatoes (as tubers, incl. minitubers)		
			ISPM 33: Minituber - A tuber produced from potato micropropagative material in pest-free growing medium in a facility under specified protected conditions		
			ISPM 33: Seed potatoes - Tubers (including minitubers) and potato micropropagative material of cultivated tuber-forming Solanum spp. for planting.		
			Note: potato propagative material is covered under 'tissue culture'		
		Tissue cultures	Includes plants in vitro		
			For potato, incl. micropropagative material, microplants		
			ISPM 33: potato micropropagative material - Plants in vitro of tuber-forming Solanum spp.		
		Pollen	Covers only pollen intended to be used for pollination. Other types of pollens are covered under Above-ground fresh plant parts or Stored products		
Fruit	- ISPM 5. <u>Fresh</u> parts of plants intended for consumption or processing and not for planting - the definition for 'fruit and vegetables' in ISPM5 covers three categories in this tree: 'fruit' (1st level), 'leaf vegetables (incl. herbs)' (2nd level) and 'underground plant parts' (1st level) -In the botanical sense, i.e. incl. fruit vegetables - includes fresh nuts	**Fruit (except nuts)**			

| Pathway 1st level	Elements of definition	Pathway 2nd level	Elements of definition	Pathway 3rd level	Elements of definition
		Nuts	- only if fresh	**Conifer nuts and cones**	
			- With or without green shells		
				Fresh nuts	
Underground fresh plant parts	- i.e. bulbs, corms, tubers, rhizomes and roots, including ware potatoes	**With green parts**	Accompanied with green parts (e.g. carrots, radish)		
	- for consumption or processing, not for planting				
	- Possibly accompanied by green parts, by soil, by plant debris				
	- the definition for 'fruits and vegetables' in ISPM5 covers three categories in this tree: 'fruit' (1st level), 'leaf vegetables (incl. herbs)' (2nd level) and 'underground plant parts' (1st level)				
		Without green parts			
Above-ground fresh plant parts	- living fresh/green parts, above-ground	**Cut flowers**			
	- not fruit				
	- not underground parts of plants				
	- not intended for planting				
	- the definition for 'fruits and vegetables' in ISPM5 covers three categories in this tree: 'fruit' (1st level), 'leaf vegetables (incl. herbs)' (2nd level) and 'underground plant parts' (1st level)				
		Cut branches	-Originating from palm trees and woody plants (unlike cut foliage)	**Christmas trees**	
			-Incl. Christmas trees and other cut branches		
			-Incl. coppiced stems		
			-For Christmas trees, only without roots or soil		
			- intended for decorative purposes (branches as wood are covered under 'round wood')		
			- dried cut branches for decorative purposes are covered under 'stored products/dried plant parts'		
				Cut green parts of palms	Incl. leaves/fronds, stalks, trunks
				Other cut branches	also covers foliage used for ornamental purposes

Pathway 1st level	Elements of definition	Pathway 2nd level	Elements of definition	Pathway 3rd level	Elements of definition
					Also covers cut branches with fruit
		Cut foliage	Originating from non-woody plants (and not cut flowers, not leaf vegetables)		
			e.g. 'living parts of Solanaceae' (if not fruit and not pfp)		
		Leaf vegetables (incl. herbs)	Includes herbs (when not accompanied with growing medium)		
			- the definition for 'fruit and vegetables' in ISPM5 covers three categories in this tree: 'fruit' (1st level), 'leaf vegetables (incl. herbs)' (2nd level) and 'underground plant parts' (1st level)		
		Others	e.g. any fresh part of plant that is not covered elsewhere above [e.g. grass?]		
Stored products/dried plant parts	ISPM 5 - Unmanufactured plant product intended for consumption or processing, stored in a dried form (this includes in particular grain and dried fruits and vegetables)	Grain	-ISPM 5 - Seeds (in the botanical sense) for processing or consumption, but not for planting		
			-Incl. for human or animal consumption (as bird seeds, cattle fodder etc.)		
		Others	Except grain, e.g. hay and straw, sugar cane, dried cut branches		
Soil/growing medium	- In most cases, intended to cover growing media with a component of organic material				
	- covers soil/growing medium as a commodity. - Soil/growing medium associated with other pathways is covered under those (e.g. plants for planting, machinery, footwear etc.)				
Natural spread	Pest moving by itself or aided by e.g. wind, water, wild animals				
Travellers	- Movement of the pest by/with people (intentionally or not) across borders	Luggage	e.g. person bringing back contaminated plants or plant parts in their luggage, or bringing back the pest intentionally		
	- Covers passengers, and others travelling internationally, e.g. plane crews, truck drivers, researchers, 'plant hunters' etc.				
		Clothes and footwear	Typically plant seeds adhering to clothes, shoes and threads, or pests associated with soil remaining on shoes		
		Leisure equipment	Typically for plants, associated with tents, fishing or canoeing gear etc.		
		Others	Incl. equipment such as tools		

Pathway 1st level	Elements of definition	Pathway 2nd level	Elements of definition	Pathway 3rd level	Elements of definition
Animals	Animal pest (e.g. Pomaceae) imported intentionally, OR pest contaminating (unintentional) other animals	**Livestock**	Contamination of livestock (both carried or moving across borders)		
		Pets and ornamental use	Pest imported intentionally or contamination such animals		
			Incl. aquarium fish, Pomaceae used for aquaria etc.		
		Others			
Manufactured/processed commodities (other than wood)		**Non-organic**	e.g. stone, steel		
		Made from plant material (other than wood)	e.g.		
			- articles (bags, seats) manufactured from cut branches (leaves, stalks, trunks) of *P. dactylifera*		
			- processed commodities (e.g. jam, textile, etc.)		
Packaging (other than WPM)					
Conveyances, vehicles and equipment	For vehicles, covers both those 'driven' across borders [not traded as such] and those imported used, as commodities	**Containers**			
		Vehicles driven across borders	e.g. planes, ship, cars, trucks, agricultural or forestry machinery, etc.		
			Independently from any commodity transported		
		Used machinery	Traded as such		
		Used vehicles	Traded as such		
		Used equipment/tools	Traded as such		
		Others			
International mail items	- covers postal orders and courier delivery services				
	- i.e. orders/imports outside main international trade of commodities (not travellers bringing the pest back across borders). Covers e.g. collectors (incl. e.g. amateur entomologists, gardeners), researchers, general public				
Hitchhiking	- defined as 'contaminating pest' in ISPM5				
	- measures listed under this category only if hitchhiking is not related to other categories above (e.g. hitchhiking on fruit will be covered under 'fruit')				

9. Likelihood of establishment outdoors in the PRA area

Establishment is defined as the '*perpetuation, for the foreseeable future, of a pest within an area after entry*' [FAO, 1990; revised ISPM 2, 1995; IPPC, 1997; formerly "established"].

In this section, the assessor should consider in particular the presence of host plants/habitats and climatic suitability and describe the area where establishment is most likely (area of potential establishment). Reference to maps such as Köppen-Geiger climate zones, day degrees and hardiness zones may help assess the likelihood of establishment (see e.g. rating guidance for climatic suitability).

Suggested sources: Tools based on climate classification may be used such as the Köppen-Geiger layered PDF tool (MacLeod & Korycinska, 2019) which has been developed to show on a map the areas corresponding to selected Köppen-Geiger classes (when using this .pdf, click on ▧ to select the 'layers'); or the EFSA ScanClim tool. Warning: using Köpen-Geiger climate zones alone is not sufficient for a detailed assessment of establishment.

Modelling the potential distribution of the pest in the PRA area (e.g. CLIMEX or R software) may provide useful information (see below).

For plants which are intentionally imported and assessed as potential pests, the assessment of the probability of establishment concerns the unintended habitat.

The assessment aims at:
1- Identifying the area of potential establishment
2- Assessing the suitability of the area of potential establishment as defined in relation to relevant factors, which leads to a rating of the likelihood of establishment in the area of potential establishment and associated uncertainty.

Seven factors (including the *Protected cultivation*, section 10) may influence the limits to the area of potential establishment and the suitability for establishment within this area. Host plants (and suitable habitats) and climate are always influencing the potential of establishment and will therefore always be taken into account. For the other factors listed, there is often little or no information available for use by risk assessors and so they cannot always be evaluated. When reviewing factors, it is useful to assess if:
►The factor is likely to influence the limits of the area of potential establishment
►The factor is likely to influence the suitability of the area of potential establishment
The considerations related to the potential area of establishment and its suitability do not need to be separated in the text.

If a factor (e.g. climate or host plants) is not considered as a restricting factor for establishment, this can be explained.

- *Host plants and suitable habitats*

For a pest to establish, it should find host plants or suitable habitat in the PRA area. Natural hosts should be of primary concern but, if such information is lacking, plants which are recorded as hosts only under experimental conditions or accidental/very occasional hosts may also be considered. The pest should also find environmental conditions suitable for its survival, multiplication and spread.
► In relation to the area of potential establishment: describe where the host plants or suitable habitats are present in the PRA area outside protected cultivation.
► In relation to its suitability: consider how likely is the distribution of hosts or suitable habitats in the area of potential establishment to favour establishment. The abundance and patchiness of the distribution of host plant species or suitable habitats in the area suitable for establishment should be assessed.

Suggested sources: For EU cultivated plant hosts consult country production data from Eurostat and FAO Stat. For more detailed crop distribution data use JRC, SEAMLESS, CAPRA maps and McGill University crop distribution maps and country datasets. For uncultivated plant distributions explore global (e.g. GBIF), European (e.g. Florae Europaeae), regional and country flora. For habitat distributions consult maps prepared by the European Environment Agency, CORINE, EUNIS etc. The distribution can be described by national region, country, continental region (e.g. south-western Europe) or by environmental zone (e.g. the Mediterranean).

- *Alternate hosts and other essential species*

The pest may need more than one host or another essential species to complete its life cycle or for a critical stage of the life cycle such as transmission (e.g. vectors), growth (e.g. root symbionts), reproduction (e.g. pollinators) or spread (e.g. seed dispersers).

► In relation to the area of potential establishment: based on the area assessed as being suitable for establishment, identify and describe the area where alternate hosts or other essential species required to complete the pest's life cycle are present. Describe how this affects the area where hosts and suitable habitats are present.

► In relation to its suitability: consider how likely is the distribution of alternate hosts or other species critical to the pest's life cycle in the area of potential establishment to favour establishment. Evaluate abundance and patchiness of the distribution of alternate hosts and other species critical for the life cycle in the area of potential establishment.

- *Climatic suitability*

►In relation to the area of potential establishment: Based on the area assessed as being suitable for establishment in previous questions, identify and describe the area where the climate is similar to that in the pest's current area of distribution. Describe how this affects the area identified where hosts, suitable habitats and other essential species are present.

When comparing climates in a pest's current distribution with those in the PRA area, it is important to ensure that, as far as possible, the variables selected are relevant to the pest's ability to exploit conditions when these are favourable for growth and reproduction and to survive unfavourable periods, such as those of extreme cold, heat, wetness or drought. It may be helpful to compare the global distribution of the pest and its hosts. If they have similar climatic responses, all the hosts in the PRA area might be considered to be at risk. A qualitative assessment of the suitability of the climate for pest establishment has been developed in the framework of PRATIQUE: rating guidance for climatic suitability

► In relation to its suitability: Evaluate how suitable the climate is in the area for potential establishment: Using pest distribution maps and maps of world climate zones (e.g. the Köppen-Geiger zones), identify the climates where the pest is currently present. Then, compare these with the climates in the area for potential establishment. The relative distributions of the hosts and the pest in areas where the pest is not still spreading may help indicate whether both the hosts and the pest have similar climatic responses (Remark: The publication by MacLeod & Korycinska (2019)[2] may be used to inform and support such an assessment). It is important to take into account the fact that the relationship between the current pest distribution and climate may not be clear because (a) the current pest distribution is poorly known, (b) the species is still spreading, (c) the limits to its distribution depend on factors such as the presence of hosts or geographical barriers e.g the sea or mountains, rather than climate and (d) climate, as measured at weather stations, is unrelated to the microclimate inhabited by the species because it completes much of its life cycle in protected or irrigated cultivation, submerged aquatic habitats, the soil, thick woody plant tissue or in vectors.

A climatic suitability risk mapping decision-support scheme has also been developed. This decision support scheme (DSS) is intended for use by risk assessors who have already undertaken a qualitative assessment of the suitability of the climate for pest establishment. To know more on this DSS and its objectives and to use it, click on the following link: Climatic Mapping DSS

In the context of the EU Life Project where risk assessments were conducted on invasive plants (under Regulation (EU) 1143/2014[3]), climate change scenarios were considered when assessing climatic suitability (Climate match comparison between the area of origin of the pest and the PRA region can be performed, but this carries uncertainty).

- *Other abiotic factors*

The major abiotic factors to be considered are the physical and chemical characteristics of the soil; others are included, for example, environmental pollution, and topography/orography. For organisms having an aquatic stage, pH, salinity, current and temperature are important factors to consider.

► In relation to the area of potential establishment: Based on the area assessed previously as being suitable for establishment, identify and describe the area that is not under protected cultivation where additional abiotic factors that can affect establishment are favorable. Describe how this affects the area identified where hosts, suitable habitats and other essential species are present.

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[2] MacLeod & Korycinska, 2019 Detailing Köppen–Geiger climate zones at sub-national to continental scale: a resource for pest risk analysis. *Bulletin OEPP/EPPO Bulletin* **49**, 73–82. Available from https://doi.org/10.1111/epp.12549.

[3] Regulation (EU) No 1143/2014 of the European Parliament and of the Council of 22 October 2014 on the prevention and management of the introduction and spread of invasive alien species. Available from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32014R1143

► In relation to its suitability: how similar are other abiotic factors that would affect pest establishment in the area of potential establishment to those in the current area of distribution? Evaluate the extent to which the abiotic factors are suitable in the area of potential establishment.

- *Competition and natural enemies*

► In relation to the area of potential establishment: identify and describe any locations where the area suitable for establishment previously identified is likely to be altered due to competition and natural enemies.

► In relation to its suitability: Evaluate how likely is it that establishment will occur despite competition from existing species, and/or despite natural enemies already present.

For pest plants, the following questions may also be considered: how likely is the pest plant to build up monospecific stands? Is the species a freshwater macrophyte? Is the species allelopathic? Is the species able to fix nitrogen? Natural enemies include antagonists (herbivores, predators and parasites). Is an organism already present in the PRA area occupying the same niche as the pest? The assessor should also consider if the species is unpalatable to grazing animals or toxic.

- *The managed environment*

Factors that should be considered include cultivation practices such as the time of year that the crop is grown, soil preparation, method of planting, irrigation, surrounding crops, time of harvest, method of harvest, soil water balance, fire regimes, disturbance, etc. Factors to consider for pest plants are for instance the regular mowing of roadsides, cleaning of water courses, etc. Existing pest management practice should also be considered.

► In relation to the area of potential establishment: Identify and describe any locations where the area suitable for establishment previously identified is likely to be altered due to the management of the environment.

► In relation to its suitability: Evaluate how favourable for establishment is the managed environment in the area of potential establishment, and how likely is the pest to establish despite existing pest management practice.

Additional factors could include characteristics which would influence establishment, such as:
- Reproductive strategy of the pest and duration of its life cycle. Evaluate characteristics which would enable the pest to reproduce effectively in a new environment.
- Adaptability of the pest. Evidence of variability which may indicate that the pest has a greater capacity to withstand environmental fluctuations, to adapt to a wider range of habitats or hosts, to develop resistance to plant protection products and to overcome host resistance. This could be an important indication that this species is likely to have a greater potential for establishment. In addition, the magnitude of future impacts may increase. High adaptability also indicates that data from the native range, e.g. on climatic responses and host range, may not continue to be representative of the population in the PRA area so that the PRA itself may need revision at a shorter interval. Furthermore, if adaptability is high, this needs to be kept in mind with regard to effective management measures.

> *Examples of high adaptability include* Bemisia tabaci *which clearly seems to be able to evolve quickly to produce new biotypes, to develop insecticide resistance and to expand its host range and* Phytophthora ramorum*, which also appears to be rapidly increasing its host range.*

- How widely has the pest established in new areas outside its original area of distribution.

By combining the previous information, identify the part of the PRA area where the presence of host plants or suitable habitats and other factors favour the establishment of the pest. The area of potential establishment may be the whole of the PRA area, or part or parts of the area (i.e. the whole EPPO region or whole or part of several countries of the EPPO region). It can be defined ecoclimatically, geographically, by crop or by production system or by types of ecosystems.

Rating of the likelihood of establishment outdoors and uncertainty

Based on the assessment of the suitability of the area in relation to relevant factors, the likelihood of establishment outdoors and uncertainty should be rated. The uncertainty relates to the suitability of the area in relation to the relevant factors, and not to the size of the area.

The Express PRA scheme (EPPO Standard PM 5/5) includes a three-level rating scale for the likelihood of establishment outdoors. Based on practical experience when performing detailed PRAs at EPPO level and following the recommendation of the EPPO PRA core members, endorsed by the Working Party on Phytosanitary Regulations in 2016, the Express PRA scheme is now used at EPPO level with ratings using a 5-level scale. Users can refer to PRAs of similar pests which may guide for ratings (e.g. using the EPPO platform on PRAs). Users should try to remain consistent with the ratings they already provided in previous PRAs. Rating of uncertainty is based on a three-level scale. Guidance on the rating of uncertainties is available as a remark in section 17 of this guidance.

Rating of the likelihood of establishment outdoors	*Very low* ☐	*Low* ☐	*Moderate* ☐	*High* ☐	*Very high* ☐
Rating of uncertainty			*Low* ☐	*Moderate* ☐	*High* ☐

Reasons for the uncertainty rating, especially when moderate or high, can be recorded.

Suggested subheadings
The following subheading may be used to structure the assessment of the likelihood of establishment:

      9.1 Host plants: presence in the area of suitable climate (including alternate hosts and other essential species if relevant)

      9.2 Climatic suitability

      9.3 Other factors (pest management practice, other abiotic factors, presence of natural enemies, etc.)

      9.4 Overall rating of the likelihood of establishment outdoor

>Return to EPPO Standard PM 5/5

10. Likelihood of establishment in protected conditions in the PRA area

The likelihood of establishment in protected conditions in the PRA area is evaluated considering the presence of host plants within protected cultivation (e.g. glasshouses, shade houses), the management practices, and whether and where the pest may establish in protected cultivation. For invasive plants, the assessor should consider whether protected conditions are a suitable habitat.

Definitions and remarks
'*Protected cultivation*' in the context of this scheme means synthetic or glass structures (e.g. glasshouses) which provide suitable conditions for host growth, protecting them from adverse environmental extremes.

The pest may already have been recorded in protected cultivation elsewhere, but it may also happen that the host is grown outside in the area where the pest is present and the possibility that hosts under protected cultivation can be infected/infested has to be considered.

Identify and describe the areas where the hosts are grown in protected cultivation or – if the pest is a plant - where similar protected cultivation occurs in the PRA area.

Rating of the likelihood of establishment in protected conditions and uncertainty
The Express PRA scheme (EPPO Standard PM 5/5) includes a three-level rating scale for the likelihood of establishment in protected conditions. Based on practical experience when performing detailed PRAs at EPPO level and following the recommendation of the EPPO PRA core members, endorsed by the Working Party on Phytosanitary Regulations in 2016, the Express PRA scheme is now used at EPPO level with ratings using a 5-level scale. Users can refer to PRAs of similar pests which may guide for ratings (e.g. using the EPPO platform on PRAs). Rating of uncertainty is based on a three-level scale. Guidance on the rating of uncertainties is available as a remark in section 17 of this guidance.

Rating of the likelihood of establishment in protected conditions	Very low ☐	Low ☐	Moderate ☐	High ☐	Very high ☐
Rating of uncertainty			Low ☐	Moderate ☐	High ☐

Reasons for the uncertainty rating, especially when moderate or high, can be recorded.

>Return to EPPO Standard PM 5/5

11. Spread in the PRA area

This section should briefly describe each mode of spread (e.g. natural flight of invertebrate pests, wind or water dispersal, carried with animals, carried within plants or plant products (in a commodity of hosts or as contaminant), carried with other traded commodities), and indicate the rate or distance of spread (based on detailed data, if available). If possible, the assessor should consider how long it would take for the pest to spread widely within the area of potential establishment if no phytosanitary measures are taken. If no specific data are available, comparisons with similar organisms may be used.

Definitions and remarks

Spread is defined as the expansion of the geographical distribution of a pest within an area. Spread potential is an important element in determining how quickly impact is expressed and how readily a pest can be contained. In the case of intentionally imported plants, the assessment of spread concerns spread from the intended habitat or the intended use to an unintended habitat, where the pest may establish. Further spread may then occur to other unintended habitats. The nature and extent of the intended habitat and the nature and amount of the intended use in that habitat will also influence the probability of spread. Some pests may not have injurious effects on plants immediately after they establish, and in particular may only spread after a certain time. In assessing the probability of spread, this should be considered, based on evidence of such behaviour.

In the PRATIQUE project, spread modules have been investigated. To decide whether it is appropriate to try to use these modules, please follow this link 'quantitative spread module'.

The most likely rate of natural spread and human assisted spread may be evaluated.

- *Natural spread*

Natural population spread, increasing the infested area, can result from the movement of the pest by flight (of an insect), wind or water dispersal, transport by vectors such as insects, birds or other animals (internally through the gut or externally on the fur), natural migration, rhizomial growth.

Consider potential vectors of the pest in the PRA area, the presence of natural barriers, and the suitability of the environment.

Spread can be described as distance covered per unit time (e.g. 50 m /year) or in increasing area occupied (e.g. km^2) over time.

- *Human assisted spread*

Consider the potential for movement with commodities, packing materials, baggage, mail or conveyances, the fact that the species is intentionally dispersed by people and the ability of the pest to be unintentionally dispersed along major transport routes. For intentionally introduced plants consider spread to the unintended habitat. Mechanical transmission through human activities (by grafting or budding and contamination of hands, clothing and tools used for pruning, cutting, thinning and preparing the soil) commonly occurs over short distances within the place of production. However, since employees often travel long distances to work and contract workers (that visit many production sites) are commonly employed, it is considered that evidence of mechanical transmission indicates the potential for at least moderate spread.

Rating guidance for the magnitude of spread and uncertainty

The Express PRA scheme (EPPO Standard PM 5/5) includes a three-level rating scale for the magnitude of spread, combining the assessments of the natural spread and human assisted spread. Based on practical experience when performing detailed PRAs at EPPO level and following the recommendation of the EPPO PRA core members, endorsed by the Working Party on Phytosanitary Regulations in 2016, the Express PRA scheme is now used at EPPO level with ratings using a 5-level scale. Users can refer to PRAs of similar pests which may guide for ratings (e.g. using the EPPO platform on PRAs). Rating of uncertainty is based on a three-level scale. Guidance on the rating of uncertainties is available as a remark in section 17 of this guidance.

Rating of the overall magnitude of spread, combining the assessments of the natural spread and human assisted spread:

Rating of the magnitude of spread	*Very low* ☐	*Low* ☐	*Moderate* ☐	*High* ☐	*Very high* ☐
Rating of uncertainty			*Low* ☐	*Moderate* ☐	*High* ☐

Reasons for the uncertainty rating, especially when moderate or high, can be recorded.

The following guidance given for natural spread and developed during PRATIQUE for all categories of pests may help rating the overall magnitude of spread:

-	< 10 m per year	=	very low
-	10 m to 1 km per year	=	low
-	1 km to 10 km per year	=	moderate
-	10 km to 50 km per year	=	high
-	More than 50 km per year	=	very high

Guidance for the overall magnitude of spread and specific to invasive plants are also given in EPPO Standard PM 5/6 *EPPO prioritization process for invasive alien plants*.

Additional indications which can be given
An estimation of the proportion of the area of potential establishment expected to have been invaded by the organism after 5 years, as well as an estimation of the time needed for the pest to reach its maximum extent in the PRA area may be given. The factors to be taken into account include:
- The rate of spread
- The survival and reproductive rate
- The relationship between population density and impact thresholds
- The time taken for impacts to be observed, e.g. through a lag phase
- Climate and land use change

Suggested subheadings
Natural spread
Human assisted spread

>Return to EPPO Standard PM 5/5

12. Impact in the current area of distribution

This section of the risk assessment process is aimed at assessing the impact in the current area of distribution, to better assess in a following step the potential impact in the PRA area. In cases where the organism has already entered and is established in part of the PRA area, the assessment of current impacts in the PRA area should be taken into account in addition to impacts elsewhere. This description can be done by area where the pest is present. Economic impact sensu-stricto, environmental impact (in particular impact on biodiversity and ecosystem services for invasive plants) and social impact may need to be specifically considered. Existing control measures applied against the pest should be briefly described because they influence the observed impact in the current area of distribution.

- *Economic impact sensu-stricto (Negative effect on crop yield and/or quality of cultivated plants or on control costs)*

Effect on crop yield and/or quality are usually expressed as a relative decrease (%) per crop per ha or relative increase in total control costs. When following the rating guidance, it is important to take into account the annual variation in crop yield and quality that normally occurs in different crops. For some crops, e.g. those grown in protected conditions, such as tomatoes, cut flowers and pot plants, the annual yield fluctuations are normally very small and a yield loss greater than 10% can be considered as a massive impact. For crops with high yearly fluctuations, e.g. fruit and arable products and a loss of more than 50% would be needed before it can be considered to be a massive impact. Other crops, such as nursery stock, outdoor vegetables and forestry, take an intermediate position. The main causes of the fluctuation are due to the weather and the lower amount of protection provided, the higher the annual variation in yield. Other aspects to be taken into account include biennial bearing (e.g. fruit) which increases yield variation, whether the product is a bulk product (maize) or a high-quality product (e.g. roses) and whether the product is harvested annually (e.g. vegetables). The more quality is an important product feature, the lower the yield variation is. If product the production cycle takes more than one year (e.g. forestry), yield variation due to weather conditions are levelled.

- *Environmental impact*

If the species has not invaded any other area, or if the invasion is too recent and too little is known about its ecology in the invaded areas, this cannot be assessed properly (assuming that no additional investigations can be undertaken during the time available for producing the PRA). The assessor may choose to answer these questions based on well-studied closely related species or data for the target species from the region of origin. Although the concept of '*environmental impact*' of an indigenous species on native biodiversity and ecosystem is debatable, in some cases native species clearly have an environmental impact, usually resulting either from climate change or ecological mismanagement (e.g. *Dendroctonus ponderosae* presently causing serious outbreaks and extending its range in Canada, various weeds now invasive in their native range, etc.). Nevertheless, the assessor should take into account the fact that the environmental impact of a pest in its region of origin is often a very poor predictor of potential impact in regions where it has been introduced. In particular, the absence of any obvious environmental impact in a region of origin should not be considered as a predictor for a low impact in a new area.

Examples of species for which Environmental impact may be difficult to assess:
- *Choristoneura fumiferana* and *Pissodes strobi*: These North American species have never invaded any area.
- *Anoplophora glabripennis* and *A. chinensis*: For the moment (2010) all outbreaks in invaded areas worldwide are still under eradication and the beetle has not yet been studied in natural areas or even semi-natural forests in invaded areas.
- *Paysandisia archon*: Their invasion in Europe is too recent to accurately assess their current impacts, and they have never invaded any other region.
- Most pathogens and strictly agricultural pests have been poorly studied for their environmental impact.

When data on impact are available in several invaded regions, priority should be given to impact observed in regions that are most closely related, geographically and eco-climatologically, to the PRA region. However, data from other regions should not be excluded. For example, when performing a PRA on an invasive pest for the entire EPPO region, data on impact already observed in EPPO should be given priority, but information from other regions should also be provided. In any case, the assessor should specify the region where the information on impact has been gathered.

o *Impact on native biodiversity*

The word '*native*' in '*native species*' or '*native biodiversity*' should be understood in a broad sense, i.e. it should also include species that have been naturalised for centuries and that play an important role in the ecosystems or local cultural heritage, such as walnut (*Juglans*) or chestnut (*Castanea*) in Europe. The assessor may also include other, more recently introduced beneficial organisms such as biological control agents or exotic plants that play a role in ecosystem services, e.g. plants used against erosion.

- ▪ *Decline in native species populations*

If possible, all mechanisms of impact on native biodiversity should be considered, but only the mechanism providing the highest score and lowest uncertainty is kept for the scoring of the indicators.

- • *For pests, mechanisms of impact may include, among others:*

Herbivory: Most impacts by plant pests occur through direct feeding on native plants.

E.g., the emerald ash borer *Agrilus planipennis* feeds on, and kills native *Fraxinus* spp. in North America. The hemlock woolly adelgid, *Adelges tsugae*, severely affects natural stands of *Tsuga* spp. in Eastern North America.

Plant pathology: A pathogen directly impacts its host plant by causing disease.

E.g. *Ophiostoma novo-ulmi* decimated *Ulmus* spp. by causing Dutch elm disease in Europe and North America.

Nematodes may also cause plant disease.

E.g. *Bursaphelenchus xylophilus* causes pine wilt, which devastates native pine stands in East Asia.

Disease transmission: Alien pests can affect native plants through disease transmission.

E.g. *Scolytus multistriatus*, a European bark beetle, is a vector of the Dutch elm disease in North America.

This can also include pests that facilitate the attack of a pathogen, without being vectors themselves.

For example, the European beech scale, *Cryptococcus fagisuga*, increases the susceptibility of the fungus *Neonectria faginata*, causal agents of the beech bark disease in North America.

Competition for resources: Alien herbivores may affect native biodiversity by competing for food or by affecting the quality and availability of food.

For example, the scale insect *Icerya purchasi*, by killing endangered plants in the Galapagos, has also caused local extinction of host specific Lepidoptera. In North America, the Asian adelgid *Pineus boerneri*, is displacing *P. coloradensis* in red pine plantations, by reducing host plant quality and forcing the native species to move to other hosts.

Predation: Plant pests may also affect native species through predation on other animals.

For example, the ladybird *Harmonia axyridis*, a pest of vineyards in North America also affects native ladybird populations through predation.

Apparent competition: Apparent competition occurs when the presence of one species indirectly decreases the fitness of another through the increased presence of a shared enemy.

An example is the variegated leafhopper, *Erythroneura variabilis*, which, when introduced into California, affected populations of the native *E. elegantula* by enhancing populations of a shared egg parasitoid.

Pesticide use: An intensive use of non-specific pesticides (including biopesticides) over wide areas may affect native biodiversity, in particular when used in natural or semi-natural habitats (e.g. forests, swamps, etc.).

For example, the use of Bt over wide areas in North America to control *Lymantria dispar* locally affects the Lepidopteran fauna; the chemical control of alien mosquitoes over wide areas worldwide has a negative impact on the aquatic fauna.

- • *For plants, mechanisms of impact may include, among others:*

Competition with native vegetation for limiting resources: Invasive plants are, simply by occupying a large amount of space in invaded habitats, expected to impose a significant impact on the native vegetation through competition for space, light, water and nutrients.

For example, the tall and densely growing alien *Fallopia* species shade out native plant species.

Allelopathy: Allelopathy is defined here as a chemically mediated interference competition between co-occurring plant species, including both direct effects of the chemicals and indirect effects of the chemicals that are mediated by the soil microbial community or other biota.

Allelopathy is considered as an important mechanism for the invasion success of various alien invasive species, including *Ailanthus altissima*, *Solidago canadensis* or exotic *Fallopia* species.

Impact of vegetation changes on higher trophic levels: Changes in plant communities also alter communities at higher trophic levels.

> For example, because alien *Fallopia* species are poorly colonized by resident invertebrate herbivores, invasion by *Fallopia* species reduces diversity and productivity of invertebrate communities, and, as a consequence, the fitness and density of vertebrates that rely on invertebrates as food source.

Changes of ecosystem processes: Change of ecosystem patterns and processes may indirectly affect native vegetation.

> For example, increased nitrogen availability caused by nitrogen-fixing alien species such as *Robinia pseudoacacia* and *Acacia* may reduce the competitive performance of local plants and favour others.

Also, changes in fire regime and pollination services may have serious impacts on native community structures. Physical and chemical modifications of habitats may also have an impact on invertebrate and microbial soil communities.

Disease vector: Alien plants can act as a vector of plant diseases affecting native vegetation.

> For example, in Europe, the sudden oak death *Phythophtora ramorum* is spread mainly by the trade of exotic ornamentals such as *Viburnum* spp. and *Rhododendron* spp.

Pesticide use: An intensive use of non-specific pesticides over wide areas may affect native biodiversity, in particular when used in natural or semi-natural habitats (e.g. forests, wetlands).

> For example, herbicides used to control invasive *Fallopia* spp. have lethal effects on amphibians.

- *Changes in the composition and structure of native species communities*

See mechanisms described for declines in native species

- *Hybridization with native species*

Hybridization between an alien and a native species or sub-species may affect the genetic identity of native species or sub-species, although well documented examples are rare for plant pests.

> For pests: The Australian lycaenid butterfly *Zizina labradus* has apparently locally displaced the endemic *Z. oxleyi* in New Zealand. In insects, examples are most common between alien and native honeybee and bumble-bee sub-species.
> For plants: The Spanish Bluebell *Hyacinthoides hispanicus* successfully hybridizes with the native bluebell *Hyacinthoides non-scripta* in the UK.

o *Alteration of ecosystem processes and patterns*

Only the impact on natural or semi-natural habitats should be considered when assessing the impact on ecosystem processes and patterns. However, natural and semi-natural habitats have to be considered in a broad sense, i.e. every habitat that is not under constant human management. It includes all EUNIS habitat types 1, except I (Regularly or recently cultivated agricultural, horticultural and domestic habitats) and J (Constructed, industrial and other artificial habitats). For example, grasslands that are regularly mown are included as well, but not those that are repeatedly re-seeded.

- *Physical modifications of habitats*

e.g. changes to the hydrology, significant increase of water turbidity, light interception, alteration of riverbanks, changes in fire regime, etc.

- *Changes in nutrient cycling and availability*

e.g. significant changes in nutrient pools in topsoil or in water.

- *modifications of natural successions*

e.g. acceleration or temporary freezing of successions.

- *Disruption of trophic and mutualistic interactions*

e.g. disruption of food web, pollination or plant-mycorrhiza webs leading to ecosystem imbalance

o *Conservation impacts*
- *Occurrence in habitats of high conservation value*

It includes all officially protected nature conservation habitats.

- *Causing harm to rare or vulnerable species*

It includes all species classified as rare, vulnerable or endangered in official national or regional lists within the PRA area.

- *Social impact*

Social effects are impacts on human well-being, other than economic impacts. The main social effects are:
- o Landscape effects. To assess the impacts on the landscape, two elements have to be involved:
    - Land use function (agriculture, living area)
    - Contribution to the wellbeing (aesthetic value, (cultural-) historic value)
- o Loss of employment
- o Effects on human health (in addition to effects on plant health)
- o Products and services such as water quality, animal grazing, hunting and fishing (in addition to effects on plant health)
- o Effects on human or animal health, the water table and tourism could be considered, as appropriate, by other agencies/authorities.

Rating of the magnitude of impact in the current area of distribution and uncertainty

The Express PRA scheme (EPPO Standard PM 5/5) includes a three-level rating scale for the magnitude of impact in the current area of distribution. The rating chosen should be based on the highest type of impact. Based on practical experience when performing detailed PRAs at EPPO level and following the recommendation of the EPPO PRA core members, endorsed by the Working Party on Phytosanitary Regulations in 2016, the Express PRA scheme is now used at EPPO level with ratings using a 5-level scale. Users can refer to PRAs of similar pests which may guide for ratings (e.g. using the EPPO platform on PRAs). Rating of uncertainty is based on a three-level scale. Guidance on the rating of uncertainties is available as a remark in section 17 of this guidance.

Rating of the magnitude of impact in the current area of distribution	*Very low* ☐	*Low* ☐	*Moderate* ☐	*High* ☐	*Very high* ☐
Rating of uncertainty			*Low* ☐	*Moderate* ☐	*High* ☐

Reasons for the uncertainty rating, especially when moderate or high, can be recorded.

Suggested subheadings
- 12.1 Nature of the damage
    - *This section can refer to the pest overview.*
- 12.2 Impact observed
- 12.3 Existing control measures
- 12.5 Rating of the magnitude of impact and uncertainty

Suggested sources:
Reference to the Common International Classification of Ecosystem Services (CICES) may help assess the impact on ecosystem services in the current area of distribution.

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13. Potential impact in the PRA area

Consider whether impacts in the area of potential establishment will be similar to that in areas already infested, taking into account availability of plant protection products, natural enemies, cultural practices, etc. in the area of potential establishment. Consider other consequences (e.g. export loss) if applicable.

- If impacts are considered largely similar, there is no need to provide details, but only the reasoning explaining why it would be similar.
- If the answer applies to a specific part of the PRA area, this should be specified, and details should be provided in the text for the rest of the area.
- If the answer is '*Yes, for a certain area*' and '*No for another*',the EPPO secretariat found very convenient to have the table of the rating of the magnitude of impact twice to be able to see the ratings in parallel.

There should be clear indications that the pest is likely to have an unacceptable economic impact in the PRA area. Unacceptable economic impact is described in ISPM No. 5 *Glossary of phytosanitary terms*, Supplement No. 2: *Guidelines on the understanding of potential economic importance and related terms*. Climatic and cultural conditions in the PRA area should be considered to decide whether important economic (including environmental or social) damage or loss to plants may occur in the PRA area. The effect of the presence of the pest on exports from the PRA area should also be taken into consideration. In some cases, the pest may only be potentially harmful, as suggested by its intrinsic attributes.

Expert judgement is used to provide an evaluation of the likely scale of impact. If precise economic evaluations are available for certain pest/host plant combinations, it will be useful to provide details.
The replies should take account of both short-term and long-term effects of all aspects of agricultural, environmental and social impact. When a qualitative impact assessment is conducted, there is no need to take the time constraint into account. An option is to evaluate the impact for different scenarios where different proportions of the area of potential establishment are considered to be invaded (e.g. 10 %, 25%). The study of a single case may be sufficient, e.g. if the effect on one host exceeds the effect on all other hosts together. It may be appropriate to consider all hosts/habitats together, if effects on these hosts are comparable. If a selection is made, it should be justified. Only in certain circumstances it will be necessary to assess the impact separately for specific hosts or habitats. This is the case if the majority of the affected producers suffer minor or moderate impacts, but a small group suffers major or massive impacts. Differences can be observed between host plants; between crops and amenity plants; or differences between cropping system: conventional vs. organic production.

When the PRA is performed on a pest proposed for deregulation, the current impact noted in the area may be linked to the implementation of phytosanitary measures. The assessor should evaluate the possible impact for a scenario where these measures targeting the pest are withdrawn.

Some organisms may not be known to be harmful in their area of current distribution but may nevertheless have the potential to become pests in the PRA area. This possibility may have to be considered in certain circumstances

- *Economic impact sensu-stricto (Negative effect on crop yield and/or quality of cultivated plants or on control costs)*

The ecological conditions in the PRA area may be adequate for pest survival but may not be suitable for pest populations to build up to levels at which significant damage is caused to the host plant(s). Rates of pest growth, reproduction, longevity and mortality may all need to be taken into account to determine whether these levels are exceeded despite the presence of natural enemies. Consider also the effects on non-commercial crops, e.g. private gardens, amenity plantings.
Consider the pest survival and population growth when producers only apply current crop protection measures.

Take into account the existing and potential control measures and their efficacy against the pest. Difficulty of control can result from such factors as lack of effective plant protection products against this pest, resistance to plant protection products, difficulty to change cultural practices, occurrence of the pest in natural habitats, private gardens or amenity land, simultaneous presence of more than one stage in the life cycle, absence of resistant cultivars.

Include both normal farm practice costs and costs of control of measures which are additional to the common agricultural practice and which are assumed to be taken from a sound managerial perspective, in particular:

      o   ease of detection of the pest:

Species that are difficult to detect will require a greater surveillance and monitoring effort which will indirectly result in higher production costs.

      o   treatment:

Treatment options may vary (plant protection products, physical removal, etc.). Treatment costs may be divided into operating (e.g. chemical, fuel, equipment) and labour (i. e. hours per ha).

The increase in production costs (including control costs) is evaluated on the basis of the relative increase (%) in total costs (e.g. €). Include the costs of all additional measures and costs incurred to prevent environmental impacts.

Consider whether plant products potentially affected by the pest are exported from the PRA area and how important such exports are, for example by estimating the proportion of production that is exported. Take into account the major existing (or potential) export markets and how likely each is to impose an export ban from the PRA area. This is expressed as a relative decrease in market size.

The impact extent to be borne by producers can be evaluated as the proportion (%) of total economic impact borne by the producers. Producers can try to transfer economic losses to consumers and to other producers in order to decrease impacts on themselves. Factors that enable producers to decrease impacts include:

      o   the alternative use of the product, e.g. a shift from human consumption to use for animal feed
      o   the negotiation power of the producer to change the price of the product,
      o   the potential to grow other crops. The ease with which production can be adjusted depends on:
            ▪   the time needed for new crops to reach full production, e.g. one season for potatoes and several years for apples,
            ▪   the availability of factors such as labour, land and the investments which may have to be made to increase production (investment in plants for planting, buildings such as glasshouses, etc.),
            ▪   factors such as market expectations and the potential for storage of the product until prices rise.
      o   Factors that limit producer's capacity to decrease impacts include:
            ▪   consumer responsiveness (can consumers postpone consumption or shift to substitutes?),
            ▪   reductions in market share due to loss of image or dependency on the harmed products, such as wood which is used as packaging material. This can also affect the sale of products which are not infested.

A producer will almost never be able to pass on all costs.

      -   *Environmental impact*

If establishment conditions (hosts and habitats, climatic conditions, abiotic factors, management methods), in the PRA area are sufficiently similar, and same native species or community, or the same threatened ecosystem services, occur in the PRA area, a similar impact may be expected. If not, it may be necessary to know whether the native species or communities, or ecosystem service in the PRA area are similarly and significantly susceptible.

> Examples: *Agrilus planipennis* (for a PRA for Europe), *Bursaphelenchus xylophilus* (for a PRA for Europe), *Diabrotica virgifera* (for a PRA for Western Europe) or the *Potato spindle tuber viroid* (for a PRA for Europe) will most likely have a similar impact in the PRA area and in the areas where they are already invasive (susceptible hosts and habitat, compatible climate, etc.). In contrast, species such as *Adelges tsugae* (for a PRA for Europe) will encounter a suitable climate but the main host plants do not occur naturally in Europe. Similarly, *Aulacaspis yasumatsui* will not encounter suitable native host plants in Europe and, in addition, will not encounter a very suitable climate outdoors. These species have to be assessed separately for the impact in the PRA area with the impact in the current area of distribution.

If the species has not invaded any other area, or if the invasion is too recent and too little is known on its ecology in the invaded areas or if the situation in the PRA area is likely to be different, you may use another, simpler rating system based on simpler impact predictors.

For plant pests, six indicators will be related to:

- o Direct impact on native plants
    - risk of native plants in the PRA area being host
    - level of damage on major native hosts in the PRA area
- o Impact on ecosystem patterns and processes
    - ecological importance of the host plants in the PRA area
- o Conservation impact
    - occurrence of the host plants in ecologically sensitive habitats
    - risk to harm rare or vulnerable species
- o Impact of pesticides
    - risk that the presence of the pest would result in an increased and intensive use of pesticides

So far PRAs carried out for plants in Europe have only concerned plants that have already been reported to be highly invasive or to have an impact. However, in the future, PRAs may be done for species that are just escaping from cultivation and have no invasion and impact history (e.g. *Acer rufinerve* in Belgium). To assess these particular cases, an additional set of questions or even another assessment approach may be needed.

- *Social impact*

See guidance provided for the impact in the current area of distribution.

Rating of the magnitude of impact in the area of potential establishment in the PRA area and uncertainty
When the magnitude of impact in the area of potential establishment in the PRA area is considered as being different from the one in the current area of distribution, the Express PRA scheme (EPPO Standard PM 5/5) includes a three-level rating scale for this rating. The rating chosen should be based on the highest type of impact. Based on practical experience when performing detailed PRAs at EPPO level and following the recommendation of the EPPO PRA core members, endorsed by the Working Party on Phytosanitary Regulations in 2016, the Express PRA scheme is now used at EPPO level with ratings using a 5-level scale. Users can refer to PRAs of similar pests which may guide for ratings (e.g. using the EPPO platform on PRAs). Rating of uncertainty is based on a three-level scale. Guidance on the rating of uncertainties is available as a remark in ection 17 of this guidance.

Rating of the magnitude of impact in the area of potential establishment	Very low ☐	Low ☐	Moderate ☐	High ☐	Very high ☐
Rating of uncertainty			Low ☐	Moderate ☐	High ☐

Reasons for the uncertainty rating, especially when moderate or high, can be recorded.

Suggested sources:
Reference to the Common International Classification of Ecosystem Services (CICES) may help assess the impact on ecosystem services in the current area of distribution.

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14. Identification of the endangered area

With reference to the area of potential establishment identified, the assessor should identify the area which would be at highest risk for economic, environmental and social impacts.

Definition

Endangered area: An area where ecological factors favour the establishment of a pest whose presence in the area will result in economically important loss (ISPM 5).

Decision and method to map the endangered area

A Decision Support Scheme (DSS) for mapping endangered areas has been developed in the framework of PRATIQUE. This DSS is designed to help pest risk analysts (a) to decide whether it is appropriate to try and create a map of endangered areas and (b) to provide guidance on the most suitable methods to follow. For guidance on mapping the endangered area click on the link at the end of this paragraph. The DSS can be found in section B (page 12) of the document linked to below. Before using the DSS for the first time it is recommended that pest risk analysts read the whole of section A (the introduction to the scheme). Guidance on whether it is appropriate to try to map endangered areas is given in pages 6-7: see sections A4 (time and expertise required), A5 (data requirements) and A6 (situations when mapping the endangered areas is most useful). DSS for Mapping Endangered Areas.

15. Overall assessment of risk

In this section, the pest risk analyst should summarize the likelihood of entry, establishment, spread and possible impact without phytosanitary measure. The suggested Table 6 below can be used to summarize the ratings.

Then, the pest risk analyst should consider whether phytosanitary measures are necessary. If the assessment shows that phytosanitary measures are not required for your country but there are indications that other EPPO countries are at higher risk, this should be mentioned.

Suggested table

Table 6. Summary of ratings

	likelihood	Uncertainty
Entry (overall)		
(summary of ratings for each pathway investigated in detail is given)		
Establishment outdoors		
Spread		
Magnitude of impact in the current area of distribution		
Magnitude of potential impact		

Rating of the overall assessment of risk and uncertainty

A rating for the overall assessment of risk in the endangered area should be given in the summary part which is placed at the beginning of the Express PRA.

The Express PRA scheme (EPPO Standard PM 5/5) includes a three-level rating scale for this rating. Rating of uncertainty is based on a three-level scale. Guidance on the rating of uncertainties is available as a remark in section 17 of this guidance. Reasons for the uncertainty rating, especially when moderate or high, can be recorded.

Stage 3. Pest risk management

16. Phytosanitary measures

The pest risk management stage provides a structured analysis of the measures that can be recommended to minimize the risks posed by a pest or pathway. The pest risk management part may be used to consider measures to prevent entry, establishment or spread of a pest. It explores options that can be implemented (i) at origin or in the exporting country, (ii) at the point of entry or (iii) within the importing country or invaded area.

Before beginning the pest risk management stage or at certain points throughout the process, it may be advisable to consult other interested bodies. For example, discussions may be needed with the exporters to determine what is possible, with the importers to clarify what is cost-effective, with government officials concerning international trade issues and with pest-control experts to determine which methods of control are available, their efficacy and the extent to which eradication is possible.

Particular attention should be paid to the level at which the pest is listed. Although it may be possible for individual countries (or group of countries) to justify listing below (sub)species level, it is important that IPPC basic principles stated in ISPM 1 are followed in particular: necessity, minimal impact, transparency, non-discrimination and technical justification (e.g. if the exporting country can demonstrate that isolates present in its territory are the same as the ones present in the importing country, the requirements for import should not be stricter than the requirements for trade within the importing country). More information is given at the following link: listing below (sub)species level.

Before considering the available risk management options, a judgement on the acceptability of the risk posed by the pest or pathway is required. In this scheme, the methods whereby risk management options are selected differ according to whether the introduction is intentional or unintentional, whether the organism is absent or already present in the PRA area and the type of entry pathway. Options to prevent unintentional entry on commodities are distinguished from options to prevent natural spread/movement or entry with other pathways such as passenger luggage. It should be noted that measures recommended for intentional introductions are often restricted to prohibiting imports and to actions that can be taken in the importing country.

The scheme requires a judgement on the reliability of each potential measure identified and an assessment of uncertainty. A reliable measure is understood to mean one that it is efficient, feasible and reproducible. Limitations of application in practice should be noted. Once all potential measures have been identified, the extent to which they are cost-effective and can be combined with other measures is evaluated. A pest may enter by many different pathways and a pathway may transport many pests. It is therefore important to repeat the process for all relevant pests and pathways of concern.

A decision has to be made to determine whether the risk from any pest/pathway combination is an acceptable risk. This decision will be based on the relationship between the level of risk identified in the pest risk assessment stage (i.e. the combination of the probability of introduction and the potential economic impact) and the importance/desirability of the trade that carries the risk of introduction of the pest.

Phytosanitary measures may already be required as a protection against other (quarantine) pests or may already be implemented in the country of origin for the same pest for the export to other countries. These measures include inspection, testing or treatments, official control in the country of origin for the pest concerned, pathway originating only from pest free areas, pest free places of production or areas of low pest prevalence for the pest concerned. Note that this is particularly relevant in the framework of a pathway analysis when the country of origin of the pathway and the pathway are well defined and information from the exporting country is available. The assessor should list these measures and identify their efficacy against the pest of concern. He/she should nevertheless bear in mind that some measures could be removed in the future.

When detailing phytosanitary measures, the EPPO Secretariat found very convenient to precisely describe the pathways in terms of commodities concerned and plant species (e.g. for broad categories such as plants for planting or wood, state to which commodities and hosts the measures are recommended). If measures are recommended for a pathway that is narrower (e.g. only to one hosts because the risk of entry with others is considered very low) or wider than at entry (e.g. applies to a family and not only hosts, because the pest is very polyphagous within the family and may attack other hosts), this can be justified here.

Possible phytosanitary measures to prevent entry are listed in section 16 of the Express PRA scheme (EPPO Standard PM 5/5) and detailed below. Table 7 is suggested to present the recommended phytosanitary measures and Table 8 to evaluate the possible phytosanitary measures.

- *Options at the place of production*:
  o visual inspection,

If this is an option, specify the period and if possible appropriate frequency. If only certain stages of the pest can be detected, the measure could be considered in combination with other measures in a Systems Approach.

  o testing,

If only certain stages of the pest can be detected by testing, the measure could be considered in combination with other measures in a Systems Approach.

  o treatment of the crop,
  o use of resistant cultivars,

This option is not relevant for pest plants.

  o growing the crop in specified conditions

E.g. protected conditions such as screened greenhouses, physical isolation, sterilized growing medium, exclusion of running water, etc.

  o harvesting only at certain times of the year, at specific crop ages or growth stages,
  o production in a certification scheme (i.e. official scheme for the production of healthy plants for planting).

In order to guarantee freedom of a crop, production site/place of production, with/without a buffer zone, or area, it should be possible to fulfil the requirements outlined in ISPM 4 and ISPM 10. Consider in particular the degree to which unintentional movement of the pest by human assistance could be. The rate of spread is a critical factor. Additional guidance is given in EPPO reference documents for the use of pest free production site, pest free place of production and pest freedom of the crop in risk management options, for the use of growing season/growing period and pest free area, in EPPO Standard PM 5/10 *Guidelines on the design and the implementation of a buffer zones*, as well as in EPPO Standard PM 5/8 *Guidelines on the phytosanitary measure '*Plants grown under physical isolation*'*). The term pre-entry quarantine should not be used (see more guidance in EPPO reference document on Pre- and Post-entry quarantine).

- *Options after harvest, at pre-clearance or during transport*
  o visual inspection of a consignment at the time of export, during transport/storage or at import

If only certain stages of the pest can be detected by testing, the measure could be considered in combination with other measures in a Systems Approach.

  o testing of the commodity,

E.g. for pest plant, seeds in a consignment.

  o treatment (chemical, thermal, irradiation, physical)

As stated in ISPM 39, kiln-drying is not a phytosanitary measure on its own, except if it meets the requirements for a certain temperature and treatment duration, i.e. as a heat treatment.

  o removal of certain parts of the plant or plant products (e.g. bark, flowers),
  o handling and packing methods

- *Options that can be implemented after entry of consignments*
  o post-entry quarantine (see more guidance in EPPO reference document on Pre- and Post-entry quarantine).
  o restrict for certain end uses, limited distribution in the PRA area, or limited periods of entry

ISPM 5 *"Glossary of Phytosanitary Terms"* defines quarantine as *"official confinement for observation and research or for further inspection, testing and/or treatment of a consignment after entry"*.

When it is believed that a bilateral agreement is needed for a measure, this should be mentioned in the PRA (including in the table of measures, i.e. in table 7). From a review of the measures recommended by EPPO, the following measures have always been accompanied by '*(in the framework of a bilateral agreement)*': limited distribution/use, harvest and/or import at specific time of the year, post-entry quarantine.

Individual measures identified should be evaluated to conclude whether these would allow to reduce the risk to an acceptable level. In particular, their cost effectiveness and potential impact on international trade should be considered. For those measures that do not reduce the risk to an acceptable level, it should be considered whether two or more measures can be combined to reduce the risk to an acceptable level. The integration of different phytosanitary measures at least two of which act independently and which

cumulatively achieve the Appropriate Level of Protection against regulated pests are known as Systems Approaches (see ISPM 14 *The use of integrated measures in a systems approach for Pest Risk Management*). It should be noted that Pest free places of production identified as phytosanitary measures may correspond to a System Approach.

If the only measures available reduce the risk but not down to an acceptable level, such measures may still be applied, as they may at least delay the introduction or spread of the pest. In this case, a combination of phytosanitary measures at or before export and internal measures should be considered.

If the pest is already established in the PRA area, measures that are applied for international trade should not be more stringent than those applied domestically/internally.

Prohibiting the pathway should be envisaged as a measure.

The relative importance of the pathways is an important element to consider in formulating phytosanitary regulation. Regulation of pathways presenting similar risks should be consistent.

All the measures or combination of measures identified as being appropriate for each pathway or for the commodity can be considered for inclusion in phytosanitary regulations in order to offer a choice of different measures to trading partners. Data requirements for surveillance and monitoring to be provided by the exporting country should be specified.

Notes: only the least stringent measure (or measures) capable of performing the task should be selected. Thus, if inspection is truly reliable, it should not be necessary to consider treatment or testing. Note also that some measures may counteract each other; for example, the requirement for resistant cultivars may make detection more difficult. It may be that some or all of these measures are already being applied to protect against one or more other pests, in which case such measures need only be applied if the other pest(s) is/are later withdrawn from the legislation. The minimum phytosanitary measure applied to any pest is the declaration in phytosanitary regulations that it is a quarantine pest. This declaration prohibits both the entry of the pest in an isolated state, and the import of consignments infested by the pest. If other phytosanitary measures are decided upon, they should accompany the declaration as a quarantine pest. Such declaration may occasionally be applied alone, especially: (1) when the pest concerned may be easily detected by phytosanitary inspection at import, (2) where the risk of the pest's introduction is low because it occurs infrequently in international trade or its biological capacity for establishment is low, or (3) if it is not possible or desirable to regulate all trade on which the pest is likely to be found. The measure has the effect of providing the legal basis for the NPPO to take action on detection of the pest (or also for eradication and other internal measures), informing trading partners that the pest is not acceptable, alerting phytosanitary inspectors to its possible presence in imported consignments, and sometimes also of requiring farmers, horticulturists, foresters and the general public to report any outbreaks.

In addition to the measure(s) selected to be applied by the exporting country, a phytosanitary certificate (PC) may be required for certain commodities. The PC is an attestation by the exporting country that the requirements of the importing country have been fulfilled. In certain circumstances, an additional declaration on the PC may be needed.

If there are no measures that reduce the risk for a pathway, or if the only effective measures unduly interfere with international trade (e.g. prohibition), are not cost-effective or have undesirable social or environmental consequences, the conclusion of the pest risk management stage may be that introduction cannot be prevented. In the case of pest with a high natural spread capacity, regional communication and collaboration is important.

A summary should list all potential management options and indicate their effectiveness (with uncertainties).

For intentionally imported plants, see the EPPO Standard PM 3/67 on *Guidelines for the management of invasive alien plants or potentially invasive alien plants which are intended for import or have been intentionally imported*. When natural spread is the major pathway, international measures are not justified and risk should be accepted because it is not manageable.

Suggested subheadings
     16.1 Measures on individual pathways to prevent entry
          This section can include the suggested Table 7 (see below) summarizing the measures recommended to prevent entry. A comprehensive table detailing the main possible measures can be included in Annex of the PRA, see Table 8 below for an example.
     16.2 Eradication and containment
     Annex. Consideration of pest risk management options

Measures to prevent entry can be summarized in a table:

Table 7. Summary of phytosanitary measures recommended to prevent entry

Possible pathway	Measures identified
Pathways as named in section 8 Example: Host plants for planting with roots	*Suggested measures* Pest free area (ISPM 4, ISPM 29) Or Pest-free production site or pest-free place of production (with all production sites pest-free), with detailed requirements as listed in Annex Or Growing under complete physical isolation (EPPO Standard PM5/8) (with requirements appropriate for *M. mali*)

Suggested table (to be included in Annex of the PRA)
The table below summarizes the consideration of possible measures for the main identified pathways (e.g. host plants for planting) based on EPPO Standard PM 5/3. When a measure is considered appropriate, it is noted "yes", or "yes, in combination" if it should be combined with other measures in a systems approach. "No" indicates that a measure is not considered appropriate. A short justification is included.

Table 8. Evaluation of possible phytosanitary measures for the main identified pathways, using EPPO Standard PM 5/3

Option	Pathway 1
Existing measures in the PRA area	
Options at the place of production	
Visual inspection at place of production	
Testing at place of production	
Treatment of crop	
Resistant cultivars	
Growing under complete physical isolation	
Specified age of plant, growth stage or time of year of harvest	
Produced in a certification scheme	
Possibility for pest freedom of the crop, pest-free production site/place of production/area?	
Pest freedom of the crop	
Pest free production site and pest free place of production	
Pest-free area	
Options after harvest, at pre-clearance or during transport	
Visual inspection of consignment	
Testing of commodity	
Treatment of the consignment	
Pest only on certain parts of plant/plant product, which can be removed	
Prevention of infestation by packing/handling method	
Options that can be implemented after entry of consignments	
Post-entry quarantine	
Limited distribution of consignments in time and/or space or limited use	
Surveillance and eradication in the importing country	

Suggested sources:
An Excel file compiling all risk management measures recommended by EPPO in EPPO PRA documents is made available for NPPOs or other authorized organisations.
A guidance document detailing standard measures for *Meloidogyne* species was prepared by the Panel on Phytosanitary Measures.

17. Uncertainty

This section lists and describes the sources of uncertainties in the PRA. This does not need to list all uncertainties, but the ones that are most critical to the assessment.

Estimation of the probability of introduction of a pest and of its economic consequences involves many uncertainties. In particular, this estimation is an extrapolation from the situation where the pest occurs to the hypothetical situation in the PRA area. It is important to document the areas of uncertainty and the degree of uncertainty in the assessment, and to indicate where expert judgement has been used.

The EPPO Express PRA scheme can be used for very different reasons (see 'Reason for performing the PRA' in Stage 1: Initiation) with a lot of variation in the volume of information collected. When a PRA was performed in a very limited time, it may be necessary to state whether a detailed PRA is needed to reduce key aspects of uncertainty (if so state which parts of the PRA should be focused on).
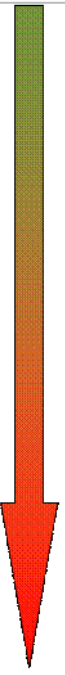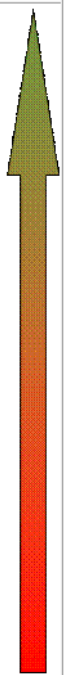
Comments on what work would be needed to address uncertainties should be added (including identifying and prioritizing of additional data to be collected and research to be conducted e.g. for distribution the need for surveys, produce epidemiological data.)

This is necessary for transparency and may also be useful for identifying and prioritizing research needs. It should be noted that the assessment of the probability and consequences of environmental hazards of pests of uncultivated plants often involves greater uncertainty than for pests of cultivated plants. This is due to the lack of information, additional complexity associated with ecosystems, and variability associated with pests, hosts or habitats.

Remark
All over the PRA process, the rating of uncertainties can be performed following the following guidance:

Table 9. Table to provide guidance regarding the use of the uncertainty within EPPO PRA schemes

Uncertainty		Interpretation / Meaning	Examples to justify the uncertainty rating	Certainty	
	Low	There is little doubt about the assessment and the risk rating. The assessor is confident	There is direct relevant evidence to support the assessment. The situation can easily be predicted. There are reliable / good quality data sources (e.g. for pest records data provided by NPPOs/RPPOs). The interpretation of data/information is straight forward. Data/information are available from a peer reviewed journal article. Data/information are not controversial, contradictory Personal communication is from experts regarded as specialists on the question raised.	High	
	Medium	There is some doubt about the assessment and the risk rating. The assessor has some confidence	There is some evidence to support the assessment. Some evidence for the prediction of the situation is available, but this prediction may be unreliable Some information is indirect, e.g. data from a other species has been used as supporting evidence, The interpretation of the data is to some extent ambiguous or contradictory.	Medium	
	High	There is considerable doubt about the assessment and the risk rating. The assessor has little confidence	There is no direct evidence to support the assessment, e.g. only data from other species have been used as supporting evidence The situation cannot be readily predicted because the evidence is poor, and difficult to interpret, e.g. because it is strongly ambiguous. The information sources are considered to be of low quality or contain information that is unreliable, e,g, because it is strongly contradictory.	Low	

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18. Remarks

Any relevant information or recommendations other than phytosanitary measures resulting from the PRA could be added, such as

- Recommendation to inform EPPO, IPPC, the EurAsian Economic Union (EAEU) or the European Union (EU) or to act at international level,
- Recommendation to inform the industry or other stakeholders about the risk posed by the pest,
- State whether a detailed PRA is needed to reduce level of uncertainty (if so, state which parts of the PRA should be focused on),
- Specify if surveys are recommended e.g. to confirm the pest status in high-risk countries or in neighbouring countries, or to determine the susceptibility of additional host species in infested countries.
- State whether the pest is a good candidate for citizen science.
- State what additional work/research could help making a decision or would be needed. For example, when phytosanitary measures are not considered appropriate, recommendations for the development of other control strategies can be made (e.g. Integrated Pest Management, certification schemes). Another example could consist of recommending planting sentinel trees of host species present in the EPPO region in infested areas to gather data on the susceptibility of European tree species to the pest.

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19. REFERENCES

All the references cited in the PRA should be provided, preferably following Instructions for authors to the EPPO Bulletin. This includes references used for Annexes.

When referring to websites, the web address and date accessed should be indicated.

It is also recommended to list all personal communications used with a date. Personal communications can also be listed at the beginning of the PRA.

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