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European and Mediterranean Plant Protection Organization
Organisation Européenne et Méditerranéenne pour la Protection des Plantes PM 3/91 (1)

Phytosanitary procedures

PM 3/91(1) Sentinel woody plants: concepts and application

Specific approval and amendment

First approved in September 2020−09.

Specific scope

This Standard provides guidance on the implementation of sentinel plants to identify new pest risks (including pathogens).

1. Introduction/background

Many recent outbreaks in the EPPO region were caused by organisms not known to be important and not regulated before their introduction in the region (e.g. *Cydalima perspectalis*, *Drosophila suzukii*). There is an increasing number of introduced pests of woody plants in many parts of the world (Brockerhof & Liebhold, 2017). In a detailed analysis of biological invasions, Seebens *et al.* (2018) show that a quarter of first records of non-indigenous pest species were not expecting them to be important pests before they were introduced in a new area.

One potential tool for tackling this problem of emerging pests is the sentinel approach, where surveillance of sentinel plants provides a tool for early warning to identify new potential pests (Eschen *et al.*, 2019; Mansfield *et al.*, 2019). The purpose of a sentinel plant programme is to detect host associations of particular plants important to the importing country with pests with which they have not co-evolved. In a sentinel plant programme, valued plants are specifically grown or located outside their natural home range, where they are exposed to organisms from the country in which they are located. Inspections of these sentinel plants will help to determine whether any of those organisms cause damage to them. Such observations can help identify potential pests and initiate pest risk analyses to identify the potential pathways and the risk of the introduction, establishment and impact of the identified pests.

Plants of valued species can be already present in the region of interest, for example in botanical gardens, arboreta or parks. These established plants (in some scientific publications referred as '*ex patriate*' plants) can be included in a sentinel programme and monitored on a regular basis for new pests (Barham, 2016; Barham *et al.*, 2016). An alternative may be to include sentinel plants planted in dedicated sites/plots and monitored on a regular basis (Roques *et al.*, 2015; Vettraino *et al.*, 2015; Kenis *et al.*, 2018).

The concept of sentinel plants was developed for perennial woody plants: forest, ornamental and fruit trees, and shrubs. Historically, the idea to use 'sentinel plants' to provide warning about pest risks appeared in respect to collections of plant species in botanical gardens and arboreta. These collections usually include a lot of species which are not indigenous to the area where they are planted. The information about which pests attack them in these areas provides precious information on pest risks. Later, it was suggested special 'sentinel' plantations of non-indigenous plant species should be created to identify pest risks. Since it is not feasible to create such plantations of non-indigenous plants, the idea was to create specific 'sentinel nurseries' of indigenous species expected to be traded and keep them without any pest control measures to see which pests will attack them and how severe the damage will be.

Despite many years of research and several publications illustrating the usefulness of sentinel plants to identify risks in a timely manner, this concept is still not well known and not used by many NPPOs. Therefore, this methodology has not been used in risk assessment and horizon scanning by NPPOs. A formalized document in the form of an EPPO Standard is therefore needed to clearly explain this approach and harmonise its application.

For the purposes of this Standard, the following terms and definitions are used, including those from the FAO ISPM 5 *Glossary of phytosanitary terms* (IPPC, 2019).

Commodity risk assessment (CRA)	Risk assessment initiated to analyse pest risks associated with international movement of a specified commodity (or other specified pathway)
Importing country	A country which could benefit from a sentinel plant programme for early warning or for getting information on pest risks associated with import of plants and plant products from a sentinel country
Pest	Any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products (ISPM 5)
Plants for planting*	Plants intended to remain planted, to be planted or replanted (ISPM 5)
Sentinel country	A country where sentinel plants are located
Sentinel plants	Plants used for identification of potential pest risks associated with international movement of plants and plant products
Sentinel arboreta	Botanical gardens and arboreta where sentinel plants are located and used as sentinel plantations
Sentinel plantation (synonym used in literature: '*ex patria* planting')	Site where non-indigenous sentinel plants are grown and monitored for identification of potential pest risks for countries where these plants are indigenous or widespread
Sentinel nursery (synonym used in literature: '*in patria* planting')	Site where indigenous plants are planted and grown without pest control measures in an exporting country to identify potential pests that could be associated with international trade of plants or derived plant products

*The ISPM 5 (IPPC, 2019) term 'plants for planting' includes seeds, cuttings, grafting material, bonsai plants, plants in vitro, seedlings, etc. It is sometimes referred to as 'plant reproductive material', 'propagation material', 'nursery stock', etc.

2. Purpose and scope of the EPPO Standard

This Standard is intended to provide NPPOs and other appropriate institutions, including national forest agencies, with an explanation of the concept of sentinel plants. This Standard gives guidance on the types and objectives of sentinel programmes, surveillance of sentinel plants, interpretation of results and their use for early warning or horizon scanning and risk analysis. This Standard is written from the perspective of the importing[1] country which wants to protect its woody plant resources and ecosystems.

Not in scope

This Standard does not cover organizational and governance arrangements for specific existing networks for sentinel plants (see Barham, 2016), pest reporting obligations which are already covered in ISPM 17 *Pest reporting* (IPPC, 2017), the use of trap plants in post border surveillance, and eradication and containment, which are covered in relevant PM 9 Standards (see also Poland & Rassati, 2018).

[1]Ideally, the objective of the 'sentinel concept' is to identify whether the international trade of plants and plant products will be safe before the import/export starts (to be proactive). Therefore, in this Standard the term 'importing country' means 'importing or potentially importing country' and 'exporting country' means 'exporting or potentially exporting country'.

3. Types of sentinel programmes

Two main objectives for the use of sentinel plants in plant health can be distinguished.

3.1. Sentinel programme for early warning

The objective is to supplement early warning systems (contributing to horizon scanning) to identify new potential pests of plants to be protected (e.g. important forest tree species). In this case, the sentinel plant species used to retrieve pest risk information are not indigenous to the country where the sentinel plants are located (sentinel country). Sentinel plants inspected in different parts of the world may act as an alert system for identifying new pests. For example, European tree species planted as sentinel plants in China have revealed seven insect species previously unknown as pests that could potentially threaten oaks (*Quercus* spp.) and beech (*Fagus sylvatica*) if introduced to Europe (Roques *et al.*, 2015). Plants present in botanical gardens and arboreta can be used as sentinel plants in this type of programme (Kirichenko & Kenis, 2016).

In the literature, this type of sentinel programme is called 'sentinel plantation' or '*ex patria* sentinel plantings' (Roques *et al.*, 2015; Eschen *et al.*, 2019).

In some cases, this type of sentinel programme using non-indigenous plants can be used to provide information which is not currently available on a specific pest–host association in a pest risk analysis (PRA).

Practical examples

- In a 20-year common garden study in Ohio, *Agrilus anxius* colonization caused complete mortality of Eurasian *Betula* species whereas North American *Betula* species exhibited high survival throughout the study (Nielsen *et al.*, 2011; Muilenburg & Herms, 2012). *A. anxius* was added to the EPPO Alert List following a suggestion from Norway, which had highlighted this pest as a potential risk for the EPPO region. A PRA was conducted and the pest was added to the EPPO A1 List of pests recommended for regulation for the EPPO region.
- In the framework of the preparation of the EPPO PRA on *Massicus raddei,* contacts were made with the International Plant Sentinel Network (IPSN) to enquire whether this pest had been detected on European *Quercus* species; in botanical gardens and arboreta in Asia no record was retrieved.
- Based on a literature study, the EFSA (2018) PRA on *Atropellis* species concluded that it was not known whether European *Pinus* species can be damaged by

Atropellis species. EFSA asked the Botanical Garden Network for information and was informed that there were no positive records in the Botanical Garden Network.
- Based on a literature study, the EFSA (2020) pest categorization of *Saperda tridentata* concluded that it was not known whether European elm is damaged by *S. tridentata* in the United States and Canada. A sentinel programme (e.g. targeted survey of European elm in the United States) could help to answer this question.

3.2. Sentinel programme to inform commodity risk assessment

The objective of this type of sentinel programme is to provide information for a pest risk assessment for a specified commodity (e.g. plants for planting) from a specified origin.

In this case, the sentinel plant species used to retrieve pest risk information are indigenous to the sentinel country. Usually, they are traded or have been requested to be traded internationally. For example, untreated plots of box tree (*Buxus microphylla*) in different regions of China were quickly and massively infested by box moth (*Cydalima perspectalis*) larvae (Kenis *et al.*, 2018).

In the literature, these types of traded or potentially traded sentinel plants are called 'sentinel nurseries' or '*in patria* sentinel plantings' (Eschen *et al.*, 2019).

In Table 1 and Figure 1 the main characteristics of the two types of sentinel programmes are summarized.

Table 1. Summary of the main characteristics of the two types of sentinel programmes

Type of sentinel programme	Objective	Type and choice of sentinel plant species	Feasibility for planted sentinel site/plots	Feasibility of monitoring of existing plants in existing plantations (e.g. parks, botanical gardens, etc.)
Sentinel plants for early warning In literature: **Sentinel plantation** Sentinel arboretum/ sentinel collection *Ex patria* planting	Early warning system to identify new pest species of a specific plant species to be protected	Species non-indigenous to the sentinel country Choice is based on economic, social or environmental value of the plants species to be protected Example: European oak, Mediterranean plant species, European forestry species	Difficult to organize, due to common plant quarantine prohibition of import of non-indigenous plant species (import for scientific use)	Non-indigenous plant species are present in botanical gardens and sentinel arboreta Survey on the presence of the sentinel plant species in existing plantations (species may have a restricted distribution in parks, botanical gardens, etc.) **Sentinel arboretum/sentinel collection**
Sentinel plants for commodity risk assessment In literature: **Sentinel nursery** *In patria* planting	Information for commodity risk assessment of current or future trade Identify the pests of concern in the country of origin of the plants for planting	Plant species indigenous in the sentinel country Specific plant species for which commodity risk assessment is conducted Example: Ornamental species non-native to EPPO region	Relatively easy to organize because the plant species are available in the sentinel country	Surveys of sentinel plants in non-treated existing plantations (i.e. outside commercial nurseries)

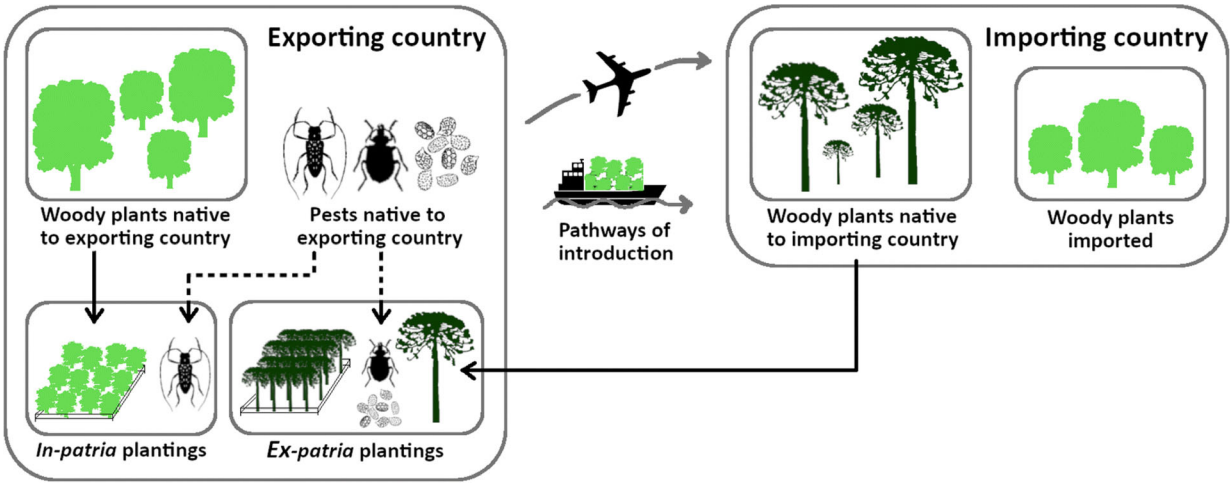

Fig. 1 Schematic representation of the two sentinel programme types named in this figure '*in patria* plantings' (sentinel nurseries) and '*ex patria* plantings' (sentinel plantations, sentinel arboreta, sentinel collections) in an exporting country, differing by the origin of the planted sentinel plants. The exporting (sentinel) country has a forested (or urban) area from which pests can spread to the *in patria* and *ex patria* plantings. *In patria* plantings consist of sentinel plant species indigenous to the exporting (sentinel) country that are surveyed for local pests. *Ex patria* plantings consist of plant species indigenous to the importing country that are surveyed to identify new pest species. *In patria* plantings typically consist of young woody plants that are planted for this purpose, while *ex patria* plantings can either be young woody plants planted for this purpose or mature trees that were planted for another purpose, such as in botanical gardens. (From Eschen *et al.*, 2019, note that caption text is adapted for this standard). [Colour figure can be viewed at wileyonlinelibrary.com]

4. Establishment of sentinel programme

When setting up a sentinel programme, an NPPO should first decide the objective of the programme and the most appropriate methodology to achieve the objective. The different methodologies have advantages and disadvantages in terms of cost, feasibility, timescale and usefulness of the results. Alternative methods for acquiring the same type of information should also be considered.

4.1. Determination of the objective of a sentinel programme

If the NPPO wants to identify potential pests of a valuable plant species, the early warning sentinel concept (sentinel plantations) is the most appropriate. If the NPPO wants to ensure a particular trade flow is safe, the commodity sentinel concept (sentinel nurseries) is the most appropriate.

4.2. Choice for the most practical type of sentinel programme

The choice for the most feasible methodology is mainly based on the presence and distribution of the plant species in the sentinel country. If the plant species is present in botanical gardens or arboreta (including any existing plantations in cities, parks, forests, private gardens, etc.), the sentinel programme may target plants in these locations. The alternative is to establish sentinel plants in a special site.

The following part discusses the advantages and disadvantages as well as the practical application of the different methodologies.

4.3. Sentinel plants in botanical gardens/arboreta

4.3.1. Advantages

A convenient strategy for assessing pests present in a sentinel country that could potentially attack plants of importance in an importing country is to survey and where needed sample trees already established in botanical gardens and arboreta. This strategy is likely to be much cheaper, quicker and easier to implement because the plants have been established and are being managed already, and has some other advantages:

(1) Trees in plant collections are more likely to be mature (and so it is possible to assess the impacts on mature trees).

(2) The collections may include a range of species of the same genus, and these trees could be a mixture of tree species indigenous to the importing country and other tree species indigenous to the sentinel country. If such a mixture is present, these trees may present a range of susceptibility to pests present in the area and comparing this susceptibility can be a useful way of evaluating the pest impact in the potentially importing country. An example is the comparison of the impact of the emerald ash borer *Agrilus planipennis* on American, European and Asian ash trees at the Main Botanical Garden in Moscow (Baranchikov *et al.*, 2014; Musolin

et al., 2017). This study helped to identify ash species that are more and less susceptible or resistant to the pest. Another survey carried out in the same Moscow botanical garden has shown that the introduced four-eyed fir bark beetle *Polygraphus proximus* does not damage fir trees of some species, e.g. *Abies alba* and *A. nordmanniana* (belonging to the section Abies within the genus *Abies*) but kills fir trees of other *Abies* species, e.g. *A. sibirica*, *A. balsamea*, *A. grandis* and *A.concolor* (from other sections of the genus *Abies*) (Baranchikov *et al.*, 2015).

(3) Plant collections are normally well curated and hence the origin and identity of the plants is likely to be well known.
(4) There are likely to be knowledgeable scientists working on the sites already who can potentially carry out surveys of the plants of interest.

4.3.2. Disadvantages

Using sentinel arboreta has some disadvantages:

(1) It is not possible to choose the tree species or cultivars.
(2) There may be a limited number of plants of each species or cultivar and creating replicated plots of species or cultivars will not be possible.

Some of the factors that need to be considered when choosing which arboretum to work with are: (1) whether the arboretum has specimens of the tree species of interest; (2) whether the NPPO or other country institutions already have some links with the garden/arboretum; (3) whether there are suitably qualified staff at the arboretum to carry out inspections; (4) whether the arboretum is located in an area with a climate comparable to the importing country. If trees are already stressed due to the climate, then they may be more or less susceptible to attacks by pests (depending on pest species), and such attacks may be not representative of what would happen if the pests were introduced into the importing country (pest risks could be overestimated or underestimated). Pests introduced into importing countries could also locate and affect stressed trees (e.g. urban trees) in the importing country.

4.3.3. Plant sentinel network

Botanic Gardens Conservation International has a database called Plantsearch (https://tools.bgci.org/global_tree_search.php), which lists the plants grown in botanical gardens and arboreta around the world. It can be used to identify gardens which may be suitable to start sentinel plant programmes. An international project, the International Plant Sentinel Network, has set up links between botanical gardens around the world.

4.3.4. Other existing sentinel plants

Other existing plantations of sentinel plants (e.g. parks, private gardens, urban trees) can also be used for sentinel approaches. For example, non-indigenous trees have been planted as forest species in many countries around the world and they have also been planted for their amenity and ornamental value in urban areas along streets and in private gardens. These all have the potential to be used as sentinels for the countries where these plants are indigenous or widely grown. However, a survey has first to be carried out to locate these sentinel plants and to get access to private gardens. The (sub)species of the tree may not always be known, especially if it is not known who planted the tree or those who planted the tree do not know the exact name and origin of it.

4.4. Sentinel plantations

The use of sentinel plantations, i.e. establishing plants of importance to importing countries in exporting countries, is the most challenging type of sentinel programme in terms of the need to obtain permits for importing and planting non-indigenous plants in the sentinel country and the difficulties in obtaining pest-free plants of an appropriate size for the study. Using a sentinel plantation, as opposed to a sentinel nursery, means that it is possible to investigate host–pest interactions not been studied before in the field. The results provide reliable evidence on the potential impact of non-indigenous pests on important hosts in the importing countries. The advantages of using sentinel plantations, as opposed to botanical gardens, is that scientists can choose appropriate locations and the most appropriate species and cultivars to study, and plant sufficient numbers of specimens in replicated sites/plots to allow a comparison of impacts between different plant species or cultivars.

4.4.1. Choice of sentinel plant species/cultivars

Some priorities for choosing hosts for sentinel plantation studies are species that are widely grown or present in the importing country, valuable plant species that are under threat in the importing country, and species that are of ecological significance to the importing country. Ideally, plants from different provenances within the importing country should be tested to see if there is any genetic variability in their susceptibility to pests.

4.4.2. Source of sentinel plants

If it is possible to obtain the species and cultivars that have been chosen for the study within the sentinel country, this is likely to be the easiest and cheapest option. However, appropriate species and cultivars may not be present in the sentinel country and the species and cultivars in the sentinel country may have become less susceptible to the pests present in the importing country. If it is not possible to obtain the chosen plants within the sentinel country, the use of imported plants can be considered. However, imported plants may have been colonized by pests in the country of origin. The plants may belong to regulated species, and sentinel countries may restrict the entry of such plants. Import regulations of selected countries on all continents have been reviewed by Eschen *et al.* (2019). Most countries require

an import permit for all live plant imports, do not allow the import of plants with soil attached and some require that all live plants are submitted to post-entry quarantine before being released. Additionally, specific phytosanitary import requirements may restrict the types of plants that can be imported or delay the import process, which can affect the health of the imported plants and result in high mortality of the plants in the sentinel plantation (Roques *et al.*, 2015).

4.4.3. Import of sentinel plants to sentinel country

To avoid difficulties, restrictions and unnecessary biosecurity risks related to the import of non-indigenous plants for planting in the sentinel country, the import of the safest categories of plants for planting should be considered (e.g. seeds, cuttings or tissue cultures). Such material is generally considered of lower pest risk than other plants for planting and the regulations with respect to its import are often less restrictive.

However, plants of a size suitable for planting need to be grown before the sentinel nursery can be established, which may take several years. When importing plants for planting, it is important to assess the presence of pests on the imported material at the time of planting. No imported material is pest free and such an assessment will allow pests originating from the planted material to be distinguished from those that infested or attacked the plants in the sentinel nursery.

4.4.4. Selection of sites for sentinel plants

To optimize the detection of relevant pest taxa, there should preferably be a close match between the environmental conditions (e.g. climate, soil, habitat type, presence of closely related host genera) of the sentinel country and the country interested in the sentinel programme. During their establishment, plants should be irrigated as required and, if necessary, fertilizer should be applied to ensure that the trees have adequate nutrients.

4.5. Sentinel nurseries

Sentinel programmes targeted to inform commodity risk assessment use plant species that are indigenous to the sentinel country.

The aim is to determine which pests could be present on plants or plant products that are being or could be traded in the future from the sentinel country to the importing country. A site with indigenous sentinel plants is likely to be easier and cheaper to set up than a sentinel plantation because the plants should be easily available within the sentinel country and legislative difficulties are less likely when establishing the programme. The major difference between a sentinel nursery and a 'normal' commercial nursery is that no pest control measures are implemented in the sentinel nursery so that it is possible to determine which pests infest the plants. The appropriate plants to establish in a sentinel nursery are plants that (1) are currently commonly exported or are planned to be exported from the sentinel country to the importing country; (2) are of the same genus or family to plants of importance to the importing country; and (3) are currently prohibited for export to the potentially importing country and the sentinel country is planning to gather evidence to support a commodity risk assessment. Suitable locations for sentinel nurseries are likely to be those close to the areas with commercial nurseries that export similar plants. Observations for pests are needed over several years because some pests may only be found in the second year, as shown by Kenis *et al.* (2018).

5. Inspection of plants, sampling and diagnosis

There are three basic steps in the monitoring of pests in a sentinel programme: (1) assessment of signs and symptoms; (2) isolation of potential pests; and (3) identification of the pest species. The interpretation of damage symptoms on sentinel plants and the identification of the causal pests can be challenging, but a first assessment can be done in the field. Indications for the type of pests could be obtained so that the suitable samples can be taken and passed on to the most appropriate expert for further identification.

An open-access field guide for the identification of damage on woody sentinel plants is available, providing schemes for rough assignment of damage symptoms to relatively broad groups of organisms (Roques *et al.*, 2017). This guide includes keys and sections for determining the cause of damage to different parts of plants, i.e. the foliage, shoots and buds, reproductive structures, roots and collars, and the stems, branches and twigs. There are separate chapters for deciduous and evergreen plants.

Morales-Rodríguez *et al.* (2019) set out some principles for inspection and sampling sentinel plants:

(1) Each part of the sentinel plants should be inspected. Different organisms can affect the same plant. Samples should be taken from a range of representative symptomatic parts of the plant.
(2) Before samples are taken, high-resolution photographs should be taken of the whole plant, the damaged part of the plant and if present and visible the pest itself.
(3) Samples can also be taken from non-symptomatic plants to test for latent infection.
(4) Sampling instruments should be sterilized after taking each sample to prevent cross-contamination.
(5) If possible, inspections and samples should be taken at least three times a year, in the spring, summer and autumn. The range of pests detected is related to the frequency of sampling and the sample size (Eschen *et al.*, 2019).

(6) Samples should also be taken from apparently healthy plants/tissue to provide an indication of what healthy tissue looks like during normal growth.
(7) Labels should include at least locality, GPS coordinates, host plant, date of collection, collector and a unique identifying number.

Insects can be sampled directly and if necessary reared on host material until they reach an adult stage to facilitate diagnosis. Pathogens can affect all plant tissues and cause a broad range of symptoms resulting in general dieback or more localized impacts such as wilting of a branch. The tissue affected and the type of damage induced may make it possible to determine which group of causal agents is involved (Morales-Rodríguez *et al.*, 2019). Ideally, samples should include the part of the plant where healthy tissue borders with infected tissue (Prospero, O'Hanlon and Vannini, 2017). If diagnostic expertise on a specific group or groups of pests is not available, the EPPO database on diagnostic expertise could be consulted and the appropriate expert contacted (http://dc.eppo.int/).

6. Arrangements between importing and sentinel countries

Sentinel programmes can only be successful if there is a strong willingness to establish and maintain this sentinel programme over several years by all actors involved and local expertise in the sentinel country or close collaboration between scientists and the NPPOs from the sentinel and importing countries (Eschen *et al.*, 2019). The NPPO of the sentinel country should always be informed or involved in a sentinel programme because new pests may be identified and need to be reported, resulting in a change in the pest status. A special bilateral (or multilateral) arrangement may be useful. It can include the following issues.

(1) *Phytosanitary import requirements*. When the creation of sentinel plantations (or sentinel nurseries) requires the import of plants for planting to a sentinel country, these imported plants for planting should meet the phytosanitary import requirements of the sentinel country. A relevant agreement between NPPOs may be useful to simplify export and import phytosanitary procedures.
(2) *Permission to plant sentinel plants on the territory of the sentinel country*. Such permission should be granted by the relevant authority in the sentinel country and may be included in the agreement between NPPOs to simplify export and import procedures.
(3) *Land for sentinel nurseries or sentinel plantations*. The land for establishment of sentinel nurseries or sentinel plantations may be provided by different authorities (in charge of forestry, research, agriculture, etc.). The arrangement with these authorities should be reached in advance and either be the subject of a separate agreement (e.g. between research institutions of participating countries) or included in the agreement between NPPOs.
(4) *Funding*. It should be agreed who will fund the sentinel plant programme, including export, import, transport, planting and survey of the sentinel plants
(5) *Reporting*. Partners of the sentinel plant programmes should come to an agreement as to who will write the report of the results and how and when they will be published. According to the principle of transparency of IPPC (2019) and to ISPM 17 (IPPC, 2017), the results concerning information on pest distribution and pest risks should be made available to all interested parties. This should be provided by the NPPO of the sentinel country.

One way of ensuring that all parties benefit from sentinel plant programmes is to create reciprocal international arrangements. Two or more NPPOs share information on pests found within their countries on sentinel plants. An example of such a project is the International Sentinel Plants Network.

7. Potential value of data generated from sentinel plant programmes

7.1. Potential benefits of sentinel plant studies

Sentinel plant programmes can help to increase the knowledge of pests in the sentinel country. In some sentinel plant studies, a large fraction of previously unidentified organisms and a significant number of new pest–host combinations have been found (Tomoshevich *et al*., 2013; Roques *et al.*, 2015; Kenis *et al.*, 2018; Eschen *et al.*, 2019).

7.2. Data from sentinel plantations and sentinel arboreta

In sentinel plantations and sentinel arboreta, plants indigenous to the importing country are naturally exposed to the pests. The sentinel plant programmes can cover pests that are well known and recorded as pests in the sentinel country, but also pests that are not known as pests in the sentinel country, have not been recorded previously in the sentinel country or even are unknown to science. It is possible to obtain information on well-known pests from scientific literature, but information on other pests may not be available to risk assessors in importing countries. Records of pests from sentinel plantations and sentinel arboreta can be used to demonstrate whether or not some of the pests present in sentinel countries could threaten plants of value to the importing country. These programmes can show that sometimes the impact of pests on sentinel plants is much more serious than on plants indigenous to the sentinel country. These data are of particular value because they are difficult to obtain by any other means without risk for an importing country. The presence of pests on sentinel trees indigenous to the importing country does not demonstrate that there is a possible pathway for the pests to be moved

between the sentinel and importing country, but raises awareness of the potential risk. If importing countries are aware of pests that may pose a risk, they can then consider carrying out pest risk assessments in which these pathways are considered.

7.3. Data from sentinel nurseries

Sentinel nurseries provide records of the pests that can attack plant species and cultivars that are currently being traded or could be traded in the future. These records can be used to initiate pest risk assessments and also commodity risk assessments for the plants grown at the nursery and plant products derived from these plants. If sentinel countries and importing countries are both aware of the pests that can be present on traded plants, it may be possible for them to agree on suitable measures to reduce the pest risk.

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