EXTERNAL SCIENTIFIC REPORT

Extensive Literature Searches Soil and Growing Media Inventories[1] (RC/EFSA/PLH/2013/01-SC1)

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ABSTRACT

In this project two inventories by means of extensive literature searches following the methodology described in the EFSA guidance on systematic review have been executed: Inventory 1 of all types of soil and growing media (if relevant components thereof) to be elaborated considering (i) the soil and growing medium imported as commodities (i.e. not in association with plants intended for planting), (ii) the soil and growing medium attached to plants for planting, and (iii) the soil and growing medium attached as a contaminant to imported goods (ranging from ware potatoes to agricultural machinery). Inventory 2, based on interceptions data and scientific and technical literature, of plant pests, plant diseases and weeds that can be associated with soil and growing medium (if relevant components thereof). Execution of Inventory 1 resulted in a list of 956 soils and growing media. Execution of Inventory 2 resulted in Excel tables for each taxonomic group separately in which the pests and diseases are linked to the soil and growing media. Additional information has been provided for processes applied to produce growing media and the impact on harmful organisms and private certification schemes applied in Europe to control the trade and use of growing media.

KEY WORDS

Soil, growing media, harmful organisms, plant growth, phytosanitary risk

DISCLAIMER

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SUMMARY

EFSA has requested to provide preparatory work for the Panel on Plant Health, which provides insight into the types and compositions of soil and growing media that arecurrently in use, and their possible association with harmful organisms. The objectives of this contract are to develop two inventories by means of extensive literature searches following the methodology described in the EFSA guidance on systematic review:

Inventory 1 of all types of soil and growing media (if relevant components thereof) to be elaborated considering

(i) the soil and growing medium imported as commodities (i.e. not in association with plants intended for planting)
(ii) the soil and growing medium attached to plants for planting
(iii) the soil and growing medium attached as a contaminant to imported goods (ranging from ware potatoes to agricultural machinery). Inventory 2, based on interceptions data and scientific and technical literature, of plant pests, plant diseases and weeds that can be associated with soil and growing medium (if relevant components thereof).

Execution of Inventory 1 resulted in 15,331 records which have been screened, of which 6,788 are used for data extraction. This resulted in a list of 881 soils and growing media.

Inventory 2 includes the quarantine organisms listed in the Council Directive 2000/29/EC, the organisms addressed by emergency measures in the EU, the organisms included in EPPO pest lists, and also examples of the most important emerging risks of plant health concern that are not listed in the EU regulation. Execution of Inventory 2 resulted in 7,611 records which have been screened, of which 1,563 are used for data extraction.

The results are presented in harmonized Excel tables for each taxonomic group separately. Additional information has been provided for processes applied to produce growing media and the impact on harmful organisms and private certification schemes applied in Europe to control the trade and use of growing media.

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BACKGROUND AS PROVIDED BY EFSA

This procurement is launched to provide preparatory work for the Panel on Plant Health in the context of the request from the EC to provide a scientific opinion on the risks to plant health posed by soil or growing medium. The background and terms of references of the request can be consulted at EFSA register of question under the Plant health section at question number EFSA-Q-2013-00405 (http://registerofquestions.efsa.europa.eu/).

Soil and growing medium provide a means via which harmful organisms to plants and plant products and other non-native invasive species, including agricultural or invasive weeds, can enter and spread into the European Union territory. The risks posed by the movement of soil and growing medium as potential pathways for the introduction and spread of harmful organisms are universally recognised and addressed in the European Union by the Council Directive 2000/29/EC. Three separate scenarios for the import and movement of soil and growing medium need to be considered when addressing the phytosanitary risks posed by these objects (i) Soil and growing medium imported as commodities (i.e. not in association with plants intended for planting); (ii) Soil and growing medium attached to plants for planting, and (iii) Soil and growing medium attached as a contaminant to imported goods (ranging from ware potatoes to agricultural machinery).

TERMS OF REFERENCE AS PROVIDED BY EFSA

The main objective of this procedure is to provide preparatory work for the Panel on Plant Health in the context of the request from the EC3 to provide a scientific opinion on the risks to plant health posed by soil or growing medium as commodities, attached to plants for planting and, as a contaminant on imported consignments.

The specific objectives of the contract resulting from the present reopening competition are to develop two inventories by means of extensive literature searches following the methodology described in the EFSA guidance on systematic review:

Inventory 1 of all types of soil and growing media (if relevant components thereof) to be elaborated considering (i) the soil and growing medium imported as commodities (i.e. not in association with plants intended for planting), (ii) the soil and growing medium attached to plants for planting, and (iii) the soil and growing medium attached as a contaminant to imported goods (ranging from ware potatoes toagricultural machinery).
For each identified type of soil and growing medium the contractor should indicate:

- The production processes involved to produce or process the soil or growing medium, from the raw material(s) to the final product(s).
- The end use in agriculture with special focus to the EU (e.g. soil improver, fertiliser, growing media for plants for planting etc.)
- The phytosanitary requirements imposed by EU regulation as well as by private certification schemes of soil and growing media before its end use.

Inventory 2, based on interceptions data and scientific and technical literature, of plant pests, plant diseases and weeds that can be associated with soil and growing medium (if relevant components thereof). The inventory should include at least the quarantine organisms listed in the Council Directive 2000/29/EC, the organisms addressed by emergency measures in the EU6, the organisms included in EPPO pest lists7 and also examples of the most important emerging risks of plant health concern that are not listed in the EU regulation.

The tasks are specified as follows:

- **Task 1**

Validate with EFSA counterpart the draft protocols for the extensive literature searches (ELS) and the document/studies selection criteria to perform the tasks 2 and 3.

- **Task 2**

Inventory 1: Perform an extensive literature search to make an inventory of all soil and growing media (and if relevant components thereof). To this effect, the currently available scientific and technical documentation, the grey literature, the relevant National Authorities websites and specific databases (trade, soil etc.) should be scrutinised. The information should be extracted to include in the inventory the soil and growing media (i) imported as commodities (i.e. not in association with plants intended for planting), (ii) attached to plants for planting, and (iii) attached as a contaminant to imported goods (ranging from ware potatoes to agricultural machinery). For each identified type of soil and growing medium (if relevant components thereof) the contractor is requested to indicate the (i) production processes (from raw material to final product), (ii) the phytosanitary requirements imposed by EU regulation as well as (iii) the requirements of the existing private certification schemes (e.g. Regeling Handels Potgronden, Netherlands; GGS Gütegemeinschaft Substrate für Pflanzen e.V Germany) and (iv) the end use(s) in agriculturec with special focus to the EU (e.g. soil improvers, fertilisers, growing media for plants for planting etc.)

- **Task 3**

Inventory 2: Perform an extensive literature search to make an inventory of the harmful organisms of plants (including weeds and invasive plants) that can be associated with soil and growing media (if relevant components thereof). To this effect, the currently available scientific and technical documentation, the grey literature, the relevant National Authorities websites and specific databases (trade, soil etc.) should be scrutinised. The information should be extracted to include in the inventory all the organisms listed in the Council Directive 2000/29/EC7, the EU emergency measures and the EPPO lists9 and also examples of the most important emerging risks of plant health concern that are not listed in the EU regulation.

For each organism the contractor should indicate the stage of the life cycle of the organisms associated with soil or growing medium (if relevant components thereof).

- **Task 4**

Synthesis and analyses of the results of the searches and the uncertainties.

This contract was awarded by EFSA to:

Contractor: IBF Consortium

Contract title: Extensive Literature Searches Soil and Growing Media Inventories

Contract number: RC/EFSA/PLH/2013/01-SC1

INTRODUCTION AND OBJECTIVES

The EFSA Panel on Plant Health has received a request from the EC to provide a scientific opinion on the risks to plant health posed by soil or growing medium. Soil and growing medium provide a means via which harmful organisms to plants and plant products and other non-native invasive species, including weeds and invasive plants, can enter and spread into the European Union territory. The risks posed by the movement of soil and growing medium as potential pathways for the introduction and spread of harmful organisms are universally recognised and addressed in the European Union by the Council Directive 2000/29/EC. Three separate scenarios for the import and movement of soil and growing medium need to be considered when addressing the phytosanitary risks posed by these objects:

i. Soil and growing medium imported as commodities (i.e. not in association with plants intended for planting);
ii. Soil and growing medium attached to plants for planting, and
iii. Soil and growing medium attached as a contaminant to imported goods (ranging from ware potatoes to agricultural machinery).

To provide a solid, science based opinion, EFSA has requested the contractor to provide preparatory work for the Panel on Plant Health, which provides insight into the types and compositions of soil and growing media that are currently in use, and their possible association with harmful organisms. The objectives of this contract are to develop two inventories by means of extensive literature searches following the methodology described in the EFSA guidance on systematic review:

- **Inventory 1** of all types of soil and growing media (if relevant components thereof) to be elaborated considering (i) the soil and growing medium imported as commodities (i.e. not in association with plants intended for planting), (ii) the soil and growing medium attached to plants for planting, and (iii) the soil and growing medium attached as a contaminant to imported goods (ranging from ware potatoes to agricultural machinery). For each identified type of soil and growing medium the contractor should indicate:
    - The production processes involved to produce or process the soil or growing medium, from the raw material(s) to the final product(s).
    - The end use in agriculture with special focus to the EU (e.g. soil improver, fertiliser, growing media for plants for planting etc.)
    - The phytosanitary requirements imposed by EU regulation as well as by private certification schemes of soil and growing media before its end use.

- **Inventory 2**, based on interceptions data and scientific and technical literature, of plant pests, plant diseases and weeds that can be associated with soil and growing medium (if relevant components thereof). The inventory should include at least the quarantine organisms listed in the Council Directive 2000/29/EC5, the organisms addressed by emergency measures in the EU6, the organisms included in EPPO pest lists7 and also examples of the most important emerging risks of plant health concern that are not listed in the EU regulation.

1. MATERIALS AND METHODS: INVENTORY 1

An Extensive Literature Search (ELS) was performed to create an inventory of soil and growing media (and if relevant components thereof). We will further refer to this list as Inventory 1. The inventory includes soil and growing media that may be:

i. imported as commodities
ii. attached to plants for planting
iii. attached as a contaminant (adhering soil or growing medium) to imported goods

The ELS was performed according to EFSA's guidance document for performing systematic reviews (EFSA, 2010). The review question was defined as follows:

"Which soil types and growing media do exist, that can be imported into the EU as commodity, in association with plants for planting, or as contaminant adhering to imported commodities?"

To avoid ambiguous use of terminology, the following definitions were applied:

Growing medium: any material in which plant roots are growing or intended for that purpose.

Soil: specific type of growing medium that is naturally occurring, composed of the loose surface material of the earth and consisting of a mixture of minerals and organic material.

Commodity: a type of plant, plant product, or other article being moved for trade or other purpose.

Adhering soil: soil that is unintentionally attached to imported goods such as agricultural commodities and machinery.

1.1. Search strategy

The search covered soils and growing media used in different ways, e.g. as substrate, amendment, fertiliser, mulch, etc. Moreover, soils and growing media could be of very different origin, including e.g. agricultural or horticultural products or waste, industrial by-products, inorganic material (e.g. rock), wood-based products, and municipal waste. A major drawback of such a broad scope is that a literature search would yield an excessively large number of records. To reduce the number of search results to an acceptable level, studies were only considered eligible if they provided evidence that a soil or growing medium was associated with plant production *or* attached as a contaminant *or* used as a commodity that can be transported. Other criteria were that the study has been published in the period of 2004-2014 and that it at least comprises an English or Dutch abstract. Dutch studies were included since the Netherlands are a key player in the horticultural industry.

The literature search was largely restricted to bibliographic scientific databases, as this yielded a very large number of records and searching in grey literature would cause the ELS to become unmanageable, while such search would provide limited added value. Hand search has been executed by screening websites of private organizations responsible for certification of production and trade of growing media. CAB Abstracts was selected as primary search database as this database covers by far the most journals relevant for the scope of the project. Additional records were searched in AGRIS and ARTIK as these databases contain domain-specific and Dutch literature, respectively. To cover also possible very recent developments in the domain of soils and growing media, a representative of the Dutch RHP foundation was interviewed by phone.

Boolean operators, proximity operators, truncation, specific tools and database specific functionalities, like CABI and AGRIS thesauri, were used to ensure that relevant search terms were included in the search strategy. Particular search terms were not included in the search strategy because they would yield a large number of records, most of which are outside the scope of the ELS. For example, "soil" was excluded, and replaced with narrower search terms such as "potting soil" and "soil mix". Also, search terms associated with sterilized growing media (e.g. in vitro, culture medium) were not included as these are frequently associated with microbiological studies. Table 1 summarizes the search strategy; the complete lists of search terms are included in Appendix A.

After removing duplicates, the final result of the bibliographic database search yielded a total of 15,331 records. The approach and results of the search strategy, including number of search hits, are presented in Figure 1.

Table 1: Search strategy of Inventory 1

Searches	Combination of search terms
Set #1	Search terms representing adhering soil
Set #2	Search terms representing soil or growing media as commodity
Set #3	Search terms representing plants for planting
Set #4	Search terms representing types of soil and growing media
Set #5	Set #3 AND #4, representing soil and growing media associated with plants for planting
Set #6	Time period of ten years, combined with OR
Set #7	Set #1 AND #6
Set #8	Set #2 AND #6
Set #9	Set #5 AND #6
Set #10	Set #7 OR #8 OR #9

1.2. Screening of records

The final unduplicated list of 15,502 records was screened by a team of nine people. Only title and abstract were screened, as data were also to be extracted from abstracts alone (see motivation below). To guarantee that a consistent screening procedure was applied by all people, a screening guidance document was developed which included a detailed description of the screening tool (Appendix B). Also, a screening exercise was performed in which all persons screened the same set of records and codes were compared to identify and discuss differences in interpretations.

Table 2 provides an overview of screening criteria and results of the screening process. Records for which no decision could be made on the basis of abstract screening were marked as a separate category that could optionally be evaluated at a later stage, depending on the results of the abstract-based data extraction.

Table 2: Applied screening criteria and screening results in absolute and relative numbers

Screening code	Interpretation	# records	% records
Excluded records			
No abstract available	Information from the database does not include an abstract	551	4%
Document type not eligible	e.g. letter to the editor, introductory chapters, theoretical/model study	90	1%
Reported study does not deal with soil and growing media	Reported study does not deal with soil and growing media (e.g. studies dealing with aquaculture or livestock production	2,161	14%
Soil and growing media are not the focus of the study	i.e. the use of a particular growing medium is arbitrary and not related to the objective or conclusions	2,702	18%
Study describes a response to dose experiment	i.e. the growing medium is used as carrier to measure the effect of nutrients, pH, salinity, etc.	2,232	15%
Soil or growing medium is not moved	i.e. study on the optimal soil conditions for restoring vegetation a in conservation area	282	2%
Included records			
Included	Proceed with data extraction	6,788	44%
Unsure – full text screening required	No decision possible on the basis of abstract screening	527	3%

1.3. Data extraction

A total of 6,788 records resulted from the screening stage as eligible for abstract-based data extraction. From this selection, 808 records were identified as dealing with sterilized growing media and not further subjected to data extraction. The remaining records were mapped into different clusters based on type of product (e.g. waste or residue, wood, compost), type of application (e.g. amendment, mulch), production environment (e.g. nursery, greenhouse) and production system (e.g. organic production, containers). Clusters of records were then assigned to the different team members involved in data extraction (nine in total). For each record, the following information was collected:

- Context in which the soil or growing medium was addressed, i.e. plant production, natural environment, adhering soil or commodity;
- Possible treatments mentioned with respect to the soil or growing medium, e.g. composting, cooking or drying;
- Soils and/or growing media mentioned in the abstract.

After approximately 25% of all records had been done, it was agreed with EFSA to limit data extraction to the collection of information that was still absent or poorly represented (i.e. extracted from less than 10 abstracts) in the inventory. This implied that soil and growing media which were scored for 10 or more times were not scored anymore. This decision was made to make the data extraction less labour-intensive by not having to check Soil and growing media very commonly mentioned (e.g. “vermiculite”, “peat”) in the steadily growing list of soils and growing media. In addition, it was decided upon consultation with EFSA to not further specify certain categories of soils and growing media, either because they had a low phytosanitary risk profile or because more detail was not considered informative to EFSA’s objectives. Specifically, these categories are commercial

products, wetting agents, animal manure and other products of animal origin, micro-organisms (e.g. mycorrhiza), and water and nutrient solutions used in soilless cropping systems.

In the initial review protocol, data extraction was supposed to distinguish between single components and mixtures, i.e. products consisting of different types of soils or growing media. However, it was agreed with EFSA to restrict data extraction to individual components, as it appeared that mixtures are often created *ad hoc* for a specific purpose and the hypothetical number of combinations of soils and growing media is endless. Moreover, for brands representing commercial products it is very difficult to identify the individual compounds and the ratio to which they are mixed. A full picture of the protocol has been presented in Figure 1.

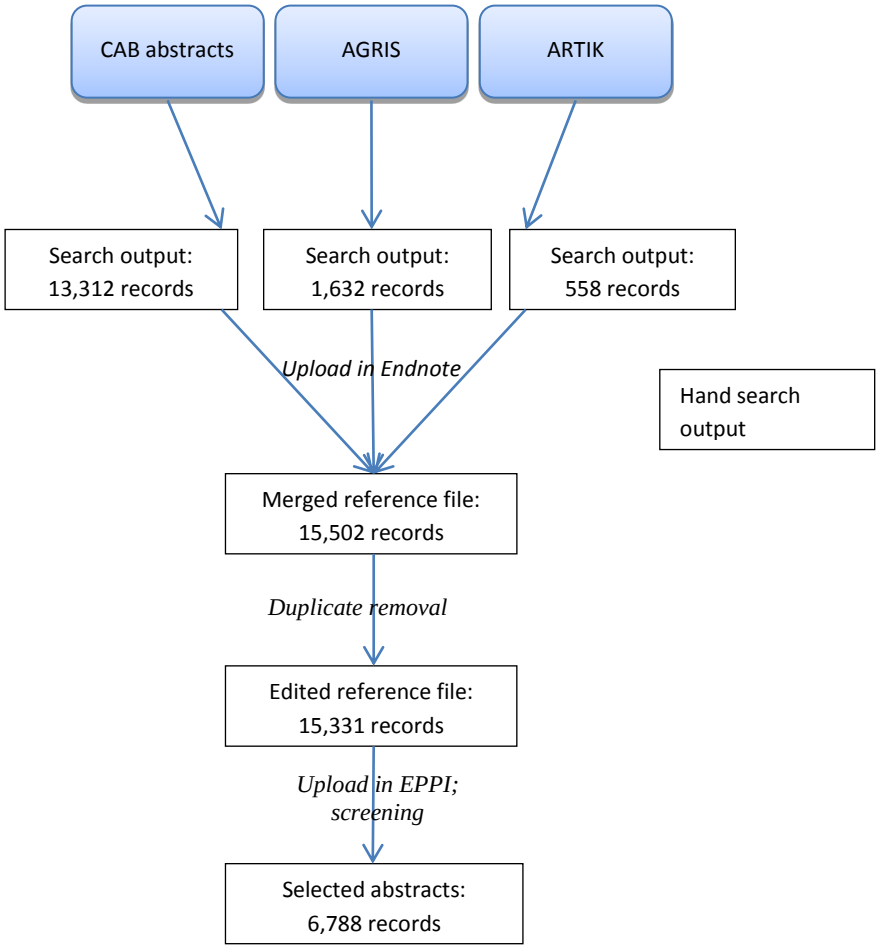

Figure 1: Schematic overview of the search and screening procedure, including the number of records resulting at each stage

1.4. Additional information

Apart from the extracted information described in section 1.3, the objectives of Inventory 1 specified the collection of the following additional information on soil and growing media:

- Characterisation of the production process of soil and growing media in relation to the possible presence of harmful organisms. This was done as a separate activity by the team member working at SoilCaresResearch with a phytopathological education. SoilCares aims to contribute globally to a sustainable agricultural production by developing widely available and affordable methods for soil and crop quality assessment as well as management recommendations. The applied method was expert judgement and knowledge based on the most important scientific literature. Based on the inventory of treatments that followed from the data extraction, a final list of relevant and possible treatments was defined. These treatments were then associated with the identified types of soil and growing media. In doing so, soils and growing media were merged into categories with comparable production processes.
- Association of soils and growing media with requirements following from private certification schemes. A separate review of existing relevant certification schemes was performed. This was not included in the ELS approach as it concerns only a small number of certification schemes and regulations.

2. MATERIALS AND METHODS: INVENTORY 2

An Extensive Literature Search (ELS) was performed to compile an inventory of plant pests, plant pathogens, weeds and invasive plants that can be associated with the soil and growing media (if relevant components thereof) identified in Inventory 1. We will further refer to this list as Inventory 2. In specific, this inventory includes:

i. The quarantine organisms listed in the Council Directive 2000/29/EC;
ii. the organisms addressed by emergency measures in the EU;
iii. the organisms included in the EPPO pest lists (A1 and A2 lists of organisms recommended for regulation, Alert lists);
iv. cases of the most important emergency risks of plant health concerns that are not listed in the EU regulation.

The ELS was performed according to EFSA's guidance document for performing systematic reviews (EFSA, 2010). The review question was defined as follows:

"Which organisms harmful to plants (i.e. plant pests, plant pathogens, weeds and invasive plants) can be associated with soil and growing media?"

The list with harmful organisms has been limited to organisms that can be associated with soil. Mites, based on their biology, are not considered to have an association with soil/growing medium and therefore are not included in the search list. In agreement with this, a search in the CAB Abstracts database for relevant records regarding species such as: Eutetranychus lewisi, E. orientalis, Oligonychus perditus, and Aculops fuchsiae has yielded no records apart from three (for E. orientalis) that were all not relevant. Other group of pests such as psyllids, aphids and whiteflies are not included in the search terms based on their biology and life cycle as there is no clear association with soil, and if any records are retrieved would be most likely not relevant as it was the case for the mites.

To avoid the ambiguous use of terminology, the following definitions were applied:

Plant pest: Any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products (ISPM 5). However, in this specific call, the term 'plant pest' does not include the pathogens and the weeds/invasive plants; the term is restricted to insects, acari, nematodes.

Plant pathogens: Micro-organisms (including viruses and viroids) causing disease to plants (ISPM 5)

Weed: A plant growing where it is not wanted. Generally used to describe plants which colonize readily, and can compete for resources with a planted crop (FAO)

Invasive plant: Plants that are introduced accidently or deliberately into a natural environment where they are not normally found, with serious negative consequences for their new environment (adapted from the definition of 'Invasive Alien Species' in http://ec.europa.eu/environment/nature/invasivealien/).

Plants: Living plants and parts thereof, including seeds and germplasm (ISPM 5)

Harmful organisms for plants: Any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products. (Council Directive 2000/29/EC)

2.1. Search strategy

Literature on harmful organisms for plants was considered only if these organisms were associated with soil and growth media. Studies were included if they: a) relate to organisms that are harmful to plants and are currently regulated in the EU (including those considered as emerging risks) or are recommended for regulation (EPPO), or are not listed in the EU regulation but considered to pose an important emergency risk for plant health, and b) describe the association of these organisms harmful to plants with soil and growing media that have a (potential) end use in an agricultural or natural environment. To demarcate the search on organisms considered as an "emerging risk", a pre-selection of organisms representative for this category was done in consultation with EFSA. Studies were excluded if they: a) consider organisms comprising (only) a threat other than to plant health (micro-organisms affecting animal/human health, food safety, etc.), or b) consider import of organisms harmful to plants that is not associated with the soil and growing media (e.g. active transport of the pest/pathogen/weed/invasive plant itself).

Other criteria were that the study has been published in the time period of 2004-2014 and that it comprises an English or Dutch abstract. In consistency with Inventory 1 search strategy, Dutch studies were included since the Netherlands are a key player in the horticultural industry.

In consistency with Inventory 1 search strategy, the literature search for Inventory 2 was restricted to one bibliographic scientific database. This search yielded a large number of records and searching in grey literature would cause the ELS to become unmanageable, while such search would provide limited added value. CAB abstracts was selected as primary search database as this database covers by far the most journals relevant for the scope of the project.

The search terms for Inventory 2 included:

1. The names of the harmful organisms (pests, pathogens and weeds/invasive plants) that fall in one of the four categories:

    a. quarantine organisms listed in the Council Directive 2000/29/EC,

b. organisms addressed by emergency measures in the EU,

c. organisms included in the EPPO pest lists (A1 and A2 lists of organisms recommended for regulation, Alert lists),

d. predefined organisms considered to pose an important emerging risk for plant health that are not listed in the EU regulation, see Appendix D

2. The soils and growing media identified in Inventory 1.

Search terms in category 1 included the synonyms of the organisms that have been used in the last ten years. For pathogens, insects and nematodes, these synonyms were retrieved from the CABI Thesaurus and EPPO pest datasheets. The weeds selected for the screening included the only genus listed in the EU Directive, seven species from the EPPO Lists and two species suggested as posing an emerging risk. The selection of the weed species among those listed in the EPPO Lists was based on the information in the Q-Bank database (http://www.q-bank.eu) and the Invasive Species Compendium datasheets (http://www.cabi.org/isc) regarding their invasiveness, negative agricultural and environmental impact and their means of distribution listing contaminated growth media as a way for dispersal - i.e. not by animals, wind etc. Weed species were also selected to cover all requested growth habitats (i.e. terrestrial, aquatic and parasitic plants). Synonyms for the selected weeds were obtained from the EPPO pest datasheets (http://www.eppo.int/INVASIVE_PLANTS/ias_lists.htm) and the Invasive Species Compendium datasheets (http://www.cabi.org/isc).

For bacteria, fungi, insects and weeds/invasive plants, the search was performed using the name and synonyms of one organism each time, combined with OR, as it was expected that the search would retrieve a large amount of records and keeping the records separated per organism would allow a more efficient handling of them. For nematodes, viruses and phytoplasmas, the search was performed using the names and synonyms of all organisms within each taxonomic group at once, combined with OR, as the number of retrieved records was expected to be smaller.

The search for Inventory 2 started when approximately 60% of the Inventory 1 records had been processed, leading to a list of about 900 terms on soils and growing media, hereafter referred to as *'Intermediate list of soil and growing media terms'*. Upon completion of Inventory 1, an additional list of about 150 terms was compiled and used to search for the Inventory 2, hereafter referred to as *"Additional list of soil and growing media terms"*. In this second list, it was agreed with EFSA not to include crop names, as this information was to be covered by the data extraction from the EPPO PQR database (https://www.eppo.int/DATABASES/pqr/pqr.htm) on the host plants for the harmful organisms under study. The lists of search terms used are included in Appendix C.

The search for Inventory 2 was performed in two phases:

Phase A: The search was performed for bacteria, fungi, viruses, phytoplasmas, insects, nematodes and weeds/invasive plants in combination with the '*Intermediate list of soil and growing media terms'*. The search strategy is shown in Table 3.

Table 3: Search strategy for Inventory 2: Phase A

Searches	Combination of search terms
Set #1	Time period of ten years, combined with OR
Set #2	Intermediate list of soil and growing media terms, combined with OR
Set #3	Name and synonyms of a harmful organism, combined with OR

Set #4	Set #1 AND #2 AND #3

Phase B: The search was performed for bacteria, fungi, viruses, insects, phytoplasmas, nematodes and weeds/invasive plants in combination with the '*Additional list of soil and growing media terms'*. The search strategy is shown in Table 4.

Table 4: Search strategy for Inventory 2: Phase B

Searches	Combination of search terms
Set #1	Intermediate list of soil and growing media terms, combined with OR
Set #2	Additional list of soil and growing media terms, combined with OR
Set #3	2 NOT 1
Set #4	Time period of ten years, combined with OR
Set #5	3 AND 4
Set #6	5 AND name and synonyms of a harmful organism combined with OR

An overview of screening criteria and results of the screening process is presented in Table 5. The final result of the bibliographic database search yielded a total of 7611 records, as shown in Table 6. It is noted that certain records were given more than one of the screening codes listed in Table 5, e.g. 'INCLUDE: Included for data extraction' and 'INCLUDE: organism is a VECTOR of an eligible pest', depending on the information presented in the abstract. The approach and results of the search strategy are presented in Figure 2.
Additional information was retrieved from EPPO PQR database and Datasheets and PRA's (Pest Risk Analysis) as presented on the website of EPPO (www.eppo.org). The EPPO PQR database contains an overview of host plants of harmful organisms. Since a considerable part of the soil and growing media are from plant origin, the host plants (Latin names) of the harmful organisms listed in the EPPO PQR database were compared with the soil and growing media from plant origin (Latin names).

Datasheets and PRA's of harmful organisms contain systematic information about host plants and means of dispersal of harmful organisms. Since these documents contain relevant information about soil and growing media additional to the extensive literature search, data have been extracted.

Furthermore, we have investigated whether Europhyt, the European database in which interceptions of harmful organisms are registered, contains relevant information which can be systematically retrieved, but this appeared not to be the case.

2.2. Screening of records

The records were screened on title and abstract by a team of six people: a bacteriologist, a mycologist, a virologist, an entomologist, a nematologist and a weed scientist. To guarantee that a consistent screening procedure was applied by all people, a screening guidance was developed which included a detailed description of the screening tool, presented in Table 3.3. Records for which no decision could be made on the basis of abstract screening were marked as a separate category that could optionally be evaluated at a later stage, depending on the results of the abstract-based data extraction.

Table 5: Overview of screening criteria and results of the screening process

Screening code	Interpretation	# records	% records
Excluded records			
EXCLUDE: No abstract available	Information from the database does not include an abstract	84	1,1%
EXCLUDE: Document	Ineligible documents include amongst	129	1,7%

type not eligible	others, letters to the editor or proceeding introductions. N.B. document types like books, book chapters or reports are eligible		
EXCLUDE: Reported study does not deal with soil and growing media	The record does not address soils or growing media that are (potentially) associated with plant production (e.g. culture medium for multiplying pathogens)	2,961	38,9%
EXCLUDE: Reported study does not deal with an eligible pest	Eligible plant pests are those currently regulated in the EU (quarantine, or addressed by emergency measures), or recommended for regulation (EPPO), or included in the list as emerging risks.	346	4,5%
EXCLUDE: Reported study is not focused on product/soil and growing media	The study is not focused on a product/soil and growing medium.	2,505	32,9%
EXCLUDE: Reported study is not focused on pest	The pest is not the focus of the study.	8	0,1%
EXCLUDE: Reported study refers to POSITIVE effect of the pest on soil and growing medium	The pest has a beneficial role for the soil and growing medium.	41	0,5%
EXCLUDE: Reported study is a dose response study		20	0,3%
Included records			
INCLUDE: Included for data extraction	Study included if: a) related to organisms that are harmful to plants and are currently regulated in the EU (including those considered as emerging risks) or are recommended for regulation (EPPO); AND b) describe the association of these organisms harmful to plants with soil and growing media that have a (potential) end use in an agricultural or natural environment. Proceed with data extraction.	453	6,0%
INCLUDE: NEGATIVE effect of soil and growing medium on the pest	The study contains data showing that a growing medium/soil amendment has a negative impact on an eligible pest.	500	6,6%
INCLUDE: STIMULATING impact on harmful organisms	The addition of a soil/growing medium enhances growth of a pest, but this soil/growing medium does not 'carry' this pest itself.	51	0,7%
INCLUDE: plant material INFECTED by eligible pest, BUT not clearly associated with soil/Gm	The study refers to infection of plants/plant material by a pest (e.g. description of symptoms), but it does not mention this plant material as ingredient of a growing medium.	406	5,3%
INCLUDE: organism is a VECTOR of an eligible pest	The study refers to the vector of an eligible pest.	72	0,9%

INCLUDE: no decision possible based on abstract	The information included in the title and abstract is not sufficient.	102	1,4%

2.3. Data extraction

As presented in Table 6, a total of 1,563 records resulted from the screening stage as eligible for abstract-based data extraction. It is noted that certain records were given more than one of the screening codes listed in Table 5, depending on the information presented in the abstract. For all records included for data extraction, the following information was collected:

- Name of pest
- Type of soil/growing medium from the Inventory 1 list, associated with the pest

For those records where there was evidence of the pest surviving in a soil/growing medium, the following additional information was collected:

- Stage of life cycle associated with soil/growing medium
- Association with plant tissue
- Survival length
- Geographical location where the study was conducted
- Geographical location of pest in the study
- Source of harmful organism
- Detection/identification method
- Conditions tested for pest survival

Table 6: Overview of results of the screening process per taxonomic group

Taxonomic group	# records retrieved from CAB database	# records selected for data extraction
Bacteria	1,140	538
Fungi	738	195
Viruses	353	12
Phytoplasmas	185	80
Insects	3,802	623
Nematodes	476	75
Weeds/invasive plants	917	40
Total number of records	***7,611***	***1,563***

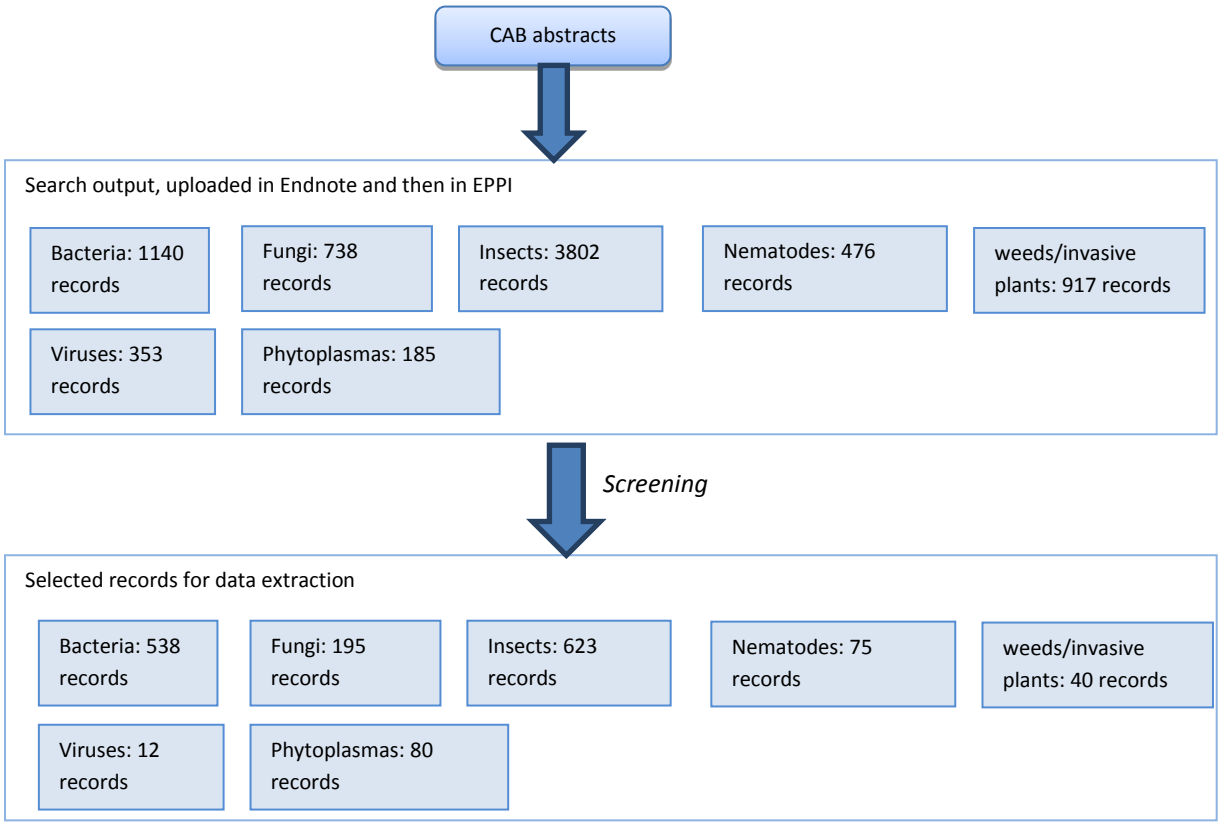

Figure 2: Schematic overview of the search and screening procedure for Inventory 2, including number of records resulting at each stage

3. RESULTS

Results have been stored in Excel data files with the following names:

Inventory 1:

- Data extraction: 'final results v2 including latin name.xlsx'
- Data extraction: 'pathways.xlsx'
- Processing of soil and growing media: 'treatments soil and growing media.xlsx'

Inventory 2, data extraction:

- Nematodes: 'final results inv II nematodes.xlsx'
- Bacteria: 'final results inv II bacteria.xlsx'
- Phytoplasmas: 'final results inv II phytoplasmas.xlsx'
- Fungi: 'final results inv II fungi.xlsx'
- Weeds: 'final results inv II weeds.xlsx'
- Viruses: 'final results inv II viruses.xlsx'
- Insects: 'final results inv II insects.xlsx'

Inventory 2, additional information (source of harmful organism, life cycle stage):
__TABLE_NEMATODES (vs. SOIL_GM – SOURCE OF HO - LIFE STAGE)
__TABLE_BACTERIA (vs. SOIL_GM – SOURCE OF HO - LIFE STAGE)
__TABLE_INSECTS_ACARI (vs. SOIL_GM – SOURCE OF HO - LIFE STAGE)
__TABLE_FUNGI (vs. SOIL_GM – SOURCE OF HO - LIFE STAGE)
__TABLE_WEEDS_PARASITIC PLANTS (vs. SOIL_GM – SOURCE OF HO - LIFE STAGE)

3.1. Results of Inventory 1: Soil and growing media

Data extraction

A final list of soil and growing media as output of the data extraction has been compiled, in which types of soil and growing media are classified in the following structure:

1. Bulkcategories
    a. Animal manure: manure (including leachate) of animal origin, e.g. cow / cattle manure, pig manure, chicken/ broiler/ poultry litter, guano (bat manure) goat dreg, poultry refuse, sheep droppings, steer manure, swine waste, fish manure
    b. Commercial products: brands representing growing media with a predefined composition of single components and a standardized quality level.
    c. Hydroponic system/ soilless culture: floating cultivation
    d. Mycorrhiza and microorganisms
    e. Other products from animal origin; growing media of animal origin not animal manure such as blood meal, bone meal etc.
    f. Sterilized growing media: (in vitro) culture media such as agar, sterilized water etc.
    g. Wetting agents: a substance that reduces the surface tension of a liquid

2. Material from plant origin
    a. Catch and cover crops/ weeds
    b. Other material from plant origin
    c. Wood (-based) or forest soil and growing media

   d. Processed products from plant origin including waste and residues

3. Inorganic and industrial / municipal material
   a. Soil and growing mediaof natural origin
   b. Processed anorganic soil and growing media
   c. Municipal and industrial waste.

The following criteria were used for the development of this structure:

1. The bulk categories have been defined to cover all growing media of which containing harmful organisms can be excluded or that further subdivision does not make sense, because the composition of the medium is still unclear.
2. Since growing media of plant origin form a major risk for containing harmful organisms and a major category in the growing media, they are distinguished from other growing media. The subdivision within this group is made for the following reasons. Catch and cover crops and weeds are not soil and growing media by themselves, but by mixing them with the soil, they can be part of the mixture. Wood (-based) or forest s&gm are a major category because forestry pests are an important category of harmful organisms. Particle size can be an indicator of the level of risk and in legislation this category is separately addressed (e.g. in the annexes of Council Directive 2000/029/EC. Furthermore processing material of plant origin can affect the level of risk of containing harmful organisms.
3. In the anorganic categories, the subdivision is based on processing intentionally (processed anorganic soil and growing media) or unintentionally (municipal and industrial) waste.

Furthermore within each category, additional subcategories are made. For material from plant origin, all growing media based on plant parts are clustered at species level. Finally, within each category, duplications have been removed and the soil and growing media are put in alphabetical order. The categories also reflect the intended use such as manure (fertilization), catch and cover crops, mycorrhiza, wetting agents, if sufficient information was available. However, making a distinction between soil improvement and growing medium could not be made on the basis of the information presented in the abstracts.

Additionally, pathways are scored if the abstract contains sufficient information. The following pathways are distinguished:

1. Associated with plant production
2. Associated with natural environment
3. Adhering soil
4. Commodity.

Processing of soil and growing media

A table with main categories of soil and growing media on one axis and the processes on the other axis has been constructed in which all potential combinations are identified and the potential impact of the process on the risk of containing harmful organisms.

Certification schemes

Within Europe, three organizations deal with certification of soil and growing media applied by consumers and professional organizations as a substrate for plant growth:

1. RHP, The Netherlands. This organization manages 6 quality marks: RHP Horticulture, RHP Consumer, RHP Mushrooms, RAG Green Roof, RAG Landscaping and RAG Soil supply.

The RHP distinguishes itself from other organization by a full chain control. This implies that not only the product will be checked, but also the whole production and transport process to the customer. The main aspects on which the growing media are checked are chemical aspects (raw material and fertilizers), physical aspects and phytosanitary aspects. The certification body MPS (Milieu Project Sierteel)-ECAS is responsible for supervising compliance with the requirements. The surveillance exists of audits at (peat)-extraction locations, as well as production-facilities. Additionally products are sampled and analysed. The product-sampling is intended to ensure that production-processes are managed in compliance with the requirements. Sampled peat products are analysed on weeds, *Plasmodiophora brassicae* and nematodes. The assessment of these organisms offers a clear indication of the overall phytosanitary status of the product. The methods for analysing the organisms are practically feasible and reliable. For weeds a germination test will be performed. To test the presence of *Plasmodiophora brassicae*, susceptible brassicaea are grown on samples to determine whether they become infested. The Oostenbrink elutriator is applied to extract free living nematodes, the Kort elutriator to extract cyst nematodes and the Bearmann funnel to extract Bursaphelenchus ssp.
The results provide the necessary insight into the phytosanitary status of the products.

2. In Appendix E an overview is given of the nematodes for which peat is analysed. The results of the tests are stored in a database that is not publicly available. Peat cannot be harvested in agricultural areas and growing media have to be free from harmful organisms and weeds. Source: www.rhp.nl/en/professional/

3. GGS, Germany. The GGS (Gütegemeinschaft für Pflanzen e.V.) manages the following growing media: bark, growing media, flower potting soils, constituents, expanded clay granules, substrates for roof gardens and substrates for tree planting. No exhaustive list of single components of the different growing media can be presented, since members of GGS have to provide the recipe of the growing medium, which will be checked. In Germany growing media which can be applied by professional users are listed in table 7 of the fertilizer law (Verordnung über das Inverkehrbringen von Düngemitteln, Bodenhilfsstoffen, Kultursubstraten und Planzenhilfsmitteln (Düngemittelverordnung – DüMV), vom 5. Dezember 2012.) Source: www.substrate-ev.org/home.html?L=1

4. CAS, France. (Le Chambre Syndicale des Ameliorants Organique et Support de Culture) source: www.cas-asso.com/fr/La-CAS/Les-permanents. The website contains only information in French. A request has been submitted by email for clarification but not responded.

3.2. Results of Inventory 2

Data extraction

The results of the data extraction of Inventory 2 are presented in Excel files. For each of the taxonomic groups (see Appendix C) separate tables were created. On each table harmful organisms are horizontally presented in alphabetical order and the soil and growing media vertically, similar as the presentation of the results of Inventory 1.

Each file contains at least

- the result of the data extraction of the ELS (sheet entitled ‘positive relationships’) (a),
- the EPPO PQR database (sheet entitled ‘EPPO PQR) (except weeds) (b) and

- the EPPO datasheets and PRAs (sheet entitled ‘EPPO PRA and DS’) (c).

The results of all taxonomic groups are summarized in a separate sheet entitled 'summary' in which the codes have the following meaning (based on the EPPO PQR, User Manual):

No information	0
Major	1
Minor	2
Incidental	3
wild/weed	4
artificial	5
unclassified	6
alternate	7
Uncertain	-1

The same codes are applied in the sheets entitled 'EPPO PQR' for all taxonomic groups except weeds.

This EPPO user's manual provides the following explanation of the codes; 'Major hosts are defined as precisily as possible, usually at the species level. Minor hosts are frequently whole genera, but like the other host categories they may also be plant families, or non-taxonomic groupings of plants, such as 'woody plants'. Incidental hosts are hosts when a pest is found on a plant but it is not known whether it can complete its life cycle on it. In the case of unclassified host no details are available. Alternate hosts are hosts when two unrelated host species feature in the life cycle of a pest.

The codes of the EPPO datasheets and PRA datasheets (sheet entitled 'EPPO PRA and DS' for all taxonomic groups have the following meaning:

Evidence of relationship (unclassified)	1
Uncertain relationship	-1

'Uncertain' means that on the basis of the difference in the taxonomic level between the host of a harmful organism and the plant material used as growing medium the relationship the risk of containing harmful organisms neither can be confirmed nor excluded.

The codes in the datasheets entitled 'positive relationship' (all taxonomic groups) mean the number of records in which the relationship between harmful organism and soil and growing medium is provided.

Furthermore, the files can contain the following sheets based on the data extraction of the ELS:

- 'Negative relationship': the soil or growing medium has a suppresive impact on the harmful organism.
- 'Stimulating relationship': the soil or growing medium has a stimulating relationship.
- 'Vector': organism acts as a vector for Harmful organisms.
- 'Geographical origin-Detection' (only phytoplasma's): the geographical origin of the harmful organism is reported as well as the method by which the harmful organism is detected.

The codes in these datasheets also mean the number of records in which the relationship between harmful organism and soil and growing medium is provided.

Finally, the sheets contain at the bottom of the sheets 'positive relationship' and 'negative relationship' additional information about the geographical origin of the pest used in the particular study, the study, the life cycle stage of the organism, the association with plant tissue, survival length, source of harmful organism, detection – identification method, and conditions tested for pest survival.

In separate Word-files for each relevant taxonomic group, the source of the harmful organism and the life cycle stage are presented per record for each soil and growing medium.

4. CONCLUSIONS AND RECOMMENDATIONS

Although an ELS is intended to provided exhaustive evidence, some demarcations had to be made because of project management related reasons:

1. Generic terms such as 'soil' and 'compost' had to be excluded
2. Screening and data extraction are based on abstracts
3. Only English and Dutch abstracts in Inventory 1 and only English abstracts are included in Inventory 2.
4. No plant names of plants without specified plant parts from the second part of the results of Inventory 1 are included in the second search strategy of Inventory 2, because of the overlap with the data from the EPPO PQR database.

Those limitations may have the consequence that not every soil and growing medium type is included in the list. This conclusion is enhanced by the observations made during data extraction. Since most records regard scientific papers presenting results of research and experiments, the records do not contain evidence about practical use of soil and growing media, but only use in experiments. It is obvious that in many cases, material of plant species which are locally available is used to produce a growing medium. Therefore, no plant species can be excluded as a source for production of growing media.

It became also apparent during data extraction of Inventory 1 that soil and growing media cannot be sharply demarcated and distinguished from other categories such as fertilizers, manure, catch and cover crops, toppings etc.

Those observations feed the discussion whether the application of methods such as a systematic review and extensive literature search is the most effective and efficient method under all circumstances. The research question dealt with in this report has a number of characteristics that complicate the use of such rigid methods:

- Very broad scope
- Difference in relevance (e.g. phytosanitary risk, movement) and current knowledge status
- The use of "bulk terms" which complicates the definition of a search strategy that is sufficiently specific and sensitive
- "Experimental use" of soil and growing media particularly informal. This is not recorded in scientific literature
- Continuous evolution of the domain, with new products being investigated and applied and virtually any organic substance being hypothetically feasible as growing medium

These complications encourage a thorough consideration of methodological aspects in future similar situations, such as:

- A precise definition of the objective of a review and specification of the insights that are to be obtained from it, including distinction between what is known already and which information is still lacking;
- Narrowing down the review question or defining several review questions at a level that enables the formulation of sufficiently specific eligibility criteria and selection of those studies that contribute to the defined knowledge demand;

- Critical evaluation of the suitability of information sources in relation to the required insights to be obtained. A broad (scientific) literature search may not always be the most efficient choice, for instance in the following cases:
    - (Scientific) literature may not always accurately reflect the current state of art, for instance if there's a high rate of innovation or many developments take place in a not-scientific environment; in such cases, alternative methods such as interviewing experts or stakeholders may be more efficient;
    - Information about the topic of interest is highly condensed in a few specific information sources, such as proceedings of media conferences, in which case a directed search through reviews and thematic issues (e.g. Acta Horticulturae) may then be more efficient.

It is therefore recommended to evaluate in which cases an extensive literature search is the most appropriate tool to apply.

REFERENCES

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FAO, 2007. Glossary of phytosanitary terms. International Standards for Phytosanitary Measures, ISPM No.5, FAO, Rome.

APPENDICES

Appendix A. Search Terms Inventory 1

CAB search terms

1. (adher* adj3 soil? or attach* adj3 soil?)

2. growing med* mix* or growing mix or growing mixes or growing mixture? or pot mix* or pot soil mix* or potted soil mix* or potting material* or potting med* mix* or potting mix* or potting soil mix* or different potting or various potting or ((pot soil? or potted soil? or potting or growing media or growing medium? or growing substrat*) adj10 (component? or composed or composing or composition? or contained or containing or manufactur* or process*))

3. container crop? or container cultivation or container culture? or container grown plant? or container plant? or "plant? in pot?" or pot culture? or pot cultivation or pot grown plant? or pot plant? or potplant? or potted plant? or potting plant? or bulb? or bud stick? or budstick? or bud wood? or budling? or budwood? or cuttings or graft wood? or grafting wood? or graftings or graftwood? or nurser* or ornamental crop? or ornamental plant? or ornamentals or planting material? or planting stock? or "plants for planting" or rhizome? or "root stock?" or rootstock? or scion? or seed tuber? or seedling? or stock type? or stocktype? or stolon* or transplant* or vegetative propagation or exp bulbs or exp vegetative propagation or exp ornamental crops or exp ornamental plants or exp planting stock or exp seed tubers

4. agricultural waste? or bark compost* or bio waste? or biowaste? or fruit waste? or growing media or growing medium? or horticultural waste? or hydroponic* or mulch* or organic amendment? or organic fertilizer? or organic waste? or pot soil? or potted soil? or potsoil* or potting media or potting medium? or potting soil? or soil conditioner? or soil mix* or soilless culture? or substrat* or uncomposted or vegetable waste? or exp agricultural wastes or exp organic amendments or exp organic wastes or exp soilless culture

5. 3 and 4

6. (2004 or 2005 or 2006 or 2007 or 2008 or 2009 or 201?).yr

7. 1 and 6

8. 2 and 6

9. 5 and 6

10. 7 or 8 or 9

AGRIS search terms:

1. (adher* adj3 soil? or attach* adj3 soil?)

2. growing med* mix* or growing mix or growing mixes or growing mixture? or pot mix* or pot soil mix* or potted soil mix* or potting material* or potting med* mix* or potting mix* or potting soil mix* or different potting or various potting or ((pot soil? or potted soil? or potting or growing media or growing medium? or growing substrat*) adj10 (component? or composed or composing or composition? or contained or containing or manufactur* or process*))

3. annuals or container crop? or container cult* or container grown or container plant* or "plant? in pot?" or pot cult* or pot grown or pot plant* or potplant? or potted plant? or potting plant? or bulb? or bud stick? or budstick? or bud wood? or budling? or budwood? or cuttings or graft wood? or grafting* or graftwood? or nurser* or ornamental crop? or ornamental plant? or ornamentals or perennials or plant* material? or plant* stock? or plant propagation or "plants for planting" or rhizome? or "root stock?" or rootstock? or scion? or seed potato* or seed tuber? or seedling? or stock type? or stocktype? or stolon* or transplant* or vegetative propagation or exp grafting or exp ornamental plants or exp plant propagation or exp vegetative propagation

4. agricultural waste? or bark compost* or bark product? or bio waste? or biowaste? or fruit waste? or growing media or growing medium? or horticultural waste? or hydroponic* or mulch* or organic amendment? or organic fertilizer? or organic waste? or pot soil? or potted soil? or potsoil* or potting compost? or potting media or potting medium? or potting soil? or soil conditioner? or soil mix* or soilless culture? or substrat* or uncomposted or vegetable waste? or exp agricultural wastes or exp crop residues or exp organic amendments or exp organic fertilizers or exp organic wastes or exp soilless culture

5. 3 and 4

6. (2004 or 2005 or 2006 or 2007 or 2008 or 2009 or 201?).yr

7. 1 and 6

8. 2 and 6

9. 5 and 6

10. 7 or 8 or 9

ARTIK search strategy:

1. (AANHANGEND* OR ADHER*) AND (GROND* OR SOIL*)

2. POTGROND* OR "POTTING MIX" OR "POTTING MIXES" OR "POTTING MIXTURE" OR "POTTING MIXTURES" OR ((GROEIMED* OR "GROWING MEDIUM" OR "GROWING MEDIA" OR "POTTING SOIL" OR "POTTING SOILS" OR SUBSTRAAT* OR SUBSTRAT*) AND (COMPONENT* OR COMPOSITION* OR FABRICAGE* OR GRONDSTOF* OR MENGSEL* OR MIX* OR PROCES* OR PRODUCTIE* OR SAMENSTELLING*))

3. (BUDWOOD OR BULB* OR "CONTAINER CROP" OR "CONTAINER CROPS" OR "CONTAINER CULTIVATION" OR "CONTAINER CULTURE" OR "CONTAINER PLANT" OR "CONTAINER PLANTS" OR "POT PLANT" OR "POT PLANTS" OR "POTTED PLANT" OR "POTTED PLANTS" OR RHIZOME* OR SEEDLING* OR AFENTEN OR AFLEGGEN OR BLADKNOPSTEK* OR BLADSTEK* OR BLOEMBOL* OR BOLLEN* OR "BOLLETJES EN KNOLLETJES ALS PLANTGOED" OR BOOMKWEKERIJ* OR BOLROKKEN OR CONTAINERPLANT* OR CONTAINERTEELT* OR ENTEN OR ENTHOUT* OR ENTMATERIA* OR GRAFT* OR GROENHOUTSTEK* OR HALFHARDHOUTSTEK* OR HARDHOUTSTEK* OR KWEKERIJ* OR MICROVERMEERDERING OR OCULATIEHOUT* OR OCULEREN OR "ONDERGRONDSE UITLOPER" OR "ONDERGRONDSE UITLOPERS" OR ONDERSTAM* OR PLANTGOED* OR PLANTENKWEKERIJ* OR PLANTENVERMEERDERING* OR PLANTMATERIA* OR POOTKNOL* OR POTPLANT* OR SCHEUTSTEK* OR SIERGEWAS* OR SIERPLANT* OR SIERTEELT* OR STEKHOUT* OR STEKKELING* OR STEKKEN OR STEKMATERIA* OR STENTEN OR VASTEPLANTENKWEKERIJ* OR "VEGETATIEVE VERMEERDERING" OR VERMEERDERINGSMATERIAAL* OR VERPLANT* OR WORTELSTEK* OR ZAAILING* OR ZACHTHOUTSTEK*) AND (AEROPONIC* OR BIOWASTE* OR "GROWING MEDIA" OR "GROWING MEDIUM" OR HYDROPONIC* OR MULCH* OR "SOIL CONDITIONERS" OR AARDAPPELAFVAL* OR "AGRARISCHE AFVALSTOFFEN" OR BODEMVERBETERAAR* OR "COMPOST VAN SCHORS" OR "CULTUUR ZONDER GROND" OR FRUITAFVAL* OR GROEIMEDIA OR GROEIMEDIUM* OR GRONDMENGSEL* OR GRONDVERBETERAAR* OR HYDROCULTUUR* OR LANDBOUWAFVAL* OR MEST OR "ORGANISCH AFVAL" OR "ORGANISCHE MESTSTOFFEN" OR "ORGANISCHE VERBETERAARS" OR SUBSTRAAT* OR SUBSTRAT* OR TOMATENAFVAL* OR TUINBOUWAFVAL* OR VOEDINGSFILMSYSTEEM*)

4. 1 or 2 or 3

5. 4 and jaar=2004,2005,2006,2007,2008,2009,2010,2011,2012,2013,2014

Appendix B Guidance for title & abstract screening of Inventory I

FAQ

1) How to interpret the exclusion criterion "does not deal with soil or Gm"?

All records in the list somehow mention a product that can possibly be used, or interpreted, as soil or Gm. How should we distinguish between records containing relevant information and records that don't?

Answer:

Records should be excluded for *not* dealing with soil or Gm *only* in the case that they describe a product without any relation to plant production and/or trade/movement. Examples of such records are:

- Piccarolo (2006): leaves and prunings....: deals with treatment of biowaste that results from pruning.
- Costa et al. (2008): performance, carcass...: deals with livestock research.

2) How to classify records mentioning, but not focusing on soil or Gm?

There were quite some records that in fact describe a soil or Gm, although not as the main subject. "not focusing on soil or Gm". How should we classify these records? In the test sample, the exclusion criterion "does not deal with soil or Gm" was quite frequently selected.

Answer:

Including all studies incidentally mentioning a soil or Gm while not actually with it, is inefficient as this will yield many records, most of which do not provide additional information. Yet, it is incorrect to identify them as "not dealing with soil or Gm". We conclude that another exclusion criterion is required here, which we define as "focus not on soil & Gm". This criterion applies if the objective and conclusions of the study are independent of the choice for a particular soil or Gm.

Examples of records applying to this exclusion criterion:

- Keski-Saari et al. (2007): phenolics ...: study on plant metabolism, Gm not considered as dependent variable;
- Farina et al. (2007): automation of...: study on irrigation technology; gm not considered as dependent variable.
- Cao et al. (2007): effects of lanthanum....: study on effect of radiation without any relation to the gm.

3) How to interpret the exclusion criterion "not (intended to be) used commercially"?

Most records do not explicitly contain evidence of commercial use of a soil or Gm. To which kind of records is this exclusion criterion aimed? Should abstracts of studies taking place under experimental circumstances be excluded on this criterion

Answer:

It appeared that commercial use is an ambiguous term. Soil and Gm may be studied in an experimental environment prior to, or in parallel with their commercial use. Also, what to do with soils used in environmental contexts? Therefore, the exclusion criterion is replaced with two alternative ones (see last page of document):

Exclude: dose response study (nutrients, pH, salinity, ...)

This category includes studies evaluating the correlation between plant growth and particular physical/chemical characteristics in a growing medium, e.g. different levels of nutrient concentration, salinity, pH, spore elements. They do not have an intention to investigate the suitability of the "carrying" substrate or Gm itself.

Examples of studies to be excluded on this criterion are:

- Oki et al. (2007): effect of nutrient levels...: solutions with different nutrient compositions to study effect of nutrient on plant.

- Garlet et al. (2007): Growth and essential...: nutrient solutions varying in potassium to study effect of nutrient on plant.

N.B. These studies are essentially different from studies evaluating the soil or Gm itself for its chemical/physical characteristics, and which should not be excluded! An example of such non-excluded study is:

- "Schroeder et al. (2004): Gas composition...": physical characteristics under investigation are related to substrate suitability.

Exclude: s & gm unlikely to be moved

Records to be excluded for this reason are those dealing with soil or Gm for which it is obvious that they are not being moved (un)deliberately elsewhere. Here, movement can be (1) as commodity, (2) as contaminant / adhering soil, or (3) with harvested crops (including, but not exclusively, plants for planting). Soil and gm used in an agricultural context will almost always be subject to (possible) movement as they may at some moment be used for the cultivation of seeds or plants for planting. Soils used in an environmental context may in some cases be subject to movement, e.g. if conservation areas are treated for some reason or endangered plants are multiplied elsewhere.

Examples of records excluded based on this criterion are:

- Anderson et al. (2004): Establishment, growth...: effect of substrate characteristics on vegetation recovery after disturbance.
- ZongQiang et al. (2007): effects of soil-moisture...: study of desert steppe soils in relation to climate change.

4) When to use the exclusion criterion "not used in natural or agricultural environment"?

Considering the reformulation suggested under question 2, this exclusion criterion is considered redundant.

5) Which products are considered as soil or Gm?

Certain records deal with additions (amendments) made to a soil, such as fertilizers, cover material, and soil improvers. Should we include these records? And does the original soil of Gm that is amended with a product need to be included in the data extraction?

Answer:

Soil and Gm include all types of amendments, so data extraction should include these amendments as well. N.B. amendments can also comprise microorganisms, such as mycorrhiza and trichoderma (fungi).

Whether the amended soil or Gm is of interest as well depends on the context: see also the answer to question 4 about this.

6) How to deal with abstracts referring to hydroponic solutions:

Some records refer to hydroponic solutions. These solutions seem not to fall in Gm categories that the ELR focuses: transferred as commodities, attached to plants for planting or contaminants for products. Do we exclude them? and which excluding criterion should we choose?

Answer:

Hydroponics refer to the system, and a hydroponic system contains a growing medium as well including water cultivation (i.e. water with nutrients), but also water-irrigated substrates such as rockwool. Hydroponics being used as substrate is thus no valid reason for exclusion. If however a hydroponic system is used for testing crop sensitivity to particular elements (e.g. nutrients), the record may be excluded; see answer to question 3.

7) How to deal with records referring to in vitro media and other sterilized media?

Sterilized media can strongly vary in composition and are frequently mentioned. Yet, their relevance is questionable, because they are mostly used for screening genotypes or basic research and are (usually) not intended for commercial use. Should we exclude them as 'not intended for commercial use'?
Answer:
In vitro media, as well as all other sterilized media, should be included as they can potentially be used commercially. However, we agree that the risk of in vitro media is very low and that specifying all such media is not relevant for the scope of the review. Therefore, a separate category under "include" will be defined in which in vitro media and other sterilized media, including (liquid or solid) culture media and sterilized water solutions can be categorized. Provided that EFSA agrees, we will not include this category in data extraction.

8) Which level of detail is required for specification of soil and Gm?
Abstracts provide different levels of detail on information on soil and Gm. When do we consider the mentioned soil(s) and/or Gm sufficiently specified for abstract data extraction, and when is full text data extraction required?

Answer:
Soil and Gm need to be specified as much as possible at the level of individual components. Apart from category (e.g. "soil", "manure", etc.) we want to know which soil (sand, clay,...), manure (farm yard, chicken). In case of mixtures (e.g. potting soil), preferably the full composition is required; not only the main components. In case this information is not (completely) available in the abstract, data extraction should take place on the basis of full text. In case you are unsure, it's better to play on safe and select full text data extraction.

Additional exclusion categories

In addition to the exclusion and inclusion criteria that were already defined and described above, 3 additional criteria have been defined to deal with particular types of records:

- exclude: abstract not available. Although records without an abstract should have been excluded already in Endnote, there might be incidental cases where an abstract is lacking (as seen in the sample set).
- Exclude: document type ineligible. Occasionally, a record may comprise a type of document that is obviously not eligible for data extraction because it is unsuitable. This is for instance the case with letters to the editor, or introduction papers of conference proceedings. N.B. Book chapters or scientific reports are in principle eligible. In case you're not sure about the eligibility of a document type, consider marking the document as unsure.
- Include: no decision possible based on abstract screening. In some cases, a record does not contain sufficient information to decide whether or not it should be included. In such case, the record should be included and subjected to full text screening. This is *not* the same as deciding that the record is suitable for full text data extraction! In the latter case, the study does *not* meet the exclusion criteria, whereas in the former it *might* meet one or more exclusion criteria.

Other recommendations

- Per record, you may only select one answer (i.e. one reason to exclude or include). The category "unsure" comprises an exception; this answer can be selected in addition to another one (the most likely answer).
- In case you're not fully sure, it's better to remain on the safe side, e.g. opt for "unsure" if you're not sure whether to include or not, and opt for "full text" if you're not sure about the level of information provided in the abstract.
- When screening the records, keep in mind the objective of the ELS, which is inventorying possible soils and growing media that can be imported into the EU. Screening should not be

biased by personal knowledge or beliefs about possible risks associated with soils or Gm, as this will follow from the second inventory!

- In case a study mentions more than one soil or Gm, the record should be classified according to the most detailed level of data extraction needed. So: select "sterilized s&Gm only if all media mentioned fall within this category, and select "s&Gm specified" only if all media are sufficiently specified.

APPENDIX C: Search Terms Inventory 2

Search terms for nematodes

1. Aphelenchoides besseyi or Aphelenchoides oryzae or Asteroaphelenchoides besseyi or Rice white tip nematode? or strawberry crimp disease nematode? or
2. Belonolaimus longicaudatus or sting nematode? or
3. Bursaphelenchus xylophilus or Aphelenchoides xylophilus or Bursaphelenchus lignicolus or pine wood nematode? or pine wilt disease or
4. Ditylenchus destructor or potato rot nematode? or
5. Ditylenchus dipsaci or Tylenchus dipsaci or Ditylenchus devastatrix or Ditylenchus secalis or Ditylenchus havensteinii or Ditylenchus hyacinthi or Ditylenchus putrefaciens or Ditylenchus tobaensis or Ditylenchus phloxidis or Ditylenchus sonchophila or Ditylenchus fragariae or Ditylenchus galeopsidis or stem nematode? or "stem and bulb eelworm?" or onion bloat or
6. Globodera pallida or Heterodera pallida or White potato cyst nematode? or pale potato cyst nematode? or
7. Globodera rostochiensis or Heterodera schachtii rostochiensis or Heterodera schachtii solani or Heterodera rostochiensis or yellow potato cyst nematode? or golden potato cyst nematode? or golden nematode? or
8. Heterodera elachista or
9. Heterodera glycines or Soybean cyst nematode? or
10. Heterodera zeae or
11. Hirschmanniella or
12. Longidorus diadecturus or
13. Meloidogyne chitwoodi or columbia root-knot nematode? or
14. Meloidogyne enterolobii or Meloidogyne mayaguensis or
15. Meloidogyne ethiopica or
16. Meloidogyne fallax or False Columbia root-knot nematode? or
17. Meloidogyne mali or Meloidogyne ulmi or
18. Nacobbus aberrans or Anguillulina aberrans or Nacobbus batatiformis or Nacobbus serendipiticus or Nacobbus serendipiticus bolivianus or Nacobbus bolivianus or Pratylenchus abberans or False root-knot nematode? or
19. Paratrichodorus porosus or Trichodorus porosus or Paratrichodorus Atlantodorus porosus or Atlantodorus porosus or Trichodorus bucrius or
20. Punctodera chalcoensis or
21. Radopholus similis citrus race or Radopholus similis citrophilus or Radopholus citrophilus or Citrus spreading decline nematode? or
22. Radopholus similis banana race or Radopholus granulosus or Radopholus acutocaudatus or Radopholus biformis or Radopholus similis similis or Burrowing nematode? or banana toppling disease nematode? or
23. Xiphinema americanum or Tylencholaimus americanus or american dagger nematode? or
24. Xiphinema bricolense or
25. Xiphinema californicum or
26. Xiphinema rivesi

Search terms for bacteria

1. (acidovorax adj3 citrulli) or (pseudomonas adj3 citrulli)
2. (clavibacter adj3 insidiosus) or aplanobacter insidiosus or bacterium insidiosum or burkholderiella insidiosa or (corynebacterium adj3 insidiosum) or corynebacterium insidiosum var saprophyticum or erwinia insidiosa or mycobacterium insidiosum or phytomonas insidiosa

3. (clavibacter adj3 michiganensis) or (corynebacterium adj3 michiganense)
4. (clavibacter adj3 sepedonicus) or aplanobacter sepedonicus or bacterium sepedonicum or (corynebacterium adj3 sepedonicum) or mycobacterium sepedonicum or phytomonas sepedonica or pseudobacterium sepedonicum
5. (curtobacterium adj3 flaccumfaciens) or (corynebacterium adj3 flaccumfaciens) or (corynebacterium flaccumfaciens var aurantiacum) or (corynebacterium flaccumfaciens var violaceum)
6. dickeya dianthicola or (erwinia adj3 dianthi) or (erwinia adj4 dianthicola) or (pectobacterium adj3 dianthicola) or pectobacterium parthenii-dianthicola
7. (pantoea adj3 stewartii) or bacillus stewartii or erwinia stewartii or pantoea stewarti
8. ralstonia solanacearum or bacillus musae or bacillus musarum or bacillus nicotianae or bacillus sesami or bacillus solanacearum or bacterium solanacearum or bacterium solanacearum var asiatica or bacterium solanacearum var asiaticum or burkholderia solanacearum or chromobacterium nicotianae or erwinia nicotianae or erwinia solanacearum or phytobacterium solanacearum or phytomonas ricini or phytomonas solanacearum or phytomonas solanacearum var asiatica or pseudomonas batatae or pseudomonas solanacearum or pseudomonas solanacearum var asiatica or pseudomonas tectonae or xanthomonas solanacearum or xanthomonas solanacearum var asiatica
9. (pseudomonas adj3 actinidiae)
10. (pseudomonas adj3 aesculi)
11. (xanthomonas adj3 citri) or (xanthomonas adj3 aurantifolii) or bacillus citri or bacterium citri or phytomonas citri or pseudomonas citri or xanthomonas smithii
12. (xanthomonas adj4 oryzae) or pseudomonas oryzae
13. (xanthomonas adj3 oryzicola)
14. (xanthomonas adj3 phaseoli) or (bacterium phaseoli) or (bacillus phaseoli) or (phytomonas phaseoli) or (pseudomonas phaseoli)
15. (xanthomonas adj3 vesicatoria) or (bacterium exitiosum) or (phytomonas exitiosa) or (phytomonas vesicatoria) or (pseudomonas exitiosa) or (pseudomonas gardneri) or (pseudomonas vesicatoria) or (xanthomonas exitiosa)
16. (xanthomonas adj3 allii)
17. (xanthomonas adj3 corylina) or (phytomonas corylina) or (pseudomonas corylina)
18. (xanthomonas adj3 dieffenbachiae) or (bacterium dieffenbachiae) or (phytomonas dieffenbachiae)
19. (xanthomonas adj4 poinsettiicola) or (xanthomonas pulcherrimae) or (xanthomonas adj4 poinsetticola)
20. (xanthomonas adj3 translucens) or (xanthomonas adj3 hordei) or bacterium translucens or phytomonas translucens or pseudomonas translucens
21. (xanthomonas fragariae)
22. (xylophilus ampelinus) or (xanthomonas ampelina)
23. (pseudomonas adj4 persicae)
24. (burkholderia caryophylli) or (phytomonas caryophylli) or (pseudomonas caryophylli)
25. (erwinia amylovora) or (bacillus amylovora) or (bacillus amylovorus) or (bacterium amylovorum) or (micrococcus amylovorus)
26. xylella fastidiosa

27. (xanthomonas adj3 pruni) or bacillus pruni or bacterium cerasi wraggi or bacterium pruni or phytomonas cerasi wraggi or phytomonas pruni or pseudomonas cerasi wraggi or pseudomonas pruni
28. (liberibacter africanus) or (liberibacter americanus) or (liberibacter asiaticus)
29. liberibacter solanacearum or candidatus liberibacter psyllaurous or candidatus liberibacter solanacearum or liberibacter psyllaurous or zebra chip
30. candidatus arsenophonus phytopathogenicus or syndrome des basses richesses
31. xanthomonas euvesicatoria or bacterium vesicatorium or xanthomonas perforans or xanthomonas gardneri
32. dickeya chrysanthemi or erwinia chrysanthemi or (pectobacterium adj4 chrysanthemi) or pectobacterium parthenii or Dickeya solani
33. Pantoea ananatis or Bacillus ananas or Erwinia ananas or Pantoea ananas
34. xanthomonas adj3 punicae
35. bacterial brown stripe or bacterial leaf blight or maize bacterial leaf blight or sugarcane leaf streak
36. burkholderia gladioli or burkholderia cocovenenans or pseudomonas antimicrobica or pseudomonas cocovenenans or pseudomonas gladioli or pseudomonas marginata

Search terms for phytoplasmas

(Phytoplasma mali) or (Apple proliferation) or (Phytoplasma prunorum) or (Apricot chlorotic leafroll) or (European stone fruit yellows) or (Phytoplasma ulmi) or (Elm phl*em necrosis mycoplasm) or (Rubus stunt phytoplasma) or (elm yellows-associated phytoplasma) or (Phytoplasma vitis) or (Grapevine flavescence dor*e) or (Phytoplasma palmae) or (Palm lethal yellowing) or (coconut lethal yellowing) or (peach rosette) or (Peach X- disease) or (Western X-disease) or (Peach yellow leafroll) or (Peach western X) or (Peach yellows) or (Peach little peach) or (Peach red suture) or (Phytoplasma pyri) or (Pear decline) or (Phytoplasma solani) or (Stolbur) or (Spiroplasma citri) or (Strawberry witches broom) or (Witches broom) or (Potato purple-top wilt) or (Maize redness) or (Phytoplasma aurantifoliae) or (Lime witches broom)

Search terms for fungi

1. Atropellis pinicola or Gordonia zelleri
2. Atropellis piniphila or Cenangium piniphilum or Atropellis arizonica
3. Ceratocystis fimbriata adj2 platani or Endoconidiophora fimbriata or Ceratocystis platani
4. Ceratocystis virescens or Endoconidiophora virescens or Ophiostoma virescens or Ceratocystis coerulescens
5. Ciborinia camelliae or Sclerotinia camelliae
6. Cronartium coleosporioides or Cronartium stalactiforme or Peridermium stalactiforme or Cronartium comandrae or Cronartium pyriforme or Peridermium pyriforme comandra or Cronartium comptoniae or Peridermium comptoniae or Cronartium himalayense or Peridermium himalayense or Cronartium quercuum or Cronartium quercus or Cronartium asclepiadeum adj2 quercuum or Cronartium cerebrum or Cronartium fusiforme or Cronartium kamtschaticum
7. Cryphonectria parasitica or Endothia parasitica or Diaporthe parasitica or Valsonectria parasitica

8. Didymella ligulicola or Mycosphaerella chrysanthemi or Mycosphaerella ligulicola or Didymella chrysanthemi or Ascochyta chrysanthemi or Phoma ligulicola or Stagonosporopsis ligulicola
9. Endocronartium harknessii or Cronartium harknessii or Peridermium harknessii or Peridermium cerebroides
10. Fusarium foetens or Gibberella pulicaris
11. Fusarium oxysporum f.sp. albedinis or Cylindrophora albedinis
12. Gibberella circinata or Fusarium circinatum or Fusarium subglutinans f. sp. pini or Fusarium lateritium f.sp. pini
13. Guignardia citricarpa or Phyllosticta citricarpa or Phoma citricarpa or Phyllostictina citricarpa
14. Heterobasidion irregular or Polyporus irregularis
15. Hypoxylon mammatum or Entoleuca mammata or Hypoxylon pruinatum or Anthostoma morsei or Fuckelia morsei
16. Mycosphaerella populorum or Davidiella populorum or Septoria musiva or Cylindrosporium oculatum
17. Phellinus weirii or Fuscoporia weirii or Inonotus weirii or Poria weirii or Fomitiporia weirii
18. Phialophora cinerescens or Verticillium cinerescens
19. Phoma andigena or Phoma andina or Stagonosporopsis andigena
20. Phymatotrichopsis omnivora or Phymatotrichum omnivorum or Ozonium omnivorum or Ozonium auricomum
21. Phytophthora fragariae adj2 fragariae
22. Phytophthora fragariae adj2 rubi or Phytophthora rubi
23. Phytophthora kernoviae
24. Phytophthora lateralis
25. Phytophthora ramorum
26. Plasmopara halstedii or Plasmopara helianthi
27. Puccinia pittieriana or Gerwasia pittieriana or Morispora ochraceoflava
28. Septoria lycopersici adj2 malagutii or Septoria malagutii
29. Synchytrium endobioticum or Synchytrium solani or Chrysophlyctis endobiotica
30. Thecaphora solani or Angiosorus solani
31. Tilletia indica or Neovossia indica
32. (Verticillium albo-atrum or Verticillium dahliae) and (hop or Humulus or Humulus lupulus)
33. (Colletotrichum xanthii or Colletotrichum acutatum) and (strawberr* or Fragaria annassa)
34. Fusarium oxysporum adj2 lactucae
35. Gremmeniella abietina or Ascocalyx abietina or Crumenula abietina or Crumenula pinea or Lagerbergia abietina or Scleroderris abietina or Scleroderris lagerbergii or Brunchorstia pinea or Brunchorstia destruens or Brunchorstia pini or Excipulina pinea or Septoria pinea or Gordonia abietina
36. Gymnosporangium globosum or Gymnosporangium fuscum adj2 globosum or Gymnosporangium juniperi-virginianae or Gymnosporangium macropus or Gymnosporangium virginianum or Podisoma juniperi-virginianae or Aecidium pyrolatum or Roestelia pyrata or Gymnosporangium asiaticum or Gymnosporangium haraeanum or Gymnosporangium chinense or Gymnosporangium koreaense or Gymnosporangium koreensis or Gymnosporangium spiniferum or Roestelia koreaensis or Roestelia koreensis or Gymnosporangium claviceps or Gymnosporangium germinale or Podisoma gymnosporangium claviceps or Caeoma germinale or Roestelia aurantiaca or Gymnosporangium yamadae

37. Phytophthora cinnamomi
38. Polymyxa betae
39. Alternaria gaisen or Alternaria kikuchiana or Macrosporium nashi
40. Alternaria mali
41. Anisogramma anomala or Apioporthe anomala or Cryptosporella anomala
42. Apiosporina morbosa or Sphaeria morbosa or Dibotryon morbosum or Otthia morbosa or Plowrightia morbosa or Cucurbitaria morbosa
43. Botryosphaeria laricina or Physalospora laricina or Guignardia laricin
44. Ceratocystis fagacearum or Endoconidiophora fagacearum or Chalara quercina
45. Cercospora angolensis or Phaeoramularia angolensis
46. Chalara fraxinea or Hymenoscyphus albidus or Hymenoscyphus pseudoalpidus
47. Chrysomyxa arctostaphyli or Melampsoropsis arctostaphyli or Peridermium coloradense
48. Diaporthe vaccinii or Phomopsis vaccinii
49. Diplodia mali
50. Elsinoe fawcettii or Sphaceloma fawcettii adj2 fawcettii
51. Elsinoe australis or Sphaceloma fawcettii adj2 viscosa or Sphaceloma australis
52. Sphaceloma fawcettii adj2 scabiosa or Ramularia scabiosa
53. Glomerella gossypii or Colletotrichum gossypii
54. Guignardia laricina or Botryosphaeria laricina or Physalospora laricina
55. Guignardia pyricola or Botryosphaeria berengeriana adj2 pyiricola or Physalospora pyricola or Macrophoma kuwatsukai or Macrophoma pyrorum
56. Melampsora farlowii or Chrysomyxa farlowii or Necium farlowii
57. Melampsora medusa or Melampsora albertensis or Caeoma faulliana or Uredo medusae
58. Monilinia fructicola or Sclerotinia fructicola
59. Mycosphaerella dearnessii or Scirrhia acicola or Systremma acicola or Lecanosticta acicola or Lecanosticta pini or Septoria acicola
60. Mycosphaerella larici-leptolepis or Phoma yano-kubotae or Phyllosticta laricis
61. Mycosphaerella pini or Scirrhia pini or Dothistroma septospora or Dothistroma pini or Cytosporina septospora
62. Mycosphaerella gibsonii or Cercospora pini-densiflorae or Cercoseptoria pini-densiflorae or Pseudocercospora pini-densiflorae
63. Ophiostoma wageneri or Ceratocystis wageneri or Leptographium wageneri adj2 ponderosum or Verticicladiella wageneri adj2 ponderosa
64. Phoma tracheiphila or Deuterophoma tracheiphila or Bakerophoma tracheiphila
65. Phyllosticta solitaria
66. Puccinia hemerocallidis or Dicaeoma hemerocallidis or Aecidium patriniae or Puccinia funkiae or Uredo hostae or Puccinia hostae
67. Puccinia horiana
68. Sirococcus clavigignenti-juglandacearum
69. Stegophora ulmea or Gnomonia ulmea or Sphaeria ulmea or Dothidella ulmea or Lambro ulmea
70. Stenocarpella macrospora or Diplodia macrospora or Macrodiplodia macrospora or Macrodiplodia zeae adj2 macrospora or Stenocarpella zeae
71. Stenocarpella maydis or Diplodia maydis or Diplodia zeae or Sphaeria maydis or Sphaeria zeae or Hendersonia zeae or Macrodiplodia zeae or Dothiora zeae
72. Venturia nashicola

73. Botrytis allii or Botrytis aclada or Botrytis byssoidea
74. Plectosphaerella cucumerina

Search terms for weeds

1. Arceuthobium
2. Pueraria lobata or Dolichos lobatus or Dolichos hirsutus or Pueraria hirsuta or Pachyrrhizus thunbergianus or Pueraria thunbergiana
3. Solanum elaeagnifolium or Solanum dealbatum or Solanum flavidum or Solanum hindsianum or Solanum leprosum or Solanum roemerianum or Solanum saponaceum or Solanum texense or Solanum uniflorum
4. Acroptilon repens or Centaurea repens or Centaurea picris or Acroptilon picris
5. Alternanthera philoxeroides or Achyrantes philoxeroides or Bucholzia philoxeroides or Telanthera philoxeroides
6. Ambrosia artemisiifolia or Ambrosia elatior or Ambrosia elata or Ambrosia paniculata
7. Fallopia japonica or Reynoutria japonica or Polygonum cuspidatum
8. Amaranthus palmeri
9. Phelipanche ramosa or Kopsia interrupta or Kopsia ramosa or Orobanche cannabis or Orobanche interrupta or Orobanche micrantha or Phelipanche ramosa or Philipaea ramose
10. Mikania micrantha or Eupatorium cordatum or Kleinia alata or Mikania alata or Mikania cordata or Mikania glechomaefolia or Mikania orinocensis or Mikania scandens or (Mikania scandens adj1 subcymosa) or Mikania sinuata or Mikania subcrenata or Mikania subcymosa or Mikania umbellifera or Mikania volubilis or Willoughbya micrantha

Search terms for viruses

(*Andean potato mottle virus*) OR (Cherry rasp leaf virus) OR (Flat apple virus) OR (Chrysanthemum stem necrosis virus) OR (Citrus leprosis virus) OR (Eggplant mosaic virus) OR (Peach rosette mosaic virus) OR (Potato black ringspot virus) OR (Watermelon silver mottle virus) OR (Watermelon silvery mottle virus) OR (Beet necrotic yellow vein virus) OR (Impatiens necrotic spot virus) OR (Pepino mosaic virus) OR (Raspberry ringspot virus) OR (Raspberry Scottish leaf curl virus) OR (Tobacco ringspot virus) OR (Tomato ringspot virus) OR (Tomato spotted wilt virus) OR (Arabis mosaic virus) OR (Andean potato latent virus) OR (Peach yellow bud mosaic virus) OR (Strawberry latent ringspot virus) OR (Tomato black ring virus) OR (Blackberry Himalaya mosaic virus) OR (Winter peach mosaic virus) OR (Grape yellow vein virus) OR (Pineapple yellow spot virus) OR (Potato spindle tuber viroid) OR (Chrysanthemum stunt viroid) OR (Coconut cadang-cadang viroid) or (Beet curly top virus) OR (Black raspberry latent virus) OR (Cherry leafroll virus) OR (Citrus mosaic virus) OR (Citrus tristeza virus) OR (Little cherry) OR (Prunus necrotic ringspot virus) OR (Satsuma dwarf virus) OR (Tatter leaf virus) OR (Strawberry crinkle virus) OR (Strawberry latent ringspot virus) OR (Strawberry mild yellow edge virus) OR (Strawberry latent C virus) OR (Strawberry vein banding virus) OR (Peach mosaic virus) OR (Plum line pattern virus) OR (Raspberry leaf curl virus) OR (Bean golden mosaic virus) OR (Cowpea mild mottle virus) OR (Lettuce infectious yellow virus) OR (Pepper mild tigre virus) OR (Squash leaf curl virus)

Search terms for insects

1. Acleris gloverana OR Western blackheaded budworm
2. Acleris variana OR Teras variana OR Peronea variana OR Peronea angusana OR Eastern blackheaded budworm
3. Aeolesthes sarta OR city longhorn beetle OR Sart longhorn beetle OR Uzbek longhorn beetle
4. Agrilus planipennis OR Agrilus feretrius OR Agrilus marcopoli OR emerald ash borer
5. Nemorimyza maculosa OR Amauromyza maculosa OR Agromyza guaranitica OR Chrysanthemum leaf miner OR burdock leaf miner
6. Anastrepha fraterculus OR Acrotoxa fraterculus OR Anastrepha braziliensis OR Anastrepha peruviana OR Anastrepha soluta OR Anthomyia frutalis OR Dacus fraterculus OR Tephritis mellea OR Trypeta fraterculus OR Trypeta unicolor OR South American fruit fly
7. Anastrepha ludens OR Acrotoxa ludens OR Trypeta ludens" OR Mexican fruit fly
8. Anastrepha obliqua OR Acrotoxa obliqua OR Anastrepha fraterculus var. mombinpraeoptans OR Anastrepha mombinpraeoptans OR Anastrepha trinidadensis OR Tephritis obliqua OR Trypeta obliqua OR West Indian fruit fly
9. Anastrepha suspensa OR Acrotoxa suspensa OR Anastrepha longimacula OR Anastrepha unipuncta OR Trypeta suspensa OR Caribbean fruit fly
10. Anthonomus bisignifer OR Anthonomus bisignatus OR Anthonomus signatus OR Minyrus japonicus OR Minyrus albopilosus OR Strawberry weevil OR strawberry blossom weevil
11. Anthonomus eugenii OR Anthonomus aeneotinctus OR Pepper weevil
12. Anthonomus grandis OR Anthonomus grandis grandis OR Anthonomus grandis thurberiae South-eastern boll weevil OR Thurberia boll weevil OR Mexican boll weevil
13. Anthonomus quadrigibbus OR Tachypterus quadrigibbus OR Tachypterellus quadrigibbus OR Tachypterellus quadrigibbus magnus OR Tachypterellus consors cerasi OR Apple curculio OR Western curculio OR large apple curculio
14. Anthonomus signatus OR Anthonomus bisignatus OR Anthonomus pallidus OR Anthonomus scutellatus OR Strawberry weevil OR strawberry bud weevil
15. Bactrocera carambolae OR Carambola fruit fly
16. Bactrocera caryae OR Dacus caryeae
17. Bactrocera cucumis OR Austrodacus cucumis OR Dacus cucumis OR Dacus tryoni var. cucumis" OR Cucumber fly
18. Bactrocera cucurbitae OR Chaetodacus cucurbitae OR Dacus cucurbitae OR Strumeta cucurbitae OR Zeugodacus cucurbitae OR Melon fly OR melon fruit fly
19. Bactrocera dorsalis OR Chaetodacus ferrugineus OR Chaetodacus ferrugineus dorsalis OR Chaetodacus ferrugineus var. okinawanus OR Dacus dorsalis OR Strumeta dorsalis OR Oriental fruit fly
20. Bactrocera invadens
21. Bactrocera kandiensis
22. Bactrocera minax OR Polistomimetes minax OR Callantra minax OR Bactrocera citri OR Mellesis citri OR Dacus citri OR Tetradacus citri OR Chinese citrus fly
23. Bactrocera occipitalis OR Chaetodacus ferrugineus var. occipitalis OR Dacus occipitalis
24. Bactrocera papayae
25. Bactrocera philippinensis
26. Bactrocera pyrifoliae

27. Bactrocera tryoni OR Chaetodacus tryoni OR Dacus ferrugineus tryoni OR Dacus tryoni OR Strumeta tryoni OR Tephritis tryoni OR Queensland fruit fly
28. Bactrocera tsuneonis OR Dacus tsuneonis OR Dacus cheni OR Japanese orange fly
29. Bactrocera zonata OR Dacus zonatus OR Dasyneura zonata OR Rivellia persicae OR peach fruit fly OR guava fruit fly
30. Blitopertha orientalis OR Anomala orientalis OR Oriental beetle
31. Carposina niponensis OR Carposina sasakii OR Carposina persicana" OR Peach fruit moth
32. Ceratitis capitata OR Ceratitis citriperda OR Ceratitis hispanica OR Pardalaspis asparagi OR Tephritis capitata OR Mediterranean fruit fly OR medfly
33. Ceratitis quinaria OR Pardalaspis quinaria OR Five-spotted fruit fly OR Rhodesian fruit fly OR Zimbabwean fruit fly
34. Ceratitis rosa OR Pterandrus rosa OR Natal fruit fly OR Natal fly
35. Conotrachelus nenuphar OR Plum curculio OR plum weevil
36. Cydia inopinata OR Grapholita inopinata OR Laspeyresia prunifoliae OR Grapholita cerasana OR Manchurian fruit moth
37. Cydia packardi OR Grapholitha packardi OR Steganoptycha pyricolana OR Enarmonia packardi OR Enarmonia pyricolana OR Laspeyresia packardi OR Laspeyresia pyricolana OR Cherry fruitworm
38. Cydia prunivora OR Grapholitha prunivora OR Enarmonia prunivora OR Semasia prunivora OR Laspeyresia prunivora OR Lesser appleworm OR plum moth
39. Dacus ciliatus Loew OR Dacus appoxanthus var. decolor OR Dacus brevistylus OR Dacus insistens OR Dacus sigmoides OR Didacus ciliatus OR Leptoxyda ciliata OR Tridacus mallyi OR Ethiopian fruit fly OR lesser pumpkin fly OR cucurbit fly
40. Dendroctonus micans OR Bostrichus micans OR Hylesinus lingiperda OR Hylesinus micansOR Great spruce bark beetle
41. Dendroctonus adjunctus OR Dendroctonus convexifrons OR Round-headed pine beetle
42. Dendroctonus brevicomis OR Dendroctonus barberi OR Western pine beetle
43. Dendroctonus frontalis OR Dendroctonus arizonicus OR Southern pine beetle
44. Dendroctonus ponderosae OR Dendroctonus monticolae OR Mountain pine beetle OR Black Hills beetle
45. Dendroctonus pseudotsugae OR Douglas fir beetle
46. Dendroctonus rufipennis OR Dendroctonus borealis OR Dendroctonus engelmanni OR Dendroctonus piceaperda OR Dendroctonus similis OR Hylurgus rufipennis OR Spruce beetle OR Engelmann spruce beetle OR red-winged pine beetle
47. Dendrolimus sibiricus OR Dendrolimus superans sibiricus OR Dendrolimus laricis OR Siberian silk moth OR Siberian moth OR Siberian conifer silk moth OR Siberian lasiocampid OR larch caterpillar
48. Diabrotica barberi OR Diabrotica longicornis barberiOR Northern corn rootworm
49. Diabrotica speciosa OR San Antonio beetle
50. Diabrotica undecimpunctata OR Diabrotica soror OR spotted cucumber beetle
51. Diabrotica virgifera OR Western corn rootworm OR Colorado corn rootworm OR Mexican corn rootworm
52. Dryocoetes confusus OR Dendroctonus abietis OR Western balsam bark beetle
53. Epitrix cucumeris OR potato flea beetle
54. Epitrix similaris

55. Epitrix subcrinita
56. Epitrix tuberis OR Tuber flea beetle
57. Erschoviella musculana OR Nycteola musculana OR arrothripus musculana" OR walnut moth OR Asian walnut moth
58. Euphranta japonica OR Rhacochlaena japonica OR Japanese cherry fruit fly
59. Frankliniella occidentalis OR Frankliniella californica OR Frankliniella helianthi OR Frankliniella moultoni OR Frankliniella trehernei OR Western flower thrips, alfalfa thrips
60. Gilphinia hercyniae
61. Gnathotrichus sulcatus OR Cryphalus sulcatus OR Gnathotrichus aciculatus OR Western hemlock wood stainer
62. Gonipterus gibberus OR Dacnirotatus bruchi OR eucalyptus snout beetle OR eucalyptus weevil OR gum tree weevil
63. Gonipterus scutellatus OR eucalyptus snout beetle OR eucalyptus weevil OR gum tree weevil
64. Helicoverpa armigera OR Heliothis armigera OR Chloridea armigera OR corn earworm OR cotton bollworm
65. Helicoverpa zea OR Heliothis zea OR Bombyx obsoleta OR Phalaena zea OR Heliothis umbrosus American bollworm OR corn earworm OR tomato fruitworm OR New World bollworm
66. Hirschmanniella spp.
67. Ips calligraphus OR Bostrichus calligraphus OR Ips ponderosae OR Ips interstitialis OR Coarse writing engraver OR six-spined ips OR six-spined engraver beetle
68. Ips confusus OR Tomicus confusus OR Piñon ips
69. Ips paraconfusus OR California five-spined engraver OR California five-spined ips
70. Ips chagnoni OR Ips cloudcrofti OR Tomicus grandicollis OR Southern pine engraver
71. Ips lecontei Arizona five-spined engraver OR Arizona five-spined ips
72. Ips pini OR Bostrichus pini OR Ips laticollis OR Ips oregonis OR Eastern pine engraver OR pine engraver beetle
73. Ips plastographus OR Tomicus plastographus OR California pine engraver
74. Ips subelongatus OR Ips fallax OR larch bark beetle OR oblong bark beetle
75. Keiferia lycopersicella OR Pthorimaea lycopersicella OR Gnorimoschema lycopersicella OR Eucatoptus lycopersicella OR Tomato pinworm
76. Leptinotarsa decemlineata OR Chrysomela decemlineata OR Doryphora decemlineata OR Polygramma "Chev." Decemlineata OR Colorado beetle
77. Leucinodes orbonalis
78. Limonius californicus OR Cardiophorus californicus OR
79. Pheletes californicus" OR sugarbeet wireworm
80. Liriomyza bryoniae OR Agromyza bryoniae OR Liriomyza solani OR Liriomyza citrulla OR Tomato leaf miner
81. Liriomyza huidobrensis OR Agromyza huidobrensis OR Liriomyza cucumifoliae OR Liriomyza langei OR Liriomyza dianthi OR Serpentine leaf miner OR pea leaf miner OR South American leaf miner
82. Liriomyza sativae OR Liriomyza pullata OR Liriomyza canomarginis OR Liriomyza minutiseta OR Liriomyza munda OR Liriomyza guytona OR Liriomyza propepusilla OR Vegetable leaf miner OR serpentine vegetable leaf miner OR cabbage leaf miner OR tomato leaf miner
83. Liriomyza trifolii OR Liriomyza alliovora OR American serpentine leaf miner OR chrysanthemum leaf miner

84. Listronotus bonariensis OR Hyperodes bonariensis OR Argentine stem weevil OR wheat stem weevil
85. Longidorus diadecturus
86. Maconellicoccus hirsutus OR Phenacoccus hirsutus OR pink hibiscus mealybug OR pink mealybug OR hibiscus mealybug
87. Margarodes prieskaensis OR Sphaeraspis prieskaensis OR Ground pearls OR margarodes
88. Margarodes vitis OR Coccionella vitis OR Margarodes vitium OR Sphaeraspis vitis OR Ground pearls OR margarodes
89. Margarodes vredendalensis OR Ground pearls OR margarodes
90. Melanotus communis OR Elater communis OR common wireworm OR corn wireworm OR community wireworm
91. Monochamus alternatus
92. Monochamus carolinensis
93. Monochamus marmorator
94. Monochamus mutator OR Monochamus maculosus
95. Monochamus nitens
96. Monochamus notatus
97. Monochamus obtusus
98. Monochamus scutellatus
99. Monochamus titillator
100. Myiopardalis pardalina
101. Myndus crudus OR Myndus cocois OR Haplaxius crudus OR Pallid cane leafhopper
102. Nacobbus aberrans OR Anguillulina aberrans OR Nacobbus batatiformis OR Nacobbus serendipiticusOR Nacobbus serendipiticus bolivianus OR False root-knot nematode
103. Naupactus leucoloma OR Graphognathus leucoloma OR Pantomorus leucoloma OR white-fringed weevil OR white-fringed beetle
104. Neoleucinodes elegantalis OR Leucinodes elegantalisOR Tomato fruit borer OR eggplant moth
105. Opogona sacchari OR Alucita sacchari OR Tinea subcervinella OR Opogona subcervinella OR Banana moth
106. Pissodes nemorensis OR Pissodes approximatus OR Pissodes canadensis OR Pissodes deodarae OR Northern pine weevil OR deodar weevil
107. Pissodes strobi OR Pissodes sitchensis OR Pissodes engelmanni ORWhite pine weevil OR Sitka spruce weevil
108. Pissodes terminalis OR Lodgepole terminal weevil
109. Premnotrypes latithorax OR Andean potato weevil
110. Premnotrypes suturicallus
111. Premnotrypes vorax
112. Rhagoletis cingulata OR Trypeta cingulata OR Eastern cherry fruit fly OR cherry fruit fly OR North American cherry fruit fly
113. Rhagoletis completa OR Rhagoletis suavis subsp. Completa OR Walnut husk fly
114. Rhagoletis fausta OR Rhagoletis intrudens OR Trypeta fausta OR Black cherry fruit fly
115. Rhagoletis indifferens (Rhagoletis cingulate subsp. Indifferens)" OR Western cherry fruit fly
116. Rhagoletis mendax OR Blueberry maggot
117. Rhagoletis pomonella OR Trypeta pomonella OR Apple maggot OR apple maggot fly

118. Rhagoletis ribicola OR Dark currant fly
119. Rhagoletis suavis OR Trypeta suavis
120. Rhizoecus hibisci OR Ripersiella hibisci OR root mealybug
121. Rhynchophorus ferrugineus OR Calandra ferruginea OR Curculio ferrugineus OR Rhynchophorus signaticollis OR Asiatic palm weevil OR coconut weevil OR red palm weevil OR red stripe weevil
122. Rhynchophorus palmarum OR palm weevil OR palm-marrow weevil OR South American palm weevil
123. Scirtothrips aurantii OR Scirtothrips acaciaeOR South African citrus thrips
124. Scirtothrips citri OR Euthrips citri OR California citrus thrips
125. Scirtothrips dorsalis OR Neophysopus fragariae OR Heliothrips minutissimus OR Anaphothrips andreae OR Scirtothrips dorsalis var. padmae OR Chilli thrips OR yellow tea thrips
126. Scolytus morawitzi OR Eccoptogaster morawitzi OR Morawitz's bark beetle
127. Spodoptera eridania OR Laphygma eridania OR Prodenia eridania OR Xylomyges eridania OR Southern armyworm
128. Spodoptera frugiperda OR Laphygma frugiperda OR Fall armyworm OR corn leafworm OR southern grassworm
129. Spodoptera littoralis OR Hadena littoralis OR Cotton leafworm OR Egyptian cottonworm OR Mediterranean brocade moth
130. Spodoptera litura OR Prodenia litura OR Cotton leafworm OR tobacco cutworm
131. Strauzia longipennis OR Sunflower maggot fly
132. Strobilomyia viaria OR Lasiomma melaniola OR Strobilomyia melaniola OR Canadian larch cone fly
133. Tecia solanivora OR Scrobipalpopsis solanivora OR Guatemalan potato moth
134. Tetropium gracilicorne OR fine-horned spruce borer
135. Thrips palmi OR Thrips leucadophilus OR Thrips gossypicola OR Chloethrips aureus OR Thrips gracilis OR Palm thrips
136. Trirhithromyia cyanescens
137. Ceroplastes ceriferus
138. Chilo suppressalis
139. Acalitus gossypii
140. Lissorhoptrus oryzophilus
141. Spodoptera exempta
142. Cydia fabivora
143. Anomis flava
144. Neoceratitis cyanescens
145. Maruca vitrata

Search terms for soil and growing media based on results of Inventory 1 (a, based on approx. 900 soil and growing media)

1. ("2004" or "2005" or "2006" or "2007" or "2008" or "2009" or 201#).yr.

2. xx200.cc. or exp agricultural wastes/ or exp bagasse/ or exp bran/ or exp diatomite/ or exp fabrics/ or exp husks/ or exp limestone/ or exp manures/ or exp molasses/ or exp plant fibres/ or exp plastics/ or exp straw/ or exp sugarcane byproducts/ or exp synthetic fibres/ or ((barley or Hordeum

vulgare or mung or mungbean? or Vigna radiata or mustard or Sinapis alba or Scabiosa or Sesbania) adj10 (cover crop? or cover plant?)).mp. or ((Brachiaria or brassica* or Cajanus cajan or canola or cereal? or clover? or cowpea? or Vigna unguiculata or Crambe or forage radish* or Raphanus sativus or grass?? or speargrass or ryegrass or Lolium multiflorum or Digitaria eriantha pentzii or forage sorghum or Sorghum bicolor x Sorghum sudanense or legume? or hairy vetch or Vicia villosa or Mucuna deeringiana or Mucuna pruriens or Phacelia or rye or Secale cereale or safflower or Carthamus tinctorius or snail medic or Medicago scutellata or soy?bean? or Glycine max or subclover? or Trifolium subterraneum or sunflower? or Helianthus annuus or Stylosanthes capitata or Stylosanthes macrocephala or Triticale or wheat? or Triticum aestivum) adj10 (cover crop? or cover plant? or green mulch* or live mulch* or living mulch* or plant? mulch*)).mp. or ((brassica* or broccoli or cabbage? or carrot? or cauliflower? or coconut? or herb? or hyacinth? or malt or onion? or pea or peas or reed? or Phragmites australis or tobacco) adj3 (residue? or waste?)).mp. or ((acai or jucara) adj5 (residue? or waste?)).mp. or acidic electroly?ed water.mp. or adhesives.mp. or almond shell?.mp. or alum.mp. or ((alnus or artemisia or datura or eupatorium or schima) and (fresh leaves or green leaf or green leaves)).mp. or anna?to.mp. or anthracite.mp. or arisco.mp. or bagasse?.mp. or baked earthen.mp. or bamboo?.mp. or basalt.mp. or bean pod?.mp. or bentonite?.mp. or ((bhimal or grewia optiva or kharik or celtis australis or timala or ficus auriculata or azadirachta indica or Murraya koenigii or Quercus leucotrichophora) and (leaf or leaves)).mp. or biochar.mp. or bioplastic?.mp. or bitumen emulsion?.mp. or black turf?.mp. or bran.mp. or brans?.mp. or (brassica carinata and pellet?).mp. or brick?.mp. or cachaca?.mp. or (camellia adj3 shell?).mp. or caragana powder?.mp. or cassava stem?.mp. or (castor adj3 pomace?).mp. or cellulose?.mp. or chaff?.mp. or chalk?.mp. or charcoal?.mp. or (citrus adj3 waste?).mp. or clay.mp. or coal.mp. or coir.mp. or coco* fiber?.mp. or coco* fibre?.mp. or coconut milk.mp. or coconut shell fib*.mp. or (coffee adj3 parchment?).mp. or coffee pulp.mp. or coffe residue?.mp. or coffee waste?.mp. or compost?.mp. or corn cob?.mp. or maize cob?.mp. or corn gluten meal.mp. or maize gluten meal.mp. or corn harvest residue?.mp. or corn residue?.mp. or maize harvest residue?.mp. or maize residue?.mp. or corn stalk?.mp. or maize stalk?.mp. or corn stover?.mp. or maize stover?.mp. or cotton gin trash.mp. or cotton residue?.mp. or cotton waste?.mp. or cotton seed oil.mp. or (biodegradable residue? or biodegradable waste? or crop residue? or crop waste? or food waste? or garden waste? or green waste? or greenwaste? or leaf litter or leaf waste? or "litter (plant)" or organic residue? or organic waste? or plant residue? or pruning debris or pruning litter or (pruning adj3 residue?) or pruning trash or pruning waste? or yard waste? or yardwaste?).mp. or crumb rubber?.mp. or date palm by-product?.mp. or (date palm adj5 waste?).mp. or (date palm? adj5 residue?).mp. or date palm leaf.mp. or date palm leaves.mp. or decomposing granite?.mp. or diatomaceous earth.mp. or diatomite.mp. or dry olive cake?.mp. or empty fruit bunch*.mp. or ((eucalypt* or leek? or thyme) and (dry adj2 powder*)).mp. or (eupatorium adj5 bag?).mp. or expanded shale?.mp. or fabric?.mp. or fel?spar?.mp. or filter cake?.mp. or filtercake?.mp. or filter mud cake?.mp. or fly ash.mp. or foam?.mp. or foil?.mp. or fruit residue?.mp. or (fruit adj5 waste?).mp. or gangetic alluvial soil?.mp. or geotextile?.mp. or ginger powder?.mp. or glass fiber?.mp. or glass fibre?.mp. or glass wool.mp. or glassfib*.mp. or glasswool.mp. or ((gliricidia or lantana) and mulch*).mp. or glue?.mp. or grape marc.mp. or grape residue?.mp. or grape pomace?.mp. or vine pomace?.mp. or grape stalk?.mp. or grape yeast?.mp. or gravel?.mp. or ground nut cake?.mp. or groundnut cake?.mp. or peanut cake?.mp. or ground nut shell?.mp. or groundnut shell?.mp. or peanut shell?.mp. or gunny bag?.mp. or gypsum?.mp. or (hazelnut adj2 shell?).mp. or hemp chip?.mp. or hull?.mp. or humus.mp. or husk?.mp. or hydrogel?.mp. or hydrophobic kaolin*.mp. or hydrous kaolin*.mp. or illite?.mp. or ((jatropha cake? or jatropha seedcake?) and (de oiled or deoiled)).mp. or kaolin based particle?.mp. or leonardite.mp. or lichen soil.mp. or light expanded.mp. or lime.mp. or limestone*.mp. or loam.mp. or local mixed grasses.mp. or loess.mp. or mahoni seed?.mp. or mahua cake?.mp. or manure?.mp. or (meadow mix* and mulch*).mp. or ((melon? or watermelon?) adj2 (biomass or residue? or shell? or waste?)).mp. or mineral ah.mp. or molasse?.mp. or moss??.mp. or mountain powder.mp. or mushroom farm waste*.mp. or mushroom waste*.mp. or mushroom residue?.mp. or mushroom substrate?.mp. or mycelial slurr*.mp. or leonardite.mp. or neem cake?.mp. or neem kernel cake?.mp. or neem seed cake?.mp. or neem oilseed cake?.mp. or neemcake?.mp. or oil

cake?.mp. or oilcake?.mp. or ((oil palm? or oilpalm) and (mesocarp fiber? or mesocarp fibre?)).mp. or oilpalm waste*.mp. or palm waste*.mp. or olive marc.mp. or olive pomace?.mp. or (olive? adj5 waste?).mp. or (orange? adj3 (peel? or residue? or waste?)).mp. or (palm oil mill effluent* or palm oil mill waste*).mp. or (palm trunk? adj3 tissue?).mp. or papaya seed flour.mp. or paper.mp. or newspaper?.mp. or pearl stone.mp. or pearlstone.mp. or peat*.mp. or (pecan? adj3 shell?).mp. or (pepper? adj3 (biomass or residue? or waste?)).mp. or perlite*.mp. or ((pinus merkusii or tusam) adj3 (litter or residue? or waste?)).mp. or phyllite?.mp. or plant fiber?.mp. or plant fibre?.mp. or plastics.mp. or posidonia.mp. or (press mud and (sugar mill? or sugarmill? or sugar factor* or sugar industr*)).mp. or propenamide propeonate.mp. or pumice?.mp. or refuse tea.mp. or tea refuse.mp. or ((regreen adj5 hybrid?) and (cover crop? or cover plant?)).mp. or rice bark.mp. or rice harvest residue?.mp. or rice residue?.mp. or rice rind.mp. or rind rice.mp. or ((rice or wheat) adj1 grain?).mp. or rock.mp. or rockwool.mp. or row cover?.mp. or rowcover?.mp. or rubber crumb?.mp. or sand.mp. or sarkanda.mp. or savanna? soil?.mp. or scoria.mp. or sesame cake?.mp. or sesame oilseed cake?.mp. or sesame oil seed cake?.mp. or shade cloth?.mp. or shadecloth?.mp. or shredded.mp. or silt.mp. or slag?.mp. or sodium alginate?.mp. or sponge?.mp. or sphagnum.mp. or straw.mp. or ((sugar cane or sugarcane) adj5 waste?).mp. or synthetic fiber?.mp. or synthetic fibre?.mp. or tailing?.mp. or talc.mp. or tea residue?.mp. or (tea adj5 waste?).mp. or tezontle.mp. or tile?.mp. or tomato soup waste?.mp. or topsoil?.mp. or torf.mp. or tuff?.mp. or (turf adj3 transloc*).mp. or (turf adj3 transfer*).mp. or turface*.mp. or turves.mp. or ulu grass*.mp. or ulugrass*.mp. or vegetable fiber?.mp. or vegetable fibre?.mp. or vegetable residue?.mp. or vegetable waste?.mp. or vermicompost?.mp. or vermiculite*.mp. or vinasse?.mp. or volcanic ash.mp. or volcanic cinder*.mp. or water hyacinth?.mp. or eichhornia crassipes.mp. or wheat gluten matrix.mp. or wheat starch.mp. or ((xaxim or dicksonia sellowiana) adj3 (powder? or substrate?)).mp. or zeatin?.mp. or zeolite*.mp. or zucchini biomass.mp. or zucchini residue?.mp. [mp=abstract, title, original title, broad terms, heading words]

3. ((biodigester* adj3 (residue? or waste?)) or bio solid* or biosolid* or (cedar bark or fir bark or eucalypt* bark or pine bark or red wood bark or spruce bark)).mp. or ((conifer needle? or fir needle? or pine needle?).mp. or exp conifer needles/) or brush* chip?.mp. or byproduct?.mp. or chip residual*.mp. or carton.mp. or condensed distiller*.mp. or cork.mp. or distill* residue?.mp. or exp distillers' residues/ or drift wood.mp. or driftwood.mp. or forest litter.mp. or hardwood mulch*.mp. or kaolin* residue?.mp. or kaolin waste?.mp. or (leaf mo?ld? and mulch*).mp. or maravalha.mp. or (monosodium glutamate* adj3 (residue? or waste?)).mp. or (municipal adj2 waste?).mp. or refuse.mp. or penicillin production residue?.mp. or phosphogypsum?.mp. or pine nugget?.mp. or poplar chip?.mp. or rapeseed cake?.mp. or river waste?.mp. or sapropel*.mp. or saw dust*.mp. or sawdust*.mp. or shredded.mp. or sludge?.mp. or exp sludges/ or slurry.mp. or slurries.mp. or spent wash.mp. or spentwash.mp. or urban garbage.mp. or tannery residue?.mp. or tannery waste?.mp. or thatch* cover?.mp. or timber waste?.mp. or "tree fern?".mp. or treefern?.mp. or waste water?.mp. or wastewater?.mp. or wood chip?.mp. or woodchip?.mp. or wood dust?.mp. or wood fiber?.mp. or wood fibre?.mp. or wood flour.mp. or wood litter.mp. or wood log?.mp. or wood mulch*.mp. or wood residue?.mp. or wood shaving?.mp. or wood waste?.mp. [mp=abstract, title, original title, broad terms, heading words]

4. (alfalfa or lucerne or Medicago sativa or Azolla or water fern? or waterfern? or bracken or brackenfern? or Pteridium aquilinum or Carex or Cannabis sativa or hemp or celeriac? or celeries or celery or Apium graveolens or Chromolaena or grass?? or Pennisetum purpureum or kenaf or Hibiscus cannabinus or Lesquerella or mahogony or Swietenia macrophylla or Swietenia mahagoni or Mikania micrantha or Parthenium or pearl millet? or pearlmillet? or Pennisetum glaucum or prajwal or Sorghum or spring vetch or Lathyrus vernus or switchgrass?? or Panicum virgatum).mp. [mp=abstract, title, original title, broad terms, heading words]

5. 1 and (2 or 3 or 4)

Search terms for soil and growing media based on results of Inventory 1 (b, based on approx. 150 soil and growing media)

((acacia? or acalypha indica or kuppaimeni or anacardium occidentale or cashew* or beta vulgaris or sugar beet? or sugarbeet? or butea monosperma or palas or carnauba or casuarina or erigeron or faidherbia or fleabane? or jojoba or leucaena or nochi or vitex negundo or pongamia or ficus roxburghii or teak or tectona grandis or vasambu or achorus calamus) adj5 (leaf or leaves)) or agrolite or alsil or alumin?um or apatite? or phosphorite? or exp apatite or (asparagus adj3 rootstock?) or asphalt* spray or attapulgite or palygorskite or ((Austroplenckia populnea or vime's or japanese cedar? or cryptomeria japonica or cypress* or chamaecyparis obtusa or rhododendron?) adj5 bark) or (bauxite residue? or bauxite waste? or red mud?) or bay oil? or bhusa or biotite or (bitum* adj5 emulsi*) or bokashi or (brazil nut? adj5 shell?) or calcium silicat* or (carnation? and post harvest residue?) or ((carnauba or copernicia prunifera) adj5 (dust or industr*)) or (cashew* adj5 integument?) or ((cassia siamea or kassod or senna siamea or locust bean tree? or parkia biglobosa or sapium or swallow wort? or swallowwort? or calotropis procera or eucalypt* or teak or tectona grandis) adj5 (extract? or leaf powder?)) or ceramsite or chipped branch?? or coke plaster or (cranberry adj5 (press or presscake?)) or (cyperus rotundus and bulb?) or (dal weed? or dalweed) or diorite or (earthworm? adj5 (casting? or excrement?)) or felt? or (flax adj5 shive?) or flysch or ((gingelly* or pongamia) adj5 cake?) or (glycyrrh* adj5 (debris or litter or residu? or waste?)) or grit or gyttja or haydite* or hornfels* or humate? or (ilex paraguariensis adj2 (tooth* or chopped stem?)) or ipomoea fistulosa dry lea* or (jiffy* adj5 pellet*) or jute bag? or lemon tree pruning* or lignocellulosic waste? or (ligustrum nepalensis and extract?) or marble or metal chip? or (mine spoil? or mining spoil? or mine waste? or mining waste?) or muslin cloth? or oxic horizon* or (platanus and leaf mo?ld?) or (polyacrylamid* adj5 granule?) or ((polyethylene terephthalate* adj5 bottle?) or pet bottle?) or (polystyren* adj5 (granule? or bead?)) or pozzolana or pyrite? or quartz or ((sago waste? or sago residue? or sago pith residue?) and press*) or (sericultur* adj5 waste?) or slate? or soilrite* or sporocarp? or stabilizate or stalite* or (terminalia catappa adj5 seed?) or (termite? adj5 (tomb or mound?)) or termitaria or (thuja and by-product?) or (tithonia and (leaf or leaves) and mulch*) or vinegar residue? or vivianite or (walnut? adj2 shell?)

APPENDIX D: Predefined organisms considered to pose an important emerging risk for plant health that are not listed in the EU regulation

Nematodes:
Belonolaimus longicaudatus
Paratrichodorus porosus

Fungi:
Botrytis allii
Plectosphaerella cucumerina

Bacteria:
Burkholderia gladioli
Acidovorax avenae subsp. avenae
Xanthomonas axonopodis pv. punicae
Pantoea ananatis
Dickeya chrysanthemi

Insects:
Ceroplastes ceriferus
Chilo suppressalis
Acalitus gossypii
Lissorhoptrus oryzophilus
Spodoptera exempta
Cydia fabivora
Anomis flava
Neoceratitis cyanescens
Maruca vitrata

Weeds:
Mikania micrantha
Phelipanche ramose

APPENDIX E: List of Nematodes subject to test on presence in Soil and Growing Media by RHP

Aphelenchoides spp.
Bursaphelenchus spp
Criconema spp.
Criconemoides spp.
Ditylenchus spp.
Globodera spp.
Helicotylenchus spp.
Hemicriconemoides spp.
Hemicycliophora spp.
Heterodera spp.
Hoplolaimus spp.
Longidorus spp.
Meloidogyne spp.
Nacobbus spp
Paralongidorus spp
Paratrichodorus spp.
Paratylenchus spp.
Pratylenchoides spp
Pratylenchus spp.
Punctodera spp
Radopholus spp.
Rotylenchulus spp
Rotylenchus spp.
Trichodorus spp.
Tylenchorhynchus spp.
Xiphinema spp.