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

PM 5/5(1)

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

Decision-Support Scheme for an Express Pest Risk Analysis

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

Specific approval and amendment: 2012-09

Introduction

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

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

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

A computerized version of this Express PRA Scheme with the CAPRA software will be prepared.

Summary[1] of the Express Pest Risk Analysis for "*Xylella fastidiosa*"

PRA area: *Norway*

Describe the endangered area:

The endangered areas are mainly the regions of Norway where stone fruit is grown: The counties Hordaland, Telemark, Buskerud, Vestfold, Sogn and Fjordane and Rogaland. The endangered area also includes private gardens where plum, cherry and ornamental *Prunus* species are planted in, and areas with nurseries and garden centres dealing with ornamental Prunus species and other host plants. Regarding other ornamental host plants, trees and wild hosts like grasses and sedges the whole country has to be defined as endangered area.

Main conclusions

Overall assessment of risk: (Copy your answer from Q 15).

Trade movements of infected plants for planting are a major pathway for *Xylella fastidiosa* introduction and spread. The majority of trees planted in Norway for commercial production are imported from the European Union, where the pathogen has recently been detected in some member countries. Also other susceptible host plants are imported to Norway, mainly ornamentals. These consignments can also carry infectious insects from the country of origin. The likelihood of entry is therefore high.

Ornamental host plants are kept in glass houses many places in Norway. Many of these are most likely imported from abroad without being assessed for the presence of X. fastidiosa. The likelihood of establishment in protected conditions in the PRA area is moderate.

Potential vectors do occurr and thrive in Norway and susceptible wild and cultivated host plants are present in large parts of the country. Summer seasons in Norway, with climatic conditions suitable for disease development are short. The likelihood of establishment outdoors in the PRA area is moderate.

The movement of infected plants for planting is an effective way for long-distance dispersal also inside the risk assessment area. Short distance spread of the pathogen may occurr with infectious vector insects, which can also be carried by wind. Infectious vector insects which overwinter as adults are most effective in terms of spreading the disease. The potential vector insects present in Norway do not over winter as adults. The likelihood of spread is moderate.

The disease can cause significant damage on plum and cherry trees as well as other trees and ornamentals. The climatic conditions in Norway are, for the time being, suboptimal for severe disease outbreaks, but low number bacterial populations of the bacteria could establish in wild and/or cultivated host plants if introductions would take place unnoticed with latently infected plants (or infectious vectors). For Norway this could result in restrictions in international plant trade and plant material exchange in science and breeding programs. Containment and/or eradication measures are expensive. The impact of an introduction could be high.

See also point 18. Remarks.

To avoid introduction of *Xylella fastidiosa* into Norway phytosanitary measures are necessary.

Phytosanitary Measures: indicate whether the pest should be recommended for immediate action in the PRA area. Summarize your answer from Q 16.

Phytosanitary measures should focus on the avoidance of introduction of the pathogen. Consignments of imported plants for planting (all host plant species) should be inspected for symptoms (and for the presence of potential insect vectors) and tested for latent infections at an appropriate rate upon arrival. Infected consignments should be rejected. Regular surveys should be carried out in order to monitor for the occurrence of the disease in Norwegian plantations, especially those which are known to be of foreign origin. If the pathogen should be detected in Norway an adequate eradication programme should be put in place by the Norwegian Food Safety Authority.

Note: If the assessment shows that phytosanitary measures are not required for your country but there are indications that other EPPO countries are at higher risk, mention it.

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

Phytosanitary risk for the *endangered area* (*Individual ratings for likelihood of entry and establishment, and for magnitude of spread and impact are provided in the document*)	High X	Moderate ☐	Low ☐
Level of uncertainty of assessment (see Q 17 for the justification of the rating. Individual ratings of uncertainty of entry, establishment, spread and impact are provided in the document)	High ☐	Moderate X	Low ☐

Other recommendations:

- ***Inform EPPO or IPPC or EU***
- ***Inform industry, other stakeholders***
- ***State whether a detailed PRA is needed to reduce level of uncertainty (if so, state which parts of the PRA should be focused on)***
- ***Specify if surveys are recommended to confirm the pest status***
- ***State what additional work/research could help making a decision.***

Express Pest Risk Analysis:
Xylella fastidiosa
(*Pest name)*

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

Juliana Irina Spies Perminow

Norwegian Institute of Bioeconomy Research (NIBIO),

Division of Biotechnology and Plant Health, Department of Viruses, Bacteria and Nematodes

Høyskoleveien 7, 1431 Aas
juliana.perminow@nibio.no

Date: 24th of August 2016

Stage 1. Initiation

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

The Norwegian Food Safety Authority asked for this Pest Risk Assessment because:

Xylella fastidiosa is a xylem limited pathogen which is able to infect a very large number of plant species, though severe symptoms are produced in only a small number of hosts. The pathogen recently occurred in Europe (Italy, France, Germany, Switzerland) for the first time and has been the cause of large scale destruction of olive plantations (olive quick decline syndrome, OQDS) in Italy. Xylem feeding insects primarily sharpshooters/ leafhoppers and spittle bugs which are common also in Norway, are the primary means of disease transmission. Disease symptoms arise from blocking of xylem vessels which produce leaf scalds, scorches and diebacks (or stunt symptoms when roots are infected), which can progress to host death. The pathogen attacks a very wide range of host plants, which include cultivated and wild plant species like grasses, sedges and trees. Important damaging diseases apart from OQDS are Pierce's disease of grapevine, citrus variegated chlorosis, peach phoney disease, plum leaf scald, cherry leaf scald, almond leaf scald and leaf scorches of coffee and hardwood trees. The diseases have been limited to hot climates with mild winters except for the scorch diseases of hardwood trees that have been found as far north as Ontario (Canada) and have caused significant disease in red wood oak species in urban plantings in New Jersey (USA).
The detection of *X. fastidiosa* at high frequency with potential vectors that are also occurring in Norway at Apulia outbreak in southern Italy, as well as recent interceptions with the host plant Coffea arabica in several Northern European countries, have increased the concern around this pathogen. Norway is not a producer of citrus, grapewine or olive but stone fruit are grown for fresh consumption.

PRA area: *specify the PRA area being assessed*

Norway

Stage 2. Pest risk assessment

1. Taxonomy: *e.g. Genus, species/ subspecies, Authority, Family, Order***,** *Kingdom.*

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

The valid scientific name is *Xylella fastidiosa* Wells et al., 1987.

Kingdom: Bacteria

Phylum: Proteobacteria

Class: Gamma Proteobacteria

Order: Xanthomonadales

Family: Xanthomonadaceae

Genus: *Xylella*

Species: *X. fastidiosa*

Xylella fastidiosa is a gammaproteobacterium in the family Xanthomonadaceae. It was initially thought to be a virus, but in the 1970s it was shown to be a bacterium. It was first described and named in 1987. To date, the genus *Xylella* consists of only one species, *X. fastidiosa*. Nevertheless, *X. fastidiosa* has substantial genotypic and phenotypic diversity, and a wide host range.

There are four accepted subspecies of *X. fastidiosa* — *fastidiosa*, *pauca*, *multiplex* and *sandyi*, although only two, subspecies *fastidiosa* and subspecies *multiplex,* are so far considered valid names by the International Society of Plant Pathology Committee on the Taxonomy of Plant Pathogenic Bacteria. Subspecies *fastidiosa* is the best-characterised group, and the only genetic group causing disease in grapevines in the USA (Pierce's disease). The subspecies *fastidiosa* is more diverse in Central America. thus, it has been suggested that its presence in the USA is the consequence of an introduction.The introduction of ssp. *fastidiosa* in Taiwan has led to an epidemic in grapevine (EFSA, 2015a).

Isolates within ssp. *pauca* causing citrus variegated chlorosis in Brazil are reasonably well characterised. The genotype present in Italy is a recombinant of alleles within subspecies. The subspecies *multiplex* appears, so far, to have the widest host range in terms of plant species expressing disease symptoms. It is subdivided into various subgroups, which are mostly associated with specific host plants. The presence of subspecies *multiplex* in Brazil is considered to be the result of an introduction from the USA associated with plums.

Common names: Pierce`s disease, citrus variegated chlorosis, olive quick decline syndrome, peach phony disease, plum leaf scald, almond leaf scald, cherry leaf scald, bacterial leaf scorch of hardwood trees.

2. Pest overview

- *Summarize the life cycle (e.g. length of life cycle, location of different life stages, temperature thresholds, humidity requirements) and other relevant information (damage should be described in Q 12). If a datasheet is available, this section should only include the basic information. If available place illustrations of the pest and the symptoms caused in Appendix 1.*
- *Host plants (for pests)/habitats (for invasive plants) (more detail should be provided in Q 7)*
- *Symptoms*
- *Detection and identification (note if a diagnostic protocol is available). State if and how the pest can be trapped.*

- **Life cycle**: *X. fastidiosa* is a Gram-negative, strictly aerobic, xylem-inhabiting, non-flagellated pathogen with a growth optimum of 26-28°C. It moves downstream, but also upstream in plants. The upstream movement is possible with long type IV pili (twitching motility). In advanced stages of infection, sap blocking biofilms are formed both in the host plant and in the foregut of the vectors. Type I pili play the most important role in biofilm formation and aggregation of cells. Biofilm formation and attachment are under control of the GacA gene, which plays a similar role in other phytopathogenic bacteria. It is also involved in physiological processes that may enhance the adaptation and tolerance of *X. fastidiosa* to environmental stresses and the competition within the host xylem. The bacterium can enter neighbouring vessels through pits, after degradation of the pith membranes, which is apparently also triggered by a diffusible signal from the bacterium. The bacterium is also present in roots and can therefore be transmitted by root grafting. Vessels can become occluded by dense colonization and high frequencies of blocked vessels are associated with disease symptom development. EPS and polygalacturonase also play a role in the break down of pit membranes and xylem occlusion. EPS also entraps hydrolytic products that can be utilised by the bacteria as carbon source. *X. fastidiosa* has been found in a latent state in many symptomless hosts, i.e. mugwort (*Artemisia douglasiana*) and watergrass (*Echinochloa cruz-galli*), that serve as a source of inoculum for vectors, although they did not move systemically in most of the symptomless hosts. Systemic movement was found in symptomless blackberry (*Rubus procerus*). *X. fastidiosa* is irregularly distributed in infected tissues, thus longer plant access time may increase chances of the vector probing infected vessels (Janse et al., 2010).
  X. fastidiosa is transmitted persistently by xylem-sapsucking insect vectors as follows: (a) acquisition from a source plant; (b) attachment and retention to vector's foregut cuticle; (c) detachment and inoculation into a new host. Vectors are mainly sharpshooters and spittlebugs (Cicadellidae), have no transstadial or transovarial transmission (nymphs shed cuticle) and the bacterium does not need a latent period. Once infected with *X. fastidiosa*, insects remain infective

with the pathogen, which multiplies in the foregut and the bacterium becomes persistent in adult insects. Only a few bacterial cells are required for transmission.

It appears that most of xylem-feeding Cicadellidae species can be or are vectors in nature, where probing behaviour (e.g. preference for young shoots or, as in *H. vitripennis*, preference of woody tissues, even transmitting the bacterium to dormant vines, leading to winter-persisting populations of the pathogen) and foregut morphological characteristics determine the efficiency of bacterial transmission.

Local possible vectors for Europe are among others (see Tab. 1) *Cicadella viridis* (green leaf-hopper) and *Philaenus spumarius* (meadow spittle bug). Although not all *X. fastidiosa* transmitting vectors play an important role in transmission from wild hosts to crops, it was found in California that inoculum presenting weed hosts (herbs and shrubs) in adjacent riparian woods facilitated spread of Pierce`s Disease into vineyards in early spring, when the blue-green sharpshooter, *G. atropunctata* apparently played an important role. Vectors that overwinter as eggs or nymphs are thought to be less important in the dissemination of the disease. It was therefore theorized that *X. fastidiosa* did not yet occur in Europe (before 2013) due to absence of vectors that survive winter as adults and, even if infected, could not cause extensive spread due to absence during the critical early spring period.

Transmission efficiency by vectors may vary. *H. vitripennis* for example transmits much more efficiently from grape to grape than from almond to almond. *H. vitripennis* is considered now one of the most important vectors responsible for spreading of *X. fastidiosa*- caused diseases in south-east United States. *H. vitripennis* has a very broad host range. It has been found on more than70 plant species in 35 families including: avocado, citrus, macadamia, and many woody ornamentals, e.g. *Fraxinus*, *Lagerstroemia* and *Rhus* (Janse et al., 2010).

- **Host plants:** Apart from the already mentioned diseases Pierce`s disease (grapewine), phoney peach disease (peach), citrus variegated chlorosis (citrus) and olive quick decline syndrome (olive), it was found that *X.fastidiosa* also causes a number of so-called leaf scorch diseases in *Prunus* spp. (including almond leaf scorch in *P.armeniaca* and plum leaf scald in *P.domestica*), *Acer* spp., *Carya illinoinensis* (pecan), *Coffea arabica* (in Brazil isolated in 1995 and pathogenic also to Citrus), *Hedera helix*, *Morus rubra* (American mulberry), *Nerium oleander, Platanus occidentalis* (sycamore), *Quercus* spp. (oak), *Ulmus americana* (elm tree). Furthermore it induces diseases of *Medicago sativa* (alfalfa dwarf), *Catharanthus roseus* (periwinkle) and *Vinca major* (both wilting symptoms), stunting of *Ambrosia artemisifolia* (ragweed).
  Many wild plants may carry the pathogen with, but more often without, showing symptoms, such as grasses, sedges and trees, these can serve as inoculum reservoirs (Janse et al., 2010). An up to date information about known hostplants is presented in Fig.2.

- **Symptoms**: Early symptoms caused by *X. fastidiosa* are a slight chlorosis or bronzing along the leaf margin or tip that intensifies and that may become water-soaked before browning and drying. These symptoms are first found on a few branches, later on almost all foliage.The affected area is delineated by a narrow chlorotic band that becomes especially clear in autumn. A premature defoliation takes place with new malformed leaves formed. Abnormally shaped fruit may also be formed and stems may show internal and external discoloration, dieback and abnormal growth, leading to eventual death of the host. For leaf symptoms in *Prunus avium*, *Polygala myrtifolia*, *Coffea arabica* and *Quercus rubrum* see Appendix 1.

- **Detection and identification**: Detection, isolation and identification of *X ylella fastidiosa* has been described by the European and Mediterranean Plant Protection Organization: PM 7/ 24 (2) Diagnostic protocol for *Xylella fastidiosa*. These detection procedures were first approved in 2004, have recently been revised and are currently in the last stage of country consultation before final approvement of the new version (EPPO, 2016a).

3. Is the pest a vector? **Yes** ☐ **No** X

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

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

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

Xylella fastidiosa may enter the country and spread by the dispersal of infected plants for planting. Nevertheless xylem feeding insects, especially sharp shooters/leafhoppers (Cicadellidae, subfamily Cicadellinae) and spittle bugs (family Cercopidae) are important vectors of *X. fastidiosa*, some of these are listed in Tab.1 (EFSA, 2015a). A study of *X. fastidiosa* in Cicadomorpha associated with leaf scorch in red oak in New Jersey, found an average infection rate of 13.89% in species of treehopper, leaf hopper and spittlebug. Vectors which may over winter as adults and serve as a means of disease reintroduction early in the growing season may constitute a particular threat. Transmission is usually from wild, generally symptomless, hosts to cultivated hosts (grapevines, peaches) rather than between cultivated hosts, though the latter can occur (CABI, 2016). Specifically, vectors will feed on different hosts during different times in their life cycle in an attempt to derive adequate nutrients for growth and reproduction. Plant hosts suitable for growth, however, may not have nutrients suitable for insect reproduction. This then forces the xylem feeders to use the high-risk strategy of finding new hosts to complete their life cycle. Transmission experiments have shown that alternative hosts may be the source of a substantial amount of inoculum that is transmitted to economically important crops by vectors that feed on both types of hosts (Lashomb et al., 2002). Xylem feeding putative vectors occurring in Norway are *Cicadella viridis, Evacanthus acuminatus*, *Evacanthus interruptus*, *Aphrophora alni*, *Aphrophora salicina, Aphrophora cortica, Aphrophora pectoralis, Philaenus spumarius, Neophilaenus campestris, Neophilaenus exclaneationis, Neophilaenus lineatus* and *Lepyronia coleoptrata* (EFSA, 2015a). *Philaenus spumarius* is very common in Norway and found in all districts. It is described as ubiquitous and polyphytophagus, especially feeding on herbaceous plants in meadows and cultivated fields. The total number of host plants in the world exceeds 1000 species. These insects are not strong flyers and their migration from one field to another is largely determined by wind (Ossiannilsson, 1981).). In the USA the spittlebug *Philaneus spumarius* has been shown to efficiently vector *X. fastidiosa* in almond in experimental transmission studies (EFSA, 2015a). In connection with the current *X. fastidiosa* outbreak in Apulia the pathogen has been detected at high frequency in the spittle bugs *P. spumarius* and *Neophilaneus campestris* as well as the leaf hopper *Euscelis lineolatus*. *E. lineolatus* is a phloem fluid feeding insect. Recent findings clearly indicate that also specialized phloem feeders such as leafhoppers, can come in contact with xylem vessels and become infected. This phenomenon needs further investigation, since up to date the role of phloem feeders in *X. fastidiosa* cycle and dissemination has been neglected. Furthermore it is worth to remind that *E. lineolatus* is already known as a vector for phytoplasmas (Elbeaino et al., 2014).
There is also the possibility that the pathogen could be introduced into the Norway with a new vector.

Insect group	**Most common species**	**Distribution**	**Potential role as vector**	**Potential role as vector: criteria**
Sharpshooters (Cicadellidae, Cicadellinae): seven species	*Cicadella viridis* (Linnaeus 1758)	All Europe	Moderate to high	Very common, wide host range but hygrophilous
Spittlebugs (Cercopoidea): 34 species	*Aphrophora alni* (Fallen 1805)	All Europe	Moderate to high	Common, wide host range
	Aphrophora salicina (Goeze 1778)	All Europe	Moderate	Common, oligophagous
	Philaenus spumarius (L.)	All Europe	High	Very common and abundant in diverse ecosystems Identified as a vector in Apulia

Tab.1: Current and potential vector species of *X. fastidiosa* in Northern Europe: main insect groups and most important potential vector species (EFSA, 2015a).

5. Regulatory status of the pest

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

Regulatory status in the European Union: *X. fastidiosa* is included in Annex I, Part A, Section I, of the Council Directive 2000/29/EC as a “harmful organism not known to occur in any part of the community and relevant for the entire community, whose introduction into, and spread within, all Member States shall be banned”.
As other diseases thought to be caused by other pathogenic agents at the time Directive 2000/29/EC was written are now attributed to *X. fastidiosa*, *X. fastidiosa* is implied though not explicitly mentioned at several places throughout the Directive:

• causative agent of peach phony rickettsia, in Annex I, Part A, Section 1;

• causative agent of Citrus variegated chlorosis, in Annex II, Part A, section I, of Council Directive 2000/29/EC, “harmful organism whose introduction into, and spread within, all Member States shall be banned if it is present on plants of *Citrus* L., *Fortunella* Swingle, *Poncirus* Raf., and their hybrids, other than fruit and seeds”.

The introduction into the EU of some known host plants is prohibited (*Citrus*, *Fortunella*, *Poncirus*, and their hybrids, other than fruit and seeds, *Vitis* other than plants originating in third countries and *Prunus*, originating from non-European countries), with the exception of dormant *Prunus* plants (free from leaves, flowers and fruit) from Mediterranean countries, Australia, New Zealand, Canada and the continental states of the USA (see Annex III, part A, of Directive 2000/29/CE) (EFSA, 2015a).

Regarding the EPPO region, Xylella fastidiosa is listed as A1 quarantine organism together with her vectors *Draeculacephala minerva*, *Graphocephala atropunctata*, *Homalodisca vitripennis* and *Xyphon fulgidum* (these vectors occur in the Americas but not in Europe)(EPPO website).

In Norway the pathogen is not regulated as a quarantine pest. The Norwegian Food Safety Authority will use the information gathered in this PRA when assessing the appropriate regulatory status for Norway.

6. Distribution

Information on distribution may be retrieved from PQR (http://www.eppo.int/DATABASES/pqr/pqr.htm), CAPRA datasets (http://capra.eppo.org/), CABI maps, etc.

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

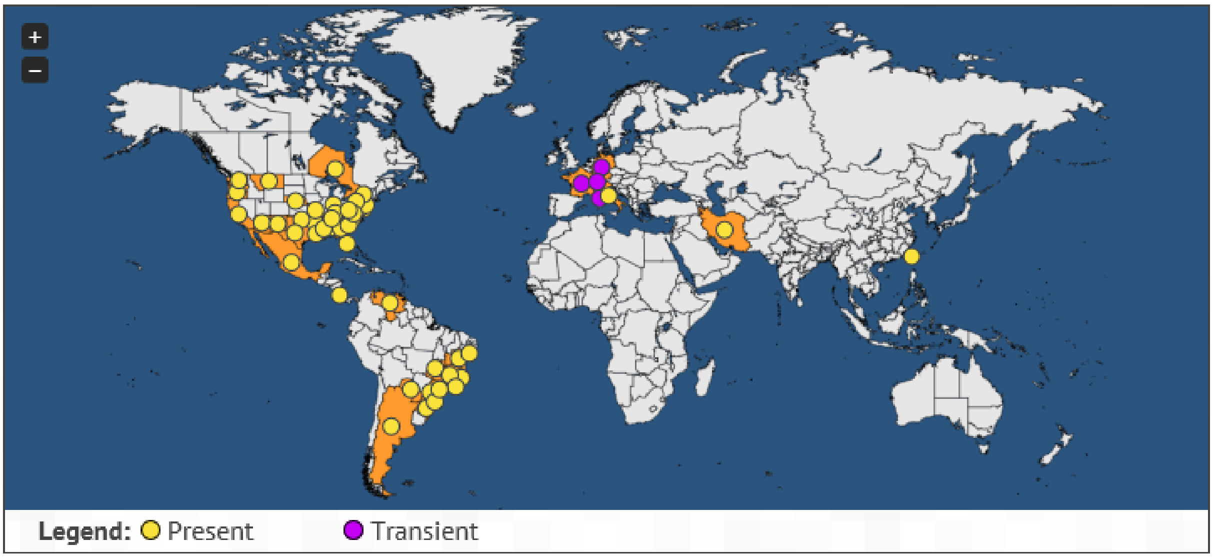

Fig. 1 Global distribution of *X. fastidiosa* EPPO PQR

Continent	***Distribution*** *(list countries, or provide a general indication , e.g. present in West Africa)*	***Provide comments on the pest status in the different countries where it occurs*** *(e.g. widespread, native, introduced….)*	***Reference***
Africa	*No records*		
America	*United States of America,* *Canada,* *Argentina,* *Brazil,* *Costa Rica,* *Mexico,* *Paraguay,* *Venezuela*	*Present/widespread* *Present/few occurrences* *Present/restricted distribution* *Present/no details* *Present/no details* *Present/no details* *Present/no details* *Present/no details*	*PQR*
Asia	*Iran,* *Taiwan*	*Present/no details* *Present/no details*	*PQR*
Europe	*France,* *Italy* *Germany* *Switzerland*	*Transient/under eradication* *Present/restricted distribution* *Transient, at one location on a single isolated potted plant, actionable, under eradication* *Transient/under eradication*	*PQR* *JKI/* *EPPO RS 2016/07* *PQR*
Oceania	*No records*		*PQR*

Tab.2 Details on distribution of *Xylella fastidiosa*.

Diseases caused by *X. fastidiosa* occur in tropical, subtropical and temperate areas, mainly in theAmericas.

North America: *X. fastidiosa* has been reported in Canada (on elm in southern Ontario, British Columbia and Saskatchewan; on maple in Alberta). Mexico and the USA (Alabama, Arizona, Arkansas, California, Delaware, District of Columbia, Florida, Georgia, Indiana, Kentucky, Louisiana, Maryland, Mississippi, Missouri, Montana, Nebraska, New Jersey, New Mexico, New York, North Carolina, Oklahoma, Oregon, Pennsylvania, South Carolina, Tennessee, Texas, Virginia, Washington, West Virginia).

Central America and Caribbean: *X. fastidiosa* has been reported in Costa Rica and Mexico. In addition it has been intercepted in consignments imported into Europe from Honduras.

South America: *X. fastidiosa* has been reported in Argentina, Brazil (Bahia, Espirito Santo, Goias, Minas Gerais, Parana, Rio Grande do Sul, Rio de Janeiro, Santa Catarina, São Paulo, Sergipe), Ecuador, Paraguay and Venezuela.

Asia: *X. fastidiosa* has been reported in Iran, India (this report remains uncertain, detection based mostly on symptom observation and coloration of xylem), Lebanon (this report remains uncertain, further analysis is needed to confirm the report based only on ELISA detection and scanning electron microscopy observations), Taiwan, and Turkey (this report remains uncertain, detection based on ELISA and electron microscopy observations; no further reports or studies published).

There are uncertainties associated with reports that incompletely describe the detection methods that were used. The tedious isolation process of *X. fastdidosa*, the difficulty in fulfilling Koch's postulates and the need also to understand the vector's role are certainly part of the explanation why the identification process has sometimes been stopped or performed inadequately. Furthermore, it should be stressed that, since infected plants might be missed because they are asymptomatic or show symptoms that could be due to drought, the known distribution can be linked only to areas where the disease has provoked clearly visible symptoms, and usually epidemics.

There are uncertainties concerning the presence of the pest in China, as it is described in literature as widespread in grapes in two provinces. However, the relevant papers do not provide details of detection methods apart from microscopy. There are uncertainties regarding the prevalence and impact of elm leaf scorch disease caused by *X. fastidiosa* on elm (Ulmus americana) in Canada, because other pests and diseases, such as Dutch elm disease (DED), can contribute to elms' decline.

• Africa: *X. fastidiosa* has not been reported.

• Europe: France reported the eradication of a confirmed case on coffee plantlets kept in contained glasshouse facilities in 2012. These coffee plants were received from Ecuador (*Coffea arabica*) and Mexico (*Coffea canephora*).

An interception of *X. fastidiosa* on coffee plants was reported by the Netherlands in October 2014. The infected plants originated from Costa Rica.

A field outbreak of *X. fastidiosa* has been recorded in the Apulia region of Italy:

In 2013, the occurrence of *X. fastidiosa* was reported in southern Italy (near Lecce, in the Salento peninsula, Apulia region), associated with quick decline symptoms on olive trees (*Olea europea*), oleander (*Nerium oleander*) and almond (*Prunus dulcis*) (EFSA, 2015a).

The bacterium was isolated in culture and identified as a genotype of *X. fastidiosa* subsp. *pauca*, molecularly identical to an isolate from Costa Rica. *Philaenus spumarius* (meadow spittlebug), a froghopper quite common in the Salento area where it thrives on olive, was identified as the main vector. The pathogen was recently introduced into Apulia with imported plant material (such as ornamentals) or, more unlikely, with a vector present in a plant consignment. The very recent interception in the Netherlands of *X. fastidiosa* in ornamental coffee plants from Costa Rica supports what is stated above (Martelli et al., 2016).

In July 2015, the first confirmed outdoors presence of the bacterium was reported in France. *X. fastidiosa* was detected on ornamental plants (*Polygala myrtifolia*) planted in a commercial area in Propriano (Corse). As a result of intensive surveys carried out in Corsica, new foci of *X. fastidiosa* have been detected, mainly in Corse-du-Sud, but also in Haute-Corse (EPPO Reporting Service, 2015). Since the first finding, the number of outbreaks in Corsica has increased as investigations progress (193 outbreaks notified until 2 December 2015) (EC Fact Sheet, 2015). In 2015, the bacterium was detected for the first time on the French mainland. It was detected in the municipality of Nice (Alpes-Maritimes department - Provence-Alpes-Côtes-d'Azur region) in one plant of *P. myrtifolia*. In France, the subspecies which is occurring on *P. myrtifolia* plants is *X. fastidiosa* subsp. *multiplex* (thus differing from Italy, where it is *X. fastidiosa* subsp. *pauca* that is occurring on olive trees). At the end of October 2015, more infected *P.*

myrtifolia plants (5) were found in Nice, and another focus was detected in the municipality of Mandelieu la Napoule (1 infected *P. myrtifolia* plant) (EPPO, 2016 b). *Polygala myrtifolia* has been found to be infected in all the outbreaks so far, although other 19 plant species have been confirmed to host the bacterium, mostly ornamentals, but also cherry plum, cork oak and sycamore maple. Negative results have been reported so far on olive, citrus and grapevine located in the proximity of these outbreaks (EC Fact Sheet, 2015).

Switzerland detected the pathogen in 4 imported coffee plants in September 2015 (re-exports from the Netherlands). These coffee plants were detained under glasshouse conditions (at 1 tropical plant centre and 1 garden centre). The situation was closer to that of an interception than to an outbreak. All coffee plants have been destroyed (EPPO RS 2015/181).

In July 2016 *Xylella fastidiosa* ssp. *fastidiosa* was detected for the first time in Germany (Saxony), in a greenhouse of a small nursery producing vegetables and ornamental plants. In one greenhouse potted plants of private owners stayed for overwinter survival. One potted *Nerium oleander* plant showed symptoms and was found to be infested in the course of an official phytosanitary inspection. The origin of the plant is not clear: "At least 4 years ago the private owner of the infested *Nerium* plant got a cutting from another private person". Official eradication measures according to Decision (EU) 2015/789 have immediately been carried out including destruction of 14 potted oleander and olive plants from the greenhouse and a survey is ongoing. Demarcated zones are being established. The buffer zone includes also part of the Land Thuringia (JKI, 2016).

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

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

The host plant range of *X. fastidiosa* is very large. Based on currently available data, the host range comprises plants in 68 families, 187 genera and more than 300 plant species (Fig. 2).

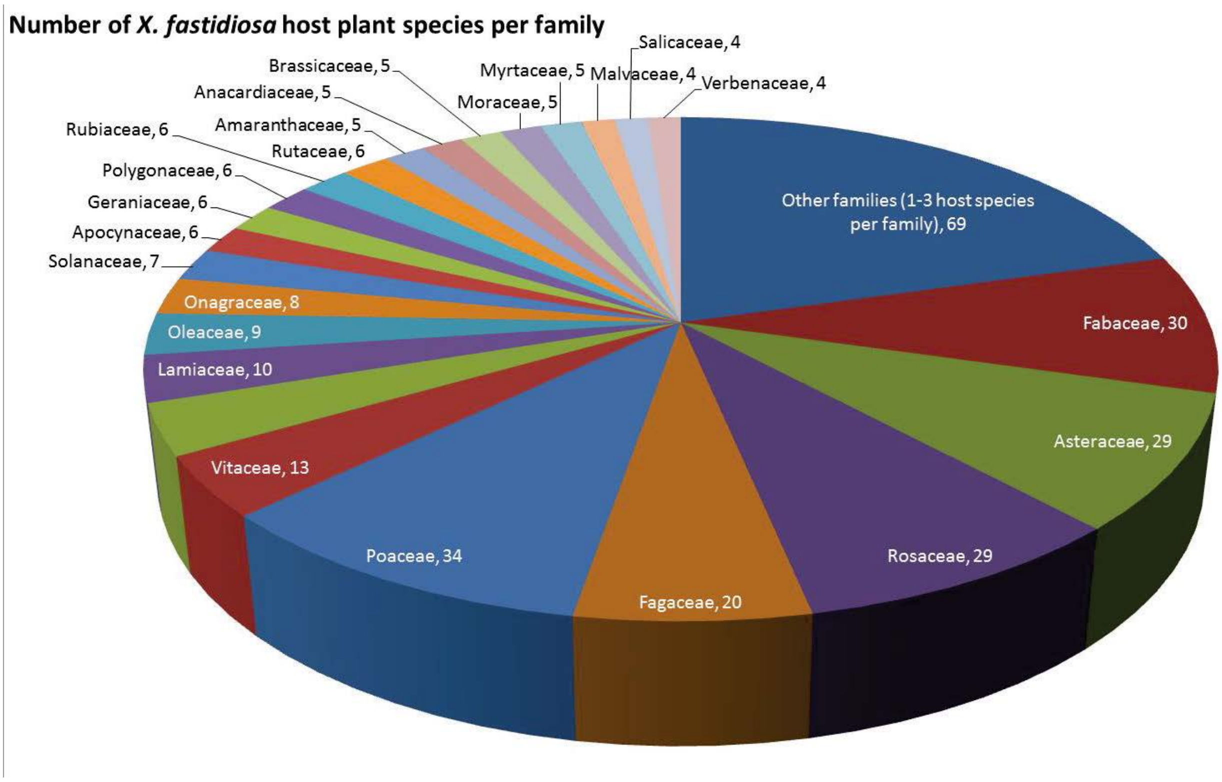

Fig.2. Number of *X. fastidiosa* host plant species per family (Stancanelli et al., 2015)

Six of the families are monocotyledons, while 59 are dicotyledons and three are gymnosperms. Despite this reported wide host range, it is important to highlight that not all of these plants express symptoms and are susceptible to disease. For some species certain varieties have been reported showing symptoms whereas others remain generally asymptomatic. In addition, not all host plant species are associated with each *X. fastidiosa* subspecies. There are some indications of host specificity; however its mechanism is not yet fully understood (Stancanelli et al., 2015).

Host Scientific name (common name) ***/ habitats****	**Presence in PRA area (Yes/No)**	**Comments (e.g. total area, major/minor crop in the PRA area,** ***major/minor habitats******)**	***Reference***
Olea europaea (Olive), *Citrus* sp. (Citrus fruit), *Prunus persica* (Peach), *Vitis vinifera* (Grapewine)	No, not as commercial crops	Occasional plantings in parks and gardens	
Stone fruit (*Prunus domestica, Prunus avium, Prunus cerasus*) Ornamental Prunus (*Prunus cerasifera, Prunus mume, Prunus serrulata, Prunus trilobata, Prunus persica, Prunus amygdalus)*	Yes	Important production for fresh consumption – plum 4366 acres, cherry 1471 acres in 2015 Popular ornamental plants.	SSB
Trees (among others: *Quercus, Ulmus, Salix, Populus, Platanus, Alnus, Fraxinus)*	Yes	Forests and woodlands, parks and urban plantings	
Ornamentals (among others): *Coffea arabica, Nerium oleander, Olea europea, Polygala myrtifolia, Rosmarinus officinalis, Hydrangea paniculata, Hedera helix, Pelargonium hortorum*)	Yes	Popular ornamental plants. Imported, often kept outside in the summer season	
Grasses (among others: *Phleum pratense, Lolium multiflorum, Lolium temulentum, Poa annua, Poa pratensis, Sorghum vulgare, Hordeum vulgare*)	Yes	Widespread in agricultural areas and the countryside	
Weeds (among others: *Urtica dioica, Trifolium sp., Echinochloa crus-galli, Lactuca serriola*)	Yes	Widespread in agricultural areas and the countryside	

Tab.3. Production or occurrence of susceptible host plants for *Xylella fastidiosa* in Norway

Infected host plants found in European countries until now are *Olea europaea, Polygala myrtifolia, Nerium oleander, Acer pseudoplatanus, Artemisia arborescens, Asparagus acutifolius, Cistus creticus, Cistus monspeliensis, Cistus salviifolius, Coffea arabica, Coronilla valentina, Dodonaea viscosa, Genista*

x spachiana (syn. Cytisus racemosus),Genista ephedroides, Euphorbia terracina, Grevillea juniperina, Hebe, Laurus nobilis, Lavandula angustifolia, Lavandula dentate, Lavandula stoechas, Myoporum insulare, Pelargonium graveolens, Prunus avium, Prunus cerasifera, Prunus dulcis, Quercus suber, Rhamnus alaternus, Rosa floribunda (syn. Rosa multiflora), Rosmarinus officinalis, Spartium junceum, Vinca, Westringia fruticose og Westringia glabra (NaturErvervstyrelsen, 2016).
Plant imports to Norway have experienced a steady and significant increase in recent years. Although Norway has few inhabitants, we are an important country for European plant exports (Hagen et al., 2012). Data on which host plant species (and volumes) are imported to Norway from abroad are not readily available. The results of an unformal nursery questionnaire carried out by Norsk Gartnerforbund are presented in Appendix 2.
However, big chains like Ikea, Plantasjen, other garden centres and even supermarkets do import many plants on their own. The following plant species are for sale in Norwegian garden centres: *Olea europaea, Nerium oleander, Coffea arabica, Citrus limon, Cytisus racemosus, Lavandula augustifolia, Hebe, Laurus nobilis*, *Pelargonium graveolens, Rosmarinus officinalis*, *Vinca major* (this is not an exhaustive list but the result of some simple web searches).Many of these plants are recommended by the venders for use on terraces or balconys.

8. Pathways for entry

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

Possible pathways *(in order of importance)*	**Short description explaining why it is considered as a pathway**	Pathway prohibited in the PRA area? Yes/No	Pest already intercepted on the pathway? Yes/No
Plants for planting	The movement of infected plants for planting is a very effective way for long-distance dispersal of *X. fastidiosa* and would also contribute to the spread of *X. Fastidiosa* (EFSA, 2015a). Trade with plants for planting is a big business nowadays. Partial records from NPPO inspection points in seven EU Member States between 2000 and 2007 include more than 150 million individual plants belonging to genera listed as host plants for *X. fastidiosa* and imported from countries where *X. fastidiosa* is known to occur *(EFSA, 2016).* No trade data are available for Norway.	No	No
Rating of the likelihood of entry	*Low* ☐	*Moderate* ☐	*High* X
Rating of uncertainty	*Low* ☐	*Moderate* X	*High* ☐
Infectious vector insects	Infectious vector insects are unlikely to enter Norway by natural spread because of the distance to infected areas. Human-assisted movement on the other hand (vectors on infested plants or on their own in vehicles) is a major potential contributor to the movement of the disease despite limited information reported on the topic. The introduction of the efficient vector *Homalodisca vitripennis* in California, French Polynesia, Hawaii and Easter Island is thought to have occurred through such means (EFSA, 2015a).	No	No
Rating of the likelihood of entry	*Low* ☐	*Moderate* X	*High* ☐
Rating of uncertainty	*Low* ☐	*Moderate* X	*High* ☐

9. Likelihood of establishment outdoors in the PRA area

Consider in particular the presence of host plants/habitats and climatic suitability and describe the area where establishment is most likely (area of potential *establishment). Reference to maps such as Köppen-Geiger climate zones, day degrees and hardiness zones may help assess the likelihood of establishment (see e.g. http://capra.eppo.org/files/links/Rating_Guidance_for_climatic_suitability.pdf).*

Presence of host plants: Host plants, cultivated or occurring spontaneously, do exist in the risk assessment area, and as efficient vectors are known to occur as well, there is a potential for establishment and spread of *Xylella fastidiosa*.
Plums and cherries are produced for fresh consumption, and are important high value products in some regions of Norway (Main counties: Hordaland, Telemark, Buskerud, Vestfold, Sogn and Fjordane and Rogaland). Plum and cherry are also commonly planted in private gardens for own consumption. Ornamental *Prunus* species and other ornamental host plants are used in parks and private gardens, and are also an important trade for nurseries and garden-centres.

Climatic suitability of the PRA area:
Disease-favourable conditions are the combination of warm nights, regular rainfall/high humidity and a long growing season (Janse et al, 2010). In vitro and in planta studies have shown that temperatures between 25 and 32°C may be critical for the epidemiology of Pierce's disease because of its rapid growth rate at these temperatures, whereas temperatures below 12 to 17°C and above 34°C may affect the survival of *X. fastidiosa* in plants (Purcell, 1980). On the other hand the maximum growth temperature of 33°C for *X. fastidiosa* is surprisingly low for a pathogen that only thrives in tropical andsubtropical climates (Hopkins et al Purcell, 2002).
Thanks to a warm and steady ocean current near its shores (the Golf Stream), Norway has a much more favourable climate than the latitude indicates. Summers can be warm and humid (for example the highest monthly mean temperature ever recorded is 22,7 °C for July 1901 in Oslo). The largest normal annual precipitation occurs in the area from the Hardanger fjord to the Møre area, which is among the highest in Europe. (Meterologisk Institutt). The Köppen –Geiger classification for Norway is Dfc (subarctic). High precipitation is common throughout the year, also in summer (Köppen-Geiger).
The temperature and humidity requirements of Xylella fastidiosa can therefore be met in some Norwegian summers. The Canadian provinces of Ontario, British Columbia, Sakatchewan (on elm) and Alberta (on maple) have had the disease for many years. Canada is also classified as Köppen- Geiger Dfc, which means that the climatic conditions are comparable. Norwegian winters on the other hand might be a limiting factor for the year to year survival of the pathogen. Experimental observations that freezing can be therapeutic for PD suggest that winter climate may limit where PD can occur. Temperatures below 10°C gradually reduced but did not eliminate populations of the bacterium in grape (Hopkins et al., 2002). Research from the United States on the other hand indicates that during winter months the pathogen population was most likely able to accumulate and survive in soil-insulated root xylem (Henneberger et al., 2004).

The vectors are mainly sharpshooters and froghoppers or spittlebugs which lack a latent period, and have no transstadial or transovarial transmission of the bacterium. The pathogen shows persistence in the vector adults, and ability to multiply in the foregut by biofilm formation. Vectors that over winter as eggs or nymphs are thought to be less important in the dissemination of the disease. It was therefore theorized that *X. fastidiosa* did not occur in Europe (before 2013) due to absence of vectors that survive winter as adults and, even if infected, could not cause extensive spread due to absence during the critical early spring period (Janse et al., 2010). Outbreaks of *X. fastidiosa* related diseases have taken place in Italy and France in recent years and endemic vectors have successfully spread the pathogen to new locations. Potential vectors in Norway are listed under point 4.

Towards the end of this century, there may be a noticeable reduction in the snow season in Norway, higher temperatures (2,5 – 3,5°C increase towards the end of the century), more precipitation and storms are expected in Norway (Norsk Polarinstitutt) and could offer more favourable conditions for the pathogen, the vectors and disease development.

Rating of the likelihood of establishment outdoors	*Low* □	*Moderate* X	*High* □
Rating of uncertainty	*Low* □	*Moderate* □	*High* X

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

Ornamental host plants are kept indoors many places in Norway, both in small private glasshouses (for over wintering) and bigger ones in connection with botanical gardens, Universities and commercial flower/ornamental plant production. Exact data about these plants and their origins are not readily available.There have been detections of the pathogen in glasshouses in France and Germany (EFSA, 2015 a; EPPO RS 2016/07).

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

11. Spread in the PRA area

- *Natural spread*
- *Human assisted spread*

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

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

Natural spread
The only route for natural spread of *X. fastidiosa* is by insect vectors that generally fly short distances, but can be transported by wind over longer distances. All xylem sap feeder insects (one phloem feeding insect has also been confirmed as a vector) should be regarded as potential vectors, including insects from the families Cicadellidae, Aphrophoridae, Cercopidae, Cicadidae and Tibicinidae. Several of these insect species are present and widely distributed within the risk assessment area (se point 4), although their ecological relevance for an effective contribution to *X. fastidiosa* spread is difficult to assess. The polyphagy of most of the vectors, and the wide range of *X. fastidiosa*-susceptible plants increase the probability of an encounter between an infectious insect and a susceptible host plant. (EFSA, 2015).
In the risk asessment area vectors do not over winter as adults and growing seasons are rather short. On the other hand suitable vectors do occur and so do many wild and cultivated host plants. That means there are many posibilities for vector host plant encounters that cannot be predicted. Furthermore there might be more host plants and vectors than currently known, with the ongoing research, especially in Europe, the lists of host plants and vectors are likely to be extended.

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

Human assisted spread
The movement of infected plants for planting is a very effective way for long-distance dispersal of X. fastidiosa and would also contribute to the spread of *X. fastidiosa* (EFSA, 2015a).

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

Besides natural spread routes, human-assisted movement (vectors on infested plants or on their own in vehicles) is a major potential contributor to the movement of the disease despite limited information reported on the topic (EFSA, 2015a).

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

12. Impact in the current area of distribution

Briefly describe the economic, ecological/environmental and social impacts in the current area of distribution.
Briefly describe the existing control measures applied against the pest.
In countries where it occurs, *X. fastidiosa* is known to cause severe direct damage to important crops such as olive, grapevine, citrus and stone fruits and also to forest trees, landscape trees and ornamental trees. It also causes indirect economic damage in areas producing plants for planting material, as exports from areas where the disease is known to occur may be forbidden (EFSA,2015a). *X. fastidiosa* has been identified in the disease outbreak that has affected 10000 hectares of olive trees in Lecce, Puglia region of Southern Italy. Stringent control measures have been enforced in this region : extensive monitoring of *X. fastidiosa* and vector(s), chemical treatments against adult vector populations, elimination of weeds and shrubs on which vector juveniles thrive in autumn-early spring, elimination of all alternative hosts of the bacterium and immediate uprooting of newly infected olive trees and those bordering them. Norms were also dictated for olive grove management according to good cultural practices, for avoiding the passive transport of vectors and pathogen across the delimited areas, and for the certification of nursery productions of susceptible hosts (Martelli et al., 2016).
Surveillance for *Xylella fastidiosa* in the area of potential establishment is crucial for disease containment and eradication (EFSA, 2016). In the European Union member countries are obliged to carry out systematic surveys on plants for planting of certain plant species and other possible host plants: „as regards measures to prevent the introduction into and the spread of *X. fastidiosa* within the Union“ (Decision 2015/789/EU, 2015). Where ever the pathogen is detected an containment or eradication regime has to be put in place.
In the production of Vitis sp. planting material an effective measure to control *X. fastidiosa* in dormant plants for planting of grape wine is hot water treatment. The standard hot water treatment of 50°C for 45 min already in place to eliminate Grapevine flavescence dorée phytoplasma from dormant planting material is also efficient for controlling X. fastidiosa in grapevine (EFSA, 2015b).
These latest measures were adopted by Commission on 17 December 2015: to update the list of regulated plants (specified plants and host plants) on the basis of the new findings reported by the French and Italian Authorities; to require the setting up of contingency plans and awareness raising campaigns for all Member States; to extend plant passport obligations for the movement within the Union of all host plants grown outside the demarcated areas, including for those coming from third countries; to introduce thermotherapy for the movement of dormant grapevine material within and out of the demarcated areas and to allow planting of host plants in some parts of the containment area of Lecce (Apulia, Italy) for scientific purposes (EC Fact Sheet, 2015).

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

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

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

Will impacts be largely the same as in the current area of distribution? No
If No
Only a few host plant species (plums and cherries) are commercially grown in Norway, but also possible disease impact on ornamentals, trees, and wild host plants should be of concern. The climatic conditions in Norway are suboptimal for the pathogen and do not allow adult vectors to survive the winter season. Severe outbreaks are therefore not expected to happen in the risk assessment area under the current climatic conditions.
Some host plant species are imported to Norway for ornamental purposes (e.g coffee, oleander, olive, lavender). These plants are not winter-hardy in Norway, they are often kept under frost free conditions during the winter, but outside in the summer season. They could represent a means of introduction, given they are infected and a suitable vector feeds on them. Low number bacterial populations could build up in cultivated or wild plants. Many wild plants can be latently infected and serve as pathogen reservoirs, like riparian weeds (Lashomb et al., 2002) and wild plums (EFSA, 2015a).

Since *X. fastidiosa* is listed as a quarantine organism in many countries, a finding in Norway would result in costly eradication efforts and restrictions in international plant trade (nurseries, garden centres) and plant material exchange in science and breeding programs. The disease could also have a negative social impact since it is not readily controllable in smallholdings and family gardens. In addition to these elements, the use of insecticide in an interception or outbreak situation could have environmental impacts (EFSA, 2015a).

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

14. Identification of the endangered area

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

The endangered areas are mainly the regions of Norway where stone fruit is grown: The counties Hordaland, Telemark, Buskerud, Vestfold, Sogn and Fjordane and Rogaland. The endangered area also includes private gardens where plum, cherry and ornamental Prunus species are planted in, and areas with nurseries and garden centres dealing with ornamental Prunus species and other host plants. Regarding other ornamental host plants, trees and wild hosts like grasses, weeds and sedges the whole country has to be defined as endangered area.

15. Overall assessment of risk

Summarize the likelihood of entry, establishment, spread and possible impact without phytosanitary measure. ***An overall rating should be given in the summary part which is placed at the beginning of the Express PRA.***

Then consider whether phytosanitary measures are necessary.

If the assessment shows that phytosanitary measures are not required for your country but there are indications that other EPPO countries are at higher risk, mention it.

Trade movements of infected plants for planting are a major pathway for *Xylella fastidiosa* introduction and spread. The majority of trees planted in Norway for commercial production are imported from the European Union, where the pathogen has recently been detected in some member countries. Also other susceptible host plants are imported to Norway, mainly ornamentals. These consignments can also carry infectious insects from the country of origin. The likelihood of entry is therefore high.

Ornamental host plants are kept in glass houses many places in Norway. Many of these are most likely imported from abroad without being assessed for the presence of X. fastidiosa. The likelihood of establishment in protected conditions in the PRA area is moderate.

Potential vectors do occurr and thrive in Norway and susceptible wild and cultivated host plants are present in large parts of the country. Summer seasons in Norway, with climatic conditions suitable for disease development are short. The likelihood of establishment outdoors in the PRA area is moderate.

The movement of infected plants for planting is an effective way for long-distance dispersal also inside the risk assessment area. Short distance spread of the pathogen may occurr with infectious vector insects, which can also be carried by wind. Infectious vector insects which over winter as adults are most effective in terms of spreading the disease. The potential vector insects present in Norway do not over winter as adults. The likelihood of spread is moderate.

The disease can cause significant damage on plum and cherry trees as well as other trees and ornamentals. The climatic conditions in Norway are, for the time being, suboptimal for severe disease outbreaks, but low number bacterial populations of the bacteria could establish in wild and/or cultivated host plants if introductions would take place unnoticed with latently infected plants (or infectious vectors). For Norway this could result in costly eradication measures and restrictions in international plant trade and plant material exchange in science and breeding programs. The impact of an introduction could be high.

See also point 18. Remarks.

To avoid introduction of *Xylella fastidiosa* into Norway phytosanitary measures are necessary.

Stage 3. Pest risk management

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

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

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

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

Prohibition
Surveillance, eradication, containment

Phytosanitary measures should focus on the avoidance of introduction of the pathogen. Consignments of imported plants for planting (all host plant species) should be inspected for symptoms (and for the presence of potential vector insects) and tested for latent infections at an appropriate rate upon arrival. Infected consignments should be rejected. Regular surveys should be carried out in order to monitor for the occurrence of the disease in Norwegian plantations, especially those which are known to be of foreign origin. If the pathogen should be detected in Norway an adequate eradication programme should be put in place by the Norwegian Food Safety Authority.
An information campaign should be initiated to strengthen public awareness about the risk of introducing this pathogen to Norway by taking home plants or cuttings from abroad.

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

There is high uncertainty about whether the pathogen has been intercepted in Norway or not. Susceptible host plants have been imported to Norway in recent years for planting indoors or outdoors, but no surveys have been carried out due to lack of awareness.

There is high uncertainty about the host range of X. fastidiosa. The official host list is frequently updated with the addition of new hosts to consider.

There is high uncertainty about the number of potential vectors. Also this list is growing as more research is focused on vector transmission. Even one phloem feeding insect has been identified as a vector recently.

There is high uncertainty about the host plant range imported to Norway. Many of the main host plant for *X. fastidiosa* (like olive, citrus and grapevine) are not produced in Norway. But some susceptible host plant species (olive, oleander, rosmarin, stone fruit and ornamental *Prunus*) are imported to Norway for commercial and ornamental purposes. Data on these imports (years, numbers) and the distribution of plants inside the country are not available.

There is medium uncertainty concerning climatic conditions in Norway. For the moment they seem to be limiting for disease development and winter survival of potential vectors but might become more favourable in the future with the expected climate change. The pathogen itsself might be able to survive winter conditions protected in the roots.

There is high uncertainty about the importance of human assissted spread of infectious vectors due to lack of information on this matter. The probability of vector survival during transport or storage is considered from unlikely to likely, with high uncertainty, owing to the lack of field evidence (EFSA,2015).

18. Remarks

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

In this assessment the overall phytosanitary risk posed by the pathogen is rated high inspite of only moderate likelihood for establishment and spread in the risk assessment area. This is on the one hand due to the fact that *Xyellla fastidiosa* is considered to be one of the most dangerous plant bacteria worldwide, causing a variety of diseases, with huge economic impact for agriculture (EC Fact Sheet, 2015). Potential damage to forests and urban plantings has also to be taken into account. Significant reduction in amenity value and economic losses associated with tree pruning, to avoid hazard and potential litigation has occurred for example in the New Jersey region, where up to 35% of urban plantings were affected (Fera, 2014).

On the other hand, the rating is a consequence of the many high uncertainties listed under point 17. The combination of a wide host range with a large number of potential vectors seems to be extremely dangerous with unforseeable consequences. The pathogen occurred for the first time in Europe only recently and many important factors concerning host range, vector transmission, epidemiology and genetic variation in this new area are still unknown. *X. fastidiosa* is naturally competent and natural populations have been demonstrated to frequently recombine (Loconsole et al., 2016). Recent research results suggest that this bacterium is able to recombine when growing inside plants or insects, and this can be a mechanism of adaptation of this incurable pathogen (Prem et al., 2016).

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

19. REFERENCES

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

CABI *Xylella fastidiosa* (Pierce's disease of grapevines) www.cabi.org/isc/datasheet/57195

Council Directive (2000) 2000/29/EC COUNCIL DIRECTIVE of 8 May 2000 on protective measures against the introduction into the Community of organisms harmful to plants or plant products and against their spread within the Community http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:169:0001:0112:EN:PDF

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Appendix 1. Relevant illustrative pictures (for information)

Xylella fastidiosa symptoms on *Prunus* (cherry). Courtesy: Donato Boscia. CNR - Institute for sustainable plant protection, UOS, Bari (IT) Laboratory, Angers (FR)

Leaf scorch caused by *Xylella fastidiosa* on a *Coffea* originating from Ecuador (Interception) Courtesy: Bruno Legendre. Anses, Plant Health Laboratory, Angers (FR)

Leaf scorch of *Polygala myrtifolia* (Milkwort) infected by *Xylella fastidiosa* subsp. *multiplex* in Corsica. Photo: Bruno Legendre, Anses Plant Health Laboratory, Angers (FR)

Symptoms of marginal leaf scorch on northern red oak. Photograph: A. B. Gould, State University of New Jersey

Philaenus spumarius, potential vector for *Xylella fastidiosa.* Photograph: Wikipedia

Appendix 2. Import of hostplants for *X. fastidiosa* to Norway in 2016

(Results from an informal survey where nurseries from the counties Rogaland, Hordaland, Akershus, Østfold, Hedmark and Aust Agder responded.The survey was conducted by Ronny Berdinesen, Norsk Gartnerforbund).

Hostplant	Number of importing nurseries	Export country
Trees and shrubs (answers from 9 nurseries)		
Alnus rhombifolia		
Quercus agrifolia		
Quercus lobata		
Quercus rubra	6	Denmark, Netherlands, Sweden, Germany
Quercus sp.	6	Denmark, Netherlands, Sweden, Germany
Hydrangea paniculata	6	Netherlands, Denmark, Germany, France
Umbellularia californica		
Morus sp.		
Eucalyptus camaldulensis		
Eucalyptus globulus		
Eugenia myrtifolia		
Fraxinus dipetala		
Fraxinus latifolia		
Olea europaea	1	Netherlands
Syringa vulgaris	9	Denmark, Netherlands
Pittosporum crassifolium		
Cotoneaster rotundifolia		
Photinia arbutifolia		
Prunus americana		
Prunus angustifolia		
Prunus armeniaca	1	Denmark
Prunus cerasifera	6	Denmark, Netherlands
Prunus dulcis		
Prunus hortulana		
Prunus mexicana		
Prunus mume		
Prunus persica	4	Denmark, Netherlands
Prunus salicina		
Prunus sp.	7	Sweden, Denmark, Netherlands, Germany, France
Prunus webbii		
Prunus webbii × *Prunus persica* Harrow *Blood*		
Rosa californica		
Rubus discolor		
Rubus ursinus		
Rubus vitifolius		
Populus fremontii		
Salix laevigata		
Salix lasiolepis		

Hostplant	Number of importing nurseries	Export country
Salix sp.	7	Sweden, Netherlands,Denmark
Acer macrophylum		
Acer negundo	3	Netherlands, Sweden
Aesculus californica		
Ulmus americana		
Ulmus sp.	5	Netherlands, Germany, Denmark
Parthenocissus quinquefolia	9	Netherlands, Germany, Denmark
Parthenocissus tricuspidata	7	Netherlands, Germany, Denmark
Vitis aestivalis		
Vitis californica		
Vitis rupestris		
Vitis sp.	6	Netherlands, Denmark
Perennials (answers from 3 nurseries)		
Conium maculatum		(no information available)
Coriandrum sativum		
Datura wrightii		
Daucus carota		
Oenanthe sarmetosa		
Catharanthus roseus		
Nerium oleander		
Vinca major	1	
Vinca minor	1	
Hedera helix		
Ambrosia acanthicarpa		
Ambrosia artemisiifolia		
Artemisia douglasiana		
Artemisia vulgaris		
Baccharis pilularis		
Baccharis salicifolia		
Bidens pilosa		
Callistephus chinensis		
Conyza canadensis		
Encelia farinosa		
Franseria acanthicarpa		
Helianthus annuus		
Lactuca serriola		
Sonchus asper		
Sonchus oleraceus		
Xanthium canadense		
Xanthium strumarium		
Lobularia maritima		
Canna sp.		
Lonicera japonica		
Symphoricarpos albus	1	
Convolvulus arvensis		
Ipomoea purpurea		

Hostplant	Number of importing nurseries	Export country
Cyperus eragrostis		
Cyperus esculentus		
Vaccinium corymbosum	1	
Vaccinium sp.	1	
Escallonia montevidensis		
Acacia longifolia		
Cytisus scoparius		
Genista monspessulana		
Lathyrus cicera		
Lathyrus clymenum		
Lathyrus saliva		
Medicago hispida		
Medicago sativa		
Melilotus albus		
Melilotus indicus		
Melilotus officinalis		
Melilotus sp.		
Spartium junceum		
Trifolium fragerum		
Trifolium hybridum		
Trifolium incarnatum		
Trifolium pratense		
Trifolium repens		
Vicia faba		
Vicia monanthus		
Vicia sativa		
Pelargonium hortorum		
Majorana hortensia		
Melissa officinalis	1	
Mentha sp.	1	
Rosmarinus officinalis	1	
Salvia apiana		
Salvia mellifera		
Malva parviflora		
Epilobium californicum		
Epilobium paniculatum		
Fuchsia magellanica	1	
Godetia grandiflora		
Oenothera hookeri		
Veronica sp.		
Avena fatua		
Brachiaria decumberis		
Brachiaria plantaginea		
Bromus catharticus		
Bromus rigidus		
Bromus sp.		
Cynodon dactylon		
Digitaria horizontalis		

Hostplant	Number of importing nurseries	Export country
Digitaria sanguinalis		
Echinochloa crusgalli		
Eragrostis diffusa		
Eriochloa gracilis		
Erodium cicutarium		
Erodium moschatum		
Festuca megalura		
Hordeum murinum		
Hordeum vulgare		
Lolium mulliflorum		
Lolium temulentum		
Paspalum dilatatum		
Pennisetum clandestimum		
Phalaris minor		
Phalaris paradoxa		
Phleum pratense		
Poa annua		
Setaria lutescens		
Sorghum halepense		
Sorghum sudanense		
Fagopyrum esculentum		
Polygonum convolvulis		
Polygonum persicaria	1	
Rheum rhaponticum		
Reseda odorata		
Simmondsia chinensis		
Duranta repens		
New host plants (added to EU host list after november 2015)		
(answers from 17 nurseries)		
Susceptible to *Xylella fastidiosa* subspecies *fastidiosa*		
Acer pseudoplatanus L.	3	Netherlands, Denmark
Artemisia arborescens L.		
Asparagus acutifolius L.		
Cistus monspeliensis L.		
Cistus salviifolius L.		
Coronilla valentina L.		
Genista x spachiana (syn. *Cytisus racemosus* Broom)		
Genista ephedroides DC.		
Hebe	4	Netherlands, Denmark
Lavandula angustifolia Mill.	9	Netherlands, Denmark,Sweden, France
Lavandula dentata L.		
Lavandula stoechas L.	1	Denmark
Myrtus communis L.		
Pelargonium graveolens L'Hér		
Polygala myrtifolia L.	2	France, Netherlands
Prunus cerasifera Ehrh.	7	Netherlands, Denmark
Quercus suber L.		

Hostplant	Number of importing nurseries	Export country
Rosa x floribunda	5	Netherlands, Denmark
Rosmarinus officinalis L.	4	Denmark, Italy, Sweden
Spartium junceum L.		
Susceptible to *Xylella fastidiosa* subspecies *pauca*		
*Acacia saligna (*Labill.) Wendl.		
Asparagus acutifolius L.		
Catharanthus		
Cistus creticus L.		
Dodonaea viscosa Jacq.		
Euphorbia terracina L.		
Grevillea juniperina L.		
Laurus nobilis L.	1	Italy
Lavandula angustifolia Mill.	3	Netherlands, Denmark
Myrtus communis L.		
Myoporum insulare R. Br.		
Nerium oleander L.		
Olea europaea L.		
Polygala myrtifolia L.		
*Prunus avium (*L.) L.	7	Netherlands, Denmark, Sweden
*Prunus dulcis (*Mill.) D.A. Webb		
Rhamnus alaternus L.		
Rosmarinus officinalis L.		
Spartium junceum L.		
Vinca	5	Denmark, Sweden
*Westringia fruticosa (*Willd.) Druce		
Westringia glabra L.		