



The Food & Environment Research Agency

Rapid Pest Risk Analysis for *Xylella fastidiosa*

STAGE 1: INITIATION

1. What is the name of the pest? *Xylella fastidiosa*.

X. fastidiosa is the only species of the bacterial genus *Xylella*, which is a sister clade to the plant pathogenic genus *Xanthomonas*. In addition to Pierce's disease of grapevine, the pathogen is associated with bacterial leaf scorch (BLS) diseases known as BLS of: oak, sycamore, almond, coffee, mulberry and oleander; plum leaf scald, citrus variegated chlorosis agent, peach phony disease and dwarf disease of alfalfa. Four subspecies-level taxa can be discriminated by sequence analysis as: *X. fastidiosa* subsp. *fastidiosa* (formerly subsp. *piercei*); subsp. *pauca*; subsp. *multiplex* and subsp. *sandyi* (Schaad et al., 2004 a, b). The biology and risks of the pathogen have been recently reviewed (Janse and Obradovic, 2010).

2. What is the pest's status in the EC Plant Health Directive (Council Directive 2000/29/EC¹) and in the lists of EPPO²?

X. fastidiosa is an EU IAI and EPPO A1 listed organism. Vectors of the pathogen (*Carneiocephala fulgida*, *Draeculacephala minerva*, *Graphocephala atropunctata*, *Homalodisca vitripennis* = *H. coagulata*) are EPPO A1 listed organisms, all but *H. vitripennis* are EU IAI listed organisms. Following confirmation of *X. fastidiosa* in the Apulia region of southern Italy in September 2013 (Saponari et al., 2013), several Plant Health actions have been instigated. EPPO has produced an alert (EPPO, 2013) and EFSA has made a rapid assessment of the threat (EFSA, 2013). Most recently, (May, 2014), the EU Plant Health Standing Committee has agreed an updated Commission Implementing Decision, which sets out new regulations in response to the outbreak (Appendix 3).

3. What is the reason for the rapid assessment?

The need for a PRA for *X. fastidiosa* was originally initiated following consideration of the pest for the UK Risk Register, which noted increasing reports of *X. fastidiosa* in the USA in recent years especially to amenity trees in north east USA. Subsequently, the first European outbreak of *X. fastidiosa* was reported in the Apulia region of southern Italy where the pathogen is associated with 'rapid decline disease of olive' over a large area (Saponari et al., 2013). Sequence information places this strain as a sister group to *X. fastidiosa* subsp. *pauca*. This PRA has taken into account information concerning the outbreak and new emergency regulations (see section 2), that were available at the time of writing and will be updated as new information becomes available.

STAGE 2: RISK ASSESSMENT

4. What is the pest's present geographical distribution?

X. fastidiosa is largely restricted to the Americas. EPPO PQR data lists the distribution as; South America: Argentina, Brazil, Costa Rica, Mexico, Paraguay, North America: (USA, 29 states), Canada (Ontario). Asia: Taiwan. In Europe, there has been a report of *X. fastidiosa* from grapevine originating from Kosovo (Berisha et al., 1998), though there is no sequence data to confirm the identification of the pathogen. The current *X. fastidiosa* outbreak from Apulia

¹ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2000L0029:20100113:EN:PDF>

² [http://archives.eppo.int/EPPOStandards/PM1_GENERAL/pm1-02\(21\)_A1A2_2012.pdf](http://archives.eppo.int/EPPOStandards/PM1_GENERAL/pm1-02(21)_A1A2_2012.pdf)

southern Italy has been confirmed by isolation of the pathogen and DNA sequence analysis (Saponari et al., 2013; Elbeaino et al., 2014).

5. Is the pest established or transient, or suspected to be established/ transient in the UK?

X. fastidiosa is absent from the UK and has never been recorded or intercepted. There have been no reported surveys of *X. fastidiosa* in the UK, however it has been noted that leaf desiccation in horse chestnut in the UK is similar to *X. fastidiosa* symptoms (J. Webber Pers. Comm. 2014; Strouts and Winter, 1994).

6. What are the pest's natural and experimental host plants; of these, which are of economic and/or environmental importance in the UK?

Hosts are listed on the *X. fastidiosa* website maintained at Berkeley University which details the tests used to identify infection (see Appendix 1). There are over 150 hosts listed, though most hosts harbour the pathogen without causing disease symptoms. Most hosts are listed for Pierce's disease strains (subsp. *fastidiosa*) and 38 hosts in total for the other subsp. *Oleander* are hosts of subsp. *sandyii*, *Citrus* and coffee are hosts of subsp. *pauca*. Many *Xylella* tree pathogens are restricted to subsp. *multiplex* including those that infect *Ulmus americanum*, *Platanus occidentalis*, *Quercus* (mainly the red oak group) and *Acer* (Mundell, 2004). A detailed phylogenetic analysis of *X. fastidiosa* isolates from the USA discriminated four phylogenetic clades within subsp. *multiplex* identified as 'almond', 'peach', 'oak' and 'other types' (Nunney et al., 2013). The almond group is comprised of isolates from almond, olive, brittlebush, black sage and purple leaf plum. The peach group isolates were from purple leaf plum, common plum, peach and apricot. The oak group included isolates from periwinkle, pin (*Q. palustris*), red (*Q. rubra*) and turkey oaks (*Q. cerris*), as well as scarlet (*Q. coccinea*), English (*Q. robur*) and shumard (*Q. shumardii*) oaks. Species of *Platanus*, *Ulmus*, *Alnus* and *Acer* were represented including American sycamore (*P. occidentalis*), *U. americanum*, *Alnus rhombifolia*, *Acer rubrum*, *Acer griseum*. Pecan isolates were also placed in the group.

Tree hosts which have been associated with diebacks and scorchs in the USA include species of *Acer*, *Aesculus*, *Cornus*, *Liquidamber*, *Morus* and *Prunus* (Barnard, 2007). The biology and extent of *X. fastidiosa* leaf scorch disease of hardwood trees in the urban landscape in USA has been reviewed (Lashomb et al., 2002) and affected trees include 18 species of mostly native oak. Urban tree diseases of oak, *P. occidentalis* and *U. americana* have been reviewed by Gould and Lashomb (2005).

The known *X. fastidiosa* host range may not be a good indicator of the hosts that may be vulnerable in Europe. The susceptibility of hosts to the pathogen and disease expression is dependent on interaction of a complex set of factors including host compatibility, host range of vectors, vector efficiency and populations, as well as climatic conditions, which are considered in more detail in sections 9-12. It is therefore difficult to predict which plants would be most severely affected by an outbreak of *X. fastidiosa* in the region. The most important known hosts in the UK are tree species especially oak, sycamore (*A. pseudoplatanus*), ash, elm, plane (*P. x acerifolia*) and species of *Prunus*. *X. fastidiosa* is well known as a serious pathogen in grapevine though disease is restricted to states in southern US. Ivy is a potentially significant environmental host (McElrone et al., 1999), though it is not known if disease is induced by *X. fastidiosa* in this host.

The host range of a specific introduced strain *X. fastidiosa* would be an important factor in predicting the likelihood of pathogen establishment. Experimental determination of host range of *X. fastidiosa* strains and sub-species has not been extensively reported. In subsp. *fastidiosa* strains isolated from grapevine, almond and lupin in southern USA it was found that all shared very close or identical similarity in nine concatenated genes (Parker et al 2012), suggesting that the same strain could infect all three hosts. US strains of *X. fastidiosa* subsp. *fastidiosa* from grapevine, elderberry and lupin as well as subsp. *multiplex* strains from almond, blackberry, mulberry, oak and sycamore were tested for their pathogenicity to blueberry (Hopkins et al., 2012). This study found two strains of subsp. *fastidiosa* from elderberry and lupin as well as

two subsp. multiplex strains from almond and blackberry produced leaf scorch symptoms when injected into blueberry. Additionally, all the strains tested (except for the blackberry strain) produced disease in almond. A strain of *X. fastidiosa* which causes leaf scorch in purple-leafed plum (*P. cerasifera*), did not produce disease symptoms (and could not be re-isolated) when inoculated into grapevine or oleander, though disease was produced in almond (Hernandez-Martinez et al., 2009). The same study found *X. fastidiosa* isolates from grapevine, oleander and almond were not pathogenic to sweetgum indicating the unique host range of the strains. Experimental transmission studies by injection (Purcell et al., 1999), found that a strain of *X. fastidiosa* isolated from oleander caused leaf scorch of periwinkle but did not cause disease (and could not be re-isolated) from grapevine, peach, olive Californian blackberry (*Rubus ursinus*) or valley oak (*Q. lobata*). Within subsp. multiplex strains isolated from elm are not pathogenic to sycamore and vice versa (Sherald, 1993). These data provide evidence for a complex relationship between strains from within a subspecies and their potential to produce disease in different hosts, which makes prediction of host range difficult.

The current *X. fastidiosa* outbreak in Apulia southern Italy has identified several hosts from which the pathogen has been isolated or detected including olive, oleander and almond (Saponari et al., 2013). Other suspected hosts associated with the outbreak include species of *Malva*, *Portulaca* (purslane), *Quercus*, *Sorghum* and periwinkle. The diagnosis of *X. fastidiosa* in *Quercus* has not been confirmed.

7. If the pest needs a vector, is it present in the UK?

Xylem feeding insects, especially sharp shooters/leafhoppers (Cicadellidae, subfamily Cicadellinae) and spittle bugs (family Cercopidae) are the most important known vectors of *X. fastidiosa* and these taxa are common in the UK. 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 (Zhang et al., 2011). 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.

In the USA the spittlebug *Philaneus spumarius*, which is common in the UK and Europe, has been shown to efficiently vector *X. fastidiosa* in almond in experimental transmission studies (Purcell, 1980a). Xylem feeding leafhoppers present in the UK are listed in the report supplied by Chris Malumphy (Appendix 4). There is also the possibility that the pathogen could be introduced into the UK with a new vector.

The current *X. fastidiosa* outbreak in Apulia has detected the pathogen at high frequency in the spittle bugs *P. spumarius* and *Neophilaneus campestris* as well as the leaf hopper *Euscelis lineolatus*, which are common or locally common in the UK (Elbeaino et al., 2014; Appendix 4). The detection of *X. fastidiosa* in leaf hopper is of note because this insect is a phloem feeder.

8. What are the pathways on which the pest is likely to move and how likely is the pest to enter the UK?

A) Plants for planting

Very unlikely Unlikely Moderately likely Likely Very likely

The Commission Implementing Decision (Appendix 3), which prohibits movement of specified hosts from the outbreak region in Italy, as well as third countries from outside the EU will reduce entry risks. However, symptomless carriage of the pathogen by a large range of hosts whose entry may be poorly regulated introduces considerable uncertainty in assessing entry risks. This is reflected in the wide range of scores.

There is a trade in plants for planting from Italy, which may include large olive trees that could provide a means of entry if the outbreak in Italy has spread further than current surveys have

indicated. Similarly, oleander and ornamental almond are sold in the UK though it is not clear if these plants are imported into the UK from Italy. Some potential host plants, including trees in the dormant state, can be imported from the Americas.

B) Hitch hiking of infected vector on imported produce or other goods.

Very unlikely Unlikely Moderately likely Likely Very likely

The risks associated with this pathway are rated unlikely because vectors are associated with green parts of host plants and would not be found in harvested produce devoid of green plant parts.

C) Seed

Very unlikely Unlikely Moderately likely Likely Very likely

Seed transmission of *X. fastidiosa* has been reported only for *Citrus* hosts and the pathogen would not be expected to be introduced by seed (Li et al., 2003). Seed transmission has not been reported in hosts infected with subsp. *multiplex*.

D) Fruit

Very unlikely Unlikely Moderately likely Likely Very likely

Infected fruits are unlikely to represent an efficient entry pathway. Grapes have been shown not to harbour the pathogen (Purcell and Saunders, 1995).

E) Natural spread through infected insect vectors

Very unlikely Unlikely Moderately likely Likely Very likely

Adult Spittlebug and leaf hopper vectors are not strong fliers and it is unlikely they will be able to cross the channel to initiate infection.

9. How likely is the pest to establish outdoors or under protection in the UK?

Outdoors:	Very unlikely	<input type="checkbox"/>	Unlikely	<input checked="" type="checkbox"/>	Moderately likely	<input checked="" type="checkbox"/>	Likely	<input type="checkbox"/>	Very likely	<input type="checkbox"/>
Under protection:	Very unlikely	<input type="checkbox"/>	Unlikely	<input type="checkbox"/>	Moderately likely	<input checked="" type="checkbox"/>	Likely	<input type="checkbox"/>	Very likely	<input type="checkbox"/>

In North America *X. fastidiosa* diseases occur mostly in southern US states, eg Pierce's disease of grapevine, peach phoney disease, almond and oleander scorch (Singh et al., 2010). In grapevine *X. fastidiosa* is not present in North America where average winter temperatures drop to below 0°C (Meyer and Kirkpatrick, 2009) and it has been suggested on the basis of modelling data that disease in this host may be restricted to southern European regions (Hoddle, 2004). Cold temperature regimes have been shown to reduce or eliminate disease in infected grapevine (Purcell, 1980b) and a model of cold curing of Pierce's disease has been developed (Lieth et al., 2011). The most northerly latitude at which the *X. fastidiosa* (subsp. *multiplex*) has been detected is the Niagara Peninsula in Ontario (Goodwin and Zhang, 1997). This study surveyed 114 trees in 48 locations in southern Ontario and detected the pathogen in three specimens of *U. americana* with leaf scorch. Tree leaf scorches in urban plantings caused by *X.*

fastidiosa are extensive in New Jersey and extend from here down the east coast to Florida (see section 12). A study of the effect of low temperature on wild and glasshouse-maintained *X. fastidiosa* subsp. *multiplex* infections of sycamore (Henneberger et al., 2004), found that in naturally infected trees there was a negative correlation between bacterial populations in shoots, but not roots, when exposed to cumulative hours below -5° C. The laboratory study found no significant effects on the presence of viable populations of *X. fastidiosa* when plants were subjected to temperatures of 5° C. The UK climate has a strong maritime influence which moderates winter temperatures. Vectors do not transmit *X. fastidiosa* through the egg or growth moulting cycles (Purcell and Findlay, 1979) and the bacterium is maintained in the adult foregut through the production of bacterial biofilm (Almeida and Purcell, 2006). The presence of potential UK insect vectors that can over winter in the adult stage, could provide a means of disease transmission early in the season and these insects may therefore, be a factor in determining the UK vulnerability to *X. fastidiosa* (Purcell, 1997). UK climatic conditions are probably toward the more northerly limit at which disease could be expected to become established which reduces risks to establishment in the UK.

In hosts infected by *X. fastidiosa* that remain asymptomatic the bacteria usually do not move systemically within the plant, though these plants may still serve as sources for vectors to acquire the pathogen, which would contribute to the potential of *X. fastidiosa* to establish in the environment (Hill and Purcell, 1997; McGaha et al., 2007). It has been observed that infected riparian weeds in New Jersey are associated with a high incidence of amenity tree disease in New Jersey (Lashomb et al., 2002) and these hosts may constitute an infection reservoir.

Leaf scorch symptoms are rather non-specific and establishment of the pathogen if introduced into the UK could develop to an advanced stage before disease is first recognised and diagnosed, which increases establishment risks.

10. How quickly could the pest spread in the UK?

Natural spread:	Very slowly	<input type="checkbox"/>	Slowly	<input checked="" type="checkbox"/>	Moderate pace	<input checked="" type="checkbox"/>	Quickly	<input type="checkbox"/>	Very quickly	<input type="checkbox"/>
In trade:	Very slowly	<input type="checkbox"/>	Slowly	<input type="checkbox"/>	Moderate pace	<input type="checkbox"/>	Quickly	<input type="checkbox"/>	Very quickly	<input checked="" type="checkbox"/>

In north east US natural tree infections have progressed slowly. There is some uncertainty on the speed of spread due to the complex nature of the disease and uncertainties with respect to vector populations, host susceptibilities, host densities and the influence of climatic conditions.

11. What is the area endangered by the pest?

Warmer UK regions with minimal winter frost conditions are most likely to be at greatest at risk.

12. What is the pest's economic, environmental or social impact within its existing distribution?

Very small	<input type="checkbox"/>	Small	<input type="checkbox"/>	Medium	<input type="checkbox"/>	Large	<input checked="" type="checkbox"/>	Very large	<input checked="" type="checkbox"/>
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Citrus variegated chlorosis affects approximately 40% of *Citrus* plants in Brazil and losses have been estimated to be approximately 120 million US dollars to the Brazilian economy (Bove and Ayres, 2007). Infection of grapevine has caused major losses in the southern USA and the pathogen precludes efficient viticulture in some of these regions. Peach phony disease and almond scorch are also economically important.

In mid-atlantic and north east USA states leaf scalds of hardwood trees have had serious impacts to urban plantings of amenity and shade trees. In 2001, 30% of 3000 (American) elm trees in Washington DC were affected by the pathogen (Gould and Lashomb, 2005). In American sycamore (*P. occidentalis*) leaf scald infections are chronic. In East Potomac Park

(Washington, DC.) a survey in 2001 found 80% of trees were affected by bacterial leaf scald (Britton et al., 1999; Lashomb *et al.*, 2002). Bacterial leaf scald of *Quercus* in the USA primarily affects red oak species and the disease has been reported from New Jersey, Florida, Texas and mid-western states. In some areas of New Jersey bacterial leaf scorch affects up to 35% of oaks planted as street trees (Gould, 2004; Lashomb et al., 2002). A long term study in this area reported disease incidence in 700 pin, red and scarlet oaks. The work concluded in 2012, and found that the percentage of infected trees increased from 20% to 35% between 2002 and 2012 and of the remaining street trees, 20% were severely affected by bacterial leaf scorch (Gould et al., 2013). In the absence of effective control measures arborists were forced to remove trees to prevent liabilities.

In the Apulia region of southern Italy the *X. fastidiosa* outbreak has is associated with Olive Quick Decline Syndrome that appeared from 2010 and has caused severe losses to olive, including extensive tree death over a large area, though the exact role of the pathogen has yet to be determined (Loconsole et al., 2014; Saponari et al., 2013). The insect *Zeuzera pyrina* and the fungus *Phaeomoniella* spp. have also been identified as potential agents that may contribute to olive dieback in the region (Guario et al., 2013).

13. What is the pest’s potential to cause economic, environmental or social impacts in the UK?

Very small Small Medium Large Very large

Climatic unsuitability will most likely limit the impacts of *X. fastidiosa* infections in the UK. However, as previously mentioned infected American elm trees with symptoms of scald have been reported as far north as the Niagaran peninsula in south Ontario. In the USA tree scalds are largely restricted to urban plantings (when often only single trees within a stand are affected) rather than woodlands or forests. The factors which lead to tree infections in the urban environment are not well understood, though differences in stress factors and vectors may be important. However, *X. fastidiosa* has been found in some woodland and tree damage can be exacerbated in conjunction with other insect pests (pers. comm. J. Lashomb). Leaf scorches in trees do not become evident until late summer and damage takes several seasons to become extensive. Despite the slow onset and decline of tree vigour and branch loss, significant economic costs and damage to the urban landscape has occurred in native hardwood trees (including *Q. rubra*, *P. occidentalis* and *U. americana*) in north eastern USA. These losses could be potentially repeated in the UK though there is considerable uncertainty as to the degree of damage that may result if the pathogen was to become established in the UK. These uncertainties relate to vector efficiency and populations, climatic considerations and also to the host range properties of an individual invasive strain. There have been no reports of diseased trees in nursery stock.

There is uncertainty as to the potential for UK establishment of the *X. fastidiosa* strain that is causing severe losses to olive in the Apulia region of southern Italy. However, the detection of *X. fastidiosa* in potential vector species which are common in the UK increases the threat from this strain. Economic, environmental and social impacts are scored as small to medium.

14. What is the pest’s potential as a vector of plant pathogens?

None.

STAGE 3: PEST RISK MANAGEMENT

15. What are the risk management options for the UK? (*Consider exclusion, eradication, containment, and non-statutory controls; under protection and/or outdoors*).

The large number of potential hosts that could harbour *X. fastidiosa* and serve as an infection reservoir and the common occurrence of insect vectors in the UK is likely to make the eradication of the disease from the wider environment very difficult. Therefore, exclusion is the best option to control the disease. New regulations are now in place (see Appendix 3), that restrict movements of specified hosts from the infected region of Apulia in southern Italy and from third countries outside the EU, to reduce the risks of *X. fastidiosa* entry.

16. Summary and conclusion of rapid assessment.

X. 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. Xylem feeding insects primarily sharpshooters/ leafhoppers and spittle bugs that are common in the UK 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. Important damaging diseases are Pierce's disease of grapevine, citrus variegated chlorosis, peach poney disease, almond leaf scald and leaf scorches of coffee and hardwood trees. The *X. fastidiosa* outbreak in Apulia in southern Italy has been associated with large scale destruction of olive plantations. However, 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 southern Ontario and have caused significant disease in red wood oak species in urban plantings in New Jersey. The UK is towards the northern limit at which *X. fastidiosa* would be expected to establish. The detection of *X. fastidiosa* at high frequency with potential vectors in the outbreak at Apulia outbreak in southern Italy that are common in the UK, has increased the threat to the UK. The recently agreed Commission Implementing Decision (Appendix 3), which sets out new regulations in response to the outbreak will reduce entry risks.

Risk of entry

The import of plants for planting originating from infected areas in the Americas and now Italy constitute an entry risk. The recent regulation prohibiting movement of specified hosts from these areas (see Commission Implementing Decision, Appendix 3) will reduce entry risks. However, the arrival of the pathogen in the Apulia region of southern Italy increases entry risks as it is possible that the pathogen has spread to a greater extent than is currently known. Hitch hiking of infected vectors on produce and fruits is considered a low risk pathway.

Risk of establishment

The UK is towards the northern limit at which *X. fastidiosa* would be expected to establish. Most subsp. of *X. fastidiosa* occur only in much warmer climates than is found in the UK and only *X. fastidiosa* subsp. *multiplex* is known to produce disease in climatic conditions similar to the UK. Due to the non-specific nature of the disease symptoms, outbreaks may remain undetected until the disease has become established which increases establishment risks. It is not clear if the strain of *X. fastidiosa* in the outbreak in the Apulia region of southern Italy could establish in UK climatic conditions. To reflect uncertainties with respect to the susceptibility of potential UK host plant species, potential vector species, vector population densities and climatic suitability, the risk of establishment is scored as unlikely to moderately likely.

Economic impact

There is considerable uncertainty as to the potential losses that may arise as a consequence of the establishment of *X. fastidiosa* in the UK. The experience of urban tree damage in north eastern USA suggests the disease presents a particular threat to amenity plantings in the UK though woodland could also be affected.

Endangered area

The whole of the UK is endangered though warmer regions may be a higher risk.

Risk management

Exclusion is the best option to control the disease. New regulations are now in place that may restrict movements of specified hosts from the infected region of Apulia in southern Italy and from third countries outside the EU, to reduce the risks of *X. fastidiosa* entry.

17. Is there a need for a detailed PRA? If yes, select the PRA area (UK or EU) and the PRA scheme (UK or EPPO) to be used. (for PH Risk Management Work stream to decide) ✓ (put tick in box)

No	<input type="checkbox"/>
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Yes	<input checked="" type="checkbox"/>	PRA area: UK or EU	EU	PRA scheme: UK or EPPO	(EFSA)
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EFSA are scheduled to produce an opinion on *X. fastidiosa* risks to the EPPO region.

18. IMAGES OF PEST

<p><i>Photo 1 (pest)</i></p> 	<p><i>Photo 2 (e.g. symptoms?)</i></p> 
<p>Bacterial leaf scorch of northern red oak <i>Quercus rubra</i>. Photo courtesy A.B. Gould</p>	<p>Bacterial leaf scorch of Oak (<i>Quercus robur</i>). Photo courtesy John Hartman, University of Kentucky (Bugwood/ Forestry Images images)</p>

19. Given the information assembled within the time scale required, is statutory action considered appropriate / justified?

Yes Statutory action

No Statutory action

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Appendices (1-4)

Appendix 1

Details of the status of *X. fastidiosa* hosts are listed at Berkeley University web page:

<http://www.cnr.berkeley.edu/xylella/control/hosts.htm>

Acacia longifolia
Acer macrophyllum
Acer negundo
Aesculus californica
Aesculus californica
*Aesculus californica**
*Agropyron sp.**
Alnus rhombifolia
Ampelopsis arborea
Amsinckia douglasiana
*Artemisia absinthium**
Artemisia douglasiana
Artemisia douglasiana
Artemisia douglasiana
Avena fatua
Avena fatua
Baccharis pilularis
Baccharis pilularis
Baccharis salicifolia
*Beta vulgaris**
Bidens pilosa var. pilosa
*Brassica rapa**
Bromus catharticus
Bromus rigidus
Bromus sp.
Callicarpa americana
Callistephus chinensis
*Calycanthus occidentalis**
*Calycanthus occidentalis**
Canna sp.
Chenopodium ambrosioides
Chenopodium ambrosioides
Citrus limon
Citrus reticulata
Citrus sinensis
Claytonia perfoliata
Conium maculatum
Coprosma baueri
Cotoneaster francheti
Cotoneaster rotundifolia
Cynodon dactylon
Cynodon dactylon
*Cynodon dactylon**
*Cyperus acuminatus**
Cyperus eragrostis
Cyperus esculentus
Cytisus scoparius
Daucus carota var. sativa
*Daucus carota**

Digitaria sanguinalis
Digitaria sanguinalis
*Distichlis spicata**
Duranta repens
Echinochloa crus-galli
Echinochloa crus-galli
*Elymus sp.**
Epilobium californicum
Epilobium paniculatum
Eragrostis diffusa
Erodium cicutarium
Escallonia montevidensis
*Eschscholzia californica**
Eugenia myrtifolia
Fragaria californica
Franseria acanthicarpa
Fraxinus dipetala
Fraxinus latifolia
*Fritillaria sp.**
Fuchsia magellanica
Genista monspessulana
Hedera helix
Hedera helix
*Hedera helix**
Helianthus sp.
*Heteromeles arbutifolia**
Heteromeles arbutifolia
Hordeum murinum
*Hordeum nodosum**
Hordeum vulgare
Hydrangea paniculata
Juglans californica
Lactuca serriola
*Lactuca serriola**
Lathyrus cicera
Lathyrus clymenium
Lathyrus sativa
Lolium multiflorum
Lolium temulentum
Lonicera japonica
Majorana hortensis
Malus sylvestris
Malva parvifolia
Matricaria suaveolens
Medicago hispida
Melilotus alba
Melilotus indica
Melilotus officinalis
Melilotus sp.
Melissa officinalis
Mentha sp.
Mimulus aurantiacus
*Nasturtium officinale**
*Nerium oleander**
*Nerium oleander**
Oeanthe sarmetosa
Oenothera hookeri
Parthenocissus quinquefolia

Parthenocissus tricuspidata
Paspalum dilatatum
Pelargonium hortorum
Pennisetum clandestinum
Phalaris minor
Phalaris paradoxa
Philadelphus lewisii
Phleum pratense
Pittosporum crassifolium
Plantago lanceolata
*Plantago lanceolata**
Platanus occidentalis
Poa annua
*Poa pratensis**
Polygonum convolvulus
Polygonum persicaria
*Polygonum ramosissimum**
*Polypogon monspeliensis**
Populus fremontii
*Populus sp.**
*Portulaca oleracea**
*Prunus armeniaca**
Prunus demissa
Prunus mume
Prunus sp.
*Pseudotsuga menziesii**
Pyracantha augustifolia
Quercus agrifolia
*Quercus domosa**
Quercus lobata
Reseda odorata
*Rhamnus californica**
Rheum rhaponticum
Rosa californica
Rosa californica
*Rosa californica**
Rosmarinus officinalis
Rubus discolor
Rubus discolor
Rubus sp.
Rubus ursinus
Rubus ursinus
Rumex crispus
*Salix bebbiana**
Salix laevigata
Salix lasiolepis
*Salix sessilifolia**
Sambucus canadensis
*Sambucus mexicana**
Sambucus mexicana
Sambucus mexicana
Setaria lutescens
Sonchus asper
Sorghum halepense
*Sorghum halepense**
Sorghum vulgare
*Sorghum vulgare**
Symphoricarpos albus

Symphoricarpos albus
Syringa vulgaris
*Tatragonia expansa**
*Toxicodendron diversilobum**
Toxicodendron diversilobum
Toxicodendron diversilobum
Trifolium fragarium
Trifolium hybridum
Trifolium incarnatum
Trifolium pratense
Trifolium repens
Trifolium repens var. *latum*
Umbellularia californica
Urtica dioica ssp. *gracilis*
Urtica dioica ssp. *gracilis*
Veronica sp.
Vicia monathus
Vinca major
Vinca major
Vinca minor
Vitis californica
*Vitis californica**
Vitis rupestris
Vitis vinifera
Vulpia myuros var. *hirsuta*
Xanthium strumarium

Hosts of *X. fastidiosa* other than Pierce's Disease strains.

Baccharis halimifolia
*Bidens leucantha**
*Chenopodium ambrosioides**
Citrus sinensis
Citrus sinensis
Commelina sp.*
*Cotoneaster pyracantha**
*Cynodon dactylon**
Diospyros sp.*
*Eupatorium capillifolium**
*Koelreuteria paniculata**
*Lantana camara**
*Ludwigia peruviana**
*Morus rubra**
*Myrica cyrifera**
Nerium oleander
Nicotiana tabacum
Panicum sp.*
Paspalum sp.*
Platanus occidentalis
Prunus persica
Prunus persica
Prunus persica
Prunus salicana
Prunus salicana
*Prunus serotina**
Quercus falcata
Quercus imbricaria
Quercus laurifolia

Quercus nigra
Quercus palustris
Quercus rubra
Quercus sp.
Rhus sp.
Solidago fistulosa
*Ulmus alata**
Ulmus americana
*Vaccinium pennsylvanicum**

Appendix 2

Statement of EFSA on host plants, entry and spread pathways and risk reduction options for *Xylella fastidiosa* Wells et al.

EFSA Journal 2013;11(11):3468 [50 pp.]. doi:10.2903/j.efsa.2013.3468

European Food Safety Authority Acknowledgment Contact

Type: Statement of EFSA On request from: European Commission Question number: EFSA-Q-2013-00890 Approved: 22 November 2013 Published: 26 November 2013 Affiliation: European Food Safety Authority (EFSA), Parma, Italy

Abstract

Following a request from the European Commission, EFSA was asked to provide urgent scientific and technical assistance on the plant pathogenic bacterium *Xylella fastidiosa*. *X. fastidiosa* was detected in olive trees in Lecce province in Apulia, Italy, in October 2013. This is the first outbreak of *X. fastidiosa* under field conditions in the European Union. EFSA reviewed the host range and vectors, the pathways for entry and spread and the risk reduction options. Known hosts include many cultivated and spontaneous plants common in Europe, however a range of European wild plant species would meet this bacterium for the first time, increasing uncertainty on the host range. All xylem-fluid feeding insects in Europe should be regarded as potential vectors of *X. fastidiosa* and identification of the vector in the Apulian outbreak is pending. The main entry pathway for *X. fastidiosa* is the movement of plants for planting. Infective vectors of *X. fastidiosa* transported on plant consignments are also of concern. The only route for natural spread of *X. fastidiosa* is by insect vectors that generally fly short distances up to 100 metres, but can be transported by wind over long distance. The movement of infected plants for planting is the most efficient way for long-distance dispersal of *X. fastidiosa*. There is no record of successful eradication of *X. fastidiosa* once established outdoors due to the broad host range of the pathogen and of its vectors. Strategies for prevention of introduction from areas where the pathogen is present and for containment of outbreak should focus on the two main pathways and be based on integrated system approach combining, when applicable, the most effective options.

Appendix 3

COMMISSION IMPLEMENTING DECISION

of XXX

as regards measures to prevent the introduction into and the spread within the Union of *Xylella fastidiosa* (Well and Raju)

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Council Directive 2000/29/EC 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, and in particular the fourth sentence of Article 16(3), thereof,

Whereas:

- (1) The Commission adopted Commission Implementing Decision 2014/87/EU as regards measures to prevent the spread within the Union of *Xylella fastidiosa* (Well and Raju) (hereinafter 'the specified organism').
- (2) Since the adoption of that Decision, the Italian authorities have carried out investigations in the infected areas and the areas surrounding them concerning the presence and nature of the specified organism. Those investigations have produced preliminary results which are sufficient to allow the adoption of more precise measures.
- (3) The investigations of the Italian authorities, as well as the available scientific and technical evidence, have confirmed that plants of *Catharanthus* G.Don, *Nerium* L., *Olea* L., *Prunus* L., and *Vinca* L. are host plants of the specified organism. Taking into account the evidence available, it is likely that plants of *Malva* L., *Portulaca* L., *Quercus* L. and *Sorghum* L. may also be host plants of that organism. Therefore, the measures should apply to plants for planting, other than seeds, of *Catharanthus* G.Don, *Nerium* L., *Olea* L., *Prunus* L., *Vinca* L., *Malva* L., *Portulaca* L., *Quercus* L. and *Sorghum* L. (hereinafter 'specified plants').
- (4) It is appropriate to establish conditions for the introduction into the Union of specified plants from third countries where the specified organism is known to be present. Specific requirements should be adopted concerning the registration, supervision and status of production sites, as well as for the inspections, sampling, testing and transport of the specified plants, to ensure that plants which are introduced into the Union are free from the specified organism.
- (5) Specified plants which have been grown for at least part of their life in a demarcated area, or which have been moved through such an area, are more likely than other plants to have been infected with the specified organism. Their movement should therefore be subject to specific requirements. Those requirements should be similar to the requirements for specified plants introduced from third countries where the specified organism is known to be present.
- (6) Member States should carry out annual surveys for the presence of the specified organism in their territories in order to prevent its introduction and spread.
- (7) In order to ensure the earliest possible action against the potential presence of the specified organism, anyone who might be aware of the presence of that organism should inform the Member States thereof. Moreover, and in order to ensure appropriate action by stakeholders, Member States should inform professional operators concerned about the potential presence of the specified organism in their territories and the measures to be taken.
- (8) To eradicate the specified organism and prevent its spread, Member States should establish demarcated areas and take the necessary measures. Those demarcated areas should consist of an infected zone and a buffer zone. The width of the buffer zone should be calculated in view of the risk of the specified organism spreading to other areas.
- (9) Where the establishment of a demarcated area does not seem necessary to eliminate the specified organism, the Member State concerned should have the possibility not to establish

a demarcated area immediately. In that case, it should eliminate the specified organism on the plants where it was first found to be present and carry out a survey to determine whether any further plants have been infected.

(10) Specific measures should be established to ensure the eradication of the specified organism where it has been found to be present.

(11) In the interest of clarity, Implementing Decision 2014/87/EU should be repealed.

(12) The measures provided for in this Decision are in accordance with the opinion of the Standing Committee on Plant Health,

HAS ADOPTED THIS DECISION:

Article 1

Definitions

For the purposes of this Decision, the following definitions shall apply:

(a) 'specified plants' means all plants for planting, other than seeds, of *Catharanthus G.Don*, *Nerium L.*, *Olea L.*, *Prunus L.*, *Vinca L.*, *Malva L.*, *Portulaca L.*, *Quercus L.* and *Sorghum L.*;

(b) 'specified organism' means *Xylella fastidiosa* (Well and Raju).

Article 2

Introduction into the Union of specified plants originating in third countries where the specified organism is known to be present

Specified plants originating in third countries where the specified organism is known to be present shall only be introduced into the Union if they fulfil the following conditions:

(a) they comply with the specific requirements for introduction, as set out in Section 1 of Annex I;

(b) on introduction into the Union they have been inspected by the responsible official body in accordance with Section 2 of Annex I for the presence of the specified organism;

(c) neither presence nor symptoms of the specified organism have been found when they were inspected in accordance with Section 2 of Annex I.

Article 3

Movement of specified plants within the Union

Specified plants which have been grown for at least part of their life in a demarcated area established in accordance with Article 7, or which have been moved through such an area, shall only be moved to and within areas other than infected zones, if they meet the conditions set out in Annex II.

Article 4

Surveys of the specified organism

1. Member States shall conduct annual surveys for the presence of the specified organism in their territory on the specified plants and on other possible host plants.

Those surveys shall be carried out by the responsible official body, or under the official supervision of the responsible official body. They shall consist of visual examinations and, in the case of any suspicion of infection by the specified organism, collection of samples and testing. Those surveys shall be based on sound scientific and technical principles, and shall be carried out at appropriate times with regard to the possibility to detect the specified organism.

Those surveys shall take account of the available scientific and technical evidence, the biology of the specified organism and its vectors, the presence and biology of specified plants or plants likely to be host plants of the specified organism, and any other appropriate information, concerning the presence of the specified organism.

2. Member States shall notify the results of those surveys to the Commission and the other Member States by 31 December of each year.

Article 5

Information about the specified organism

1. Where anyone becomes aware of the presence of the specified organism, or has reason to suspect such a presence, that person shall immediately inform the responsible official body.

The responsible official body shall immediately record such information.

2. Where appropriate, the responsible official body shall request the person referred to in paragraph 1 to provide that body with any other information concerning the presence of the specified organism which is in the possession of that person.

Article 6

Confirmation of presence

1. Where the responsible official body has been informed of a presence, or suspected presence, of the specified organism on the basis of the surveys referred to in Article 4(1), or in accordance with Article 5, it shall take all necessary steps to confirm that presence.

2. Where the presence of the specified organism is confirmed in an area where that presence was previously unknown, the Member State concerned shall, within five working days from the time of the confirmation notify the Commission and the other Member States of that presence.

The same shall apply in the case of the official confirmation of the presence of the specified organism on a plant species previously not known to be a host plant. Those notifications shall be submitted in writing.

3. Member States shall ensure that professional operators whose specified plants may be affected by the specified organism, are immediately informed of the presence of the specified organism in the territory of that Member State, and become aware of the respective risks and measures to be taken.

Article 7

Demarcated areas

1. Where the results of the surveys referred to in Article 4(1) show the presence of the specified organism, or where such a presence is confirmed in accordance with Article 6(1), the Member State concerned shall without delay demarcate an area, hereinafter 'demarcated area'.

2. The demarcated area shall consist of a zone in which the specified organism was found to be present, hereinafter 'the infected zone'. That zone shall be defined in accordance with Section 1 of Annex III. The demarcated area shall further consist of a zone surrounding the infected zone, hereinafter 'the buffer zone'. That zone shall be defined in accordance with Section 1 of Annex III.

3. Member States shall take measures in the demarcated areas, as set out in Section 2 of Annex III.

4. By way of derogation from paragraph 1, the Member State may decide not to establish a demarcated area immediately where the all of the following conditions are fulfilled:

(a) there is evidence that the specified organism has been recently introduced into the area with the plants on which it was found;

(b) there is an indication that those plants were infected before their introduction into the area concerned;

(c) no relevant vectors have been detected in the vicinity of these plants providing evidence that no further spread of the specified organism has occurred.

In that case, it shall carry out a survey to determine whether any plants have been infected other than those on which it was first found to be present. On the basis of that survey, the

Member State shall determine whether there is a need to establish a demarcated area. The Member State concerned shall notify to the Commission and the other Member States the conclusions of those surveys, as well as the justification for not establishing a demarcated area.

5. Member States shall set time periods for the implementation of the measures provided for in paragraph 3 and, where relevant, for the carrying out of the survey referred to paragraph 4.

Article 8

Reporting on measures

1. Member States shall, within 30 days of the notification referred to in the first subparagraph of Article 6(2), report to the Commission and the other Member States on the measures they have taken or intend to take in accordance with Article 7(3), as well as the time periods referred to in Article 7(5).

The report shall also include the following elements:

- (a) information on the location of the demarcated area, and description of its characteristics which may be relevant for the eradication and prevention of the spread of the specified organism;
- (b) a map showing the delimitation of the demarcated area;
- (c) information on the presence of the specified organism and its vectors;
- (d) measures to comply with the requirements concerning the movement of specified plants within the Union as set out in Article 3.

That report shall describe the evidence and criteria on which the measures are based.

2. Member States shall by 31 December of each year communicate to the Commission and the other Member States a report including an up-to-date version of the information referred to in paragraph 1.

Article 9

Repeal

Decision 2014/87/EC is repealed.

Article 10

Addressees

This Decision is addressed to the Member States.

Done at Brussels,

For the Commission

Tonio BORG

Member of the Commission

Appendix 4

UK xylem feeding bugs which may potentially serve as *X. fastidiosa* vectors. Report produced by Chris Malumphy January 2014.

There are 16 species of bug found in the UK that feed on the Xylem (listed below). The majority breed on herbaceous plants (including hosts of *X. fastidiosa*). However, the adults of several species often feed on a wider host range than the nymphs.

Aphrophora alni is a very common species across the UK, and feeds on a wide range of trees and bushes, especially willows (*Salix*), birch (*Betula*), alder (*Alnus*) and poplar (*Populus*). I can't find records of it feeding on *Quercus* or *Fagus* but this cannot be ruled out.

Aphrophora pectoralis and *Aphrophora salicina* feed on *Salix*.

Graphocephala fennahi is native to North American and was introduced to the UK in the 1930s. It feeds on Rhododendrons.

Cicadellidae – 7 species

Euscelis lineolatus (phloem feeder listed as a potential vector according to Elbeaino et al., 2014)

Subfamily Cicadellinae, tribe Cicadellini

Cicadella lasiocarpae Ossiannilsson

Cicadella viridis (L.) VERY COMMON

Graphocephala fennahi Young

Subfamily Cicadellinae, tribe Evacanthini

Evacanthus acuminatus (Fabricius)

Evacanthus interruptus (Linnaeus)

Subfamily Cicadellinae, tribe Anoterostemmatini

Anoterostemma ivanoffi (Lethierry)

Aphrophoridae – 9 species

Aphrophora alni (Fallen)

Aphrophora major Uhler

Aphrophora pectoralis Matsumura

Aphrophora salicina (Goeze)

Neophilaenus campestris (Fallen)

Neophilaenus exclamationis (Thunberg)

Neophilaenus lineatus (Linnaeus)

Neophilaenus longiceps (Puton)

Philaenus spumarius (L.) VERY COMMON

Cercopidae – 1 species

Cercopis vulnerata Rossi