NURSERY PAPERS
SEPTEMBER 2017

XYLELLA FASTIDIOSA: ONE OF THE WORLD'S MOST FEARED PLANT PATHOGENS

The bacteria *Xylella fastidiosa* is a plant pathogen of significant concern worldwide and would rank as one of Australia's most feared plant pathogens. In recent years it has infested crops from America to Europe and its spread is likely to continue.

Many landscape species such as elms, maples, oaks and oleander are affected, along with important cropping plants including citrus, grapes, olives, almond, peach and coffee. Other hosts include avocado, blueberry, plum, pecan, sour cherry, rosemary and blackberry.

In this month's Nursery Paper the team from the National Nursery Industry Biosecurity Program will explore *X. fastidiosa* in depth and examine some of the current outbreaks around the world.

Pierce's Disease on grape vines. PHOTO CREDIT: Jack Kelly Clark.

Summary

- *X. fastidiosa* has caused widespread economic and environmental damage, costing Californian citrus growers $100 million/yr and killing 1000-year-old olive trees in Europe
- More than 350 different plants are hosts to the bacteria, with more added each year as various plant species are tested
- There is no effective cure for infected plants, with the most effective approach being to manage the insect vectors which transmit the bacterium in their mouth parts
- *X. fastidiosa* is not yet present in Australia but national surveillance is underway, diagnostic standards are being developed and control options researched, to ensure Australia is prepared for potential outbreaks.


Figure 1. Global distribution of *X. fastidiosa.*

This communication has been funded by Hort Innovation using the nursery research and development levy and contributions from the Australian Government.
Hort Innovation Strategic levy investment | NURSERY FUND

The wide host range of the bacterium *X. fastidiosa* and the considerable damage it has done globally make it a plant pathogen of significant concern for the Australian nursery industry, and for the wider horticultural sector and the environment. This plant pathogen is rapidly spreading across the world and does not yet have a defined host list, as susceptible plant species continue to be found.

Some hosts of *X. fastidiosa* are known to be asymptomatic, meaning that clear visual signs of infection are absent and detection of the bacteria is difficult to impossible.

MORPHOLOGY

X. fastidiosa is known by a number of common names, generally linked to a specific host, with the most recognisable being Pierce's disease in grapevines. Other common names include California vine disease, Anaheim disease, Dwarf disease, Phony disease, Plum leaf scald, Bacterial leaf scorch and Variegated chlorosis in citrus.

While there is only one known species of *X. fastidiosa*, four subspecies have been identified and accepted and another two subspecies proposed. These subspecies are broadly associated with a range of different hosts which are noted below in **Table 1**.

There is a high degree of genetic variability between the subspecies and this may lead to potentially new strains of the bacteria.

X. fastidiosa is an aerobic (requires oxygen) and fastidious (requires specific nutrients) bacterium residing in a specialised environment, namely, the xylem tissue of plants. *X. fastidiosa* are single celled, rod shaped bacteria which lack flagella. The bacteria are approximately 0.9 - 4 micrometres in length and 0.25 - 0.35 micrometres in radius.

HOSTS

More than 350 different plants are hosts to *X. fastidiosa* across a wide range of genera and families, with more being added each year based on the testing of various plant species around the world. Many landscape species in crops such as elms, maples, oaks and oleander are affected, along with important cropping plants including citrus, grapes, olives, almond, peach and coffee. Other hosts reported include avocado, blueberry, plum, pecan, sour cherry, rosemary and blackberry. Some hosts are known to be asymptomatic, meaning that clear visual signs of infection are absent and detection of the bacteria is difficult to impossible.

Glassy Wing Sharp Shooter (GWSS) (*Homalodisca vitripennis*). PHOTO CREDIT: Jack Kelly Clark.

SYMPTOMS

The symptoms caused by *X. fastidiosa* vary depending upon the individual host and the rate and extent of bacteria colonisation within the host. Generally infection causes the xylem (plant tissue which moves water/fluids) in the infected plants to become blocked. This in turn reduces the ability of the plant to transpire and in mature trees death can occur within 1 to 2 years. Plants under drought conditions or those that are stressed will often succumb to the infection of *X. fastidiosa* more rapidly than those growing in a healthy environment.

The symptoms displayed vary depending upon the host but are similar to those exhibited through water stress, which can confuse the diagnosis. These symptoms may range from leaf scorch, necrotic spots on leaves and leaf margins, chlorosis or bronzing, shoot stunting, fruit deformation and die back, through to eventual death.

TABLE 1. *Xylella fastidiosa* subspecies by hosts

Subspecies name	Host(s)	Associated disease(s)	Found in
Subsp. *fastidiosa*	Alfalfa, almond, grape, maple	Almond leaf scorch, Pierce's disease of grapevines	North America, Central America, Iran, Taiwan
Subsp. *multiplex*	Almond, blueberry, elm, peach, pigeon grape, plum, sycamore	Phony disease of peach, plum leaf scald	North and South America, France
Subsp. *pauca*	Citrus, coffee, olive	Citrus variegated chlorosis	South America, Italy
Subsp. *sandyi*	Oleander	Oleander leaf scorch	North America
Subsp. *morus* (proposed)	Mulberry	Mulberry leaf scorch	North America
Subsp. *tashke* (proposed)	Chitalpa (ornamental hybrid)		North America
Pear leaf scorch	Pear	Pear leaf scorch	Taiwan

SOURCE: Department of Agriculture & Water Resources.

Bacterial Leaf Scorch symptoms on ginkgo (*Ginkgo biloba*). PHOTO CREDIT: Elizabeth Bush, Virginia Polytechnic Institute and State University.

DISPERSAL

The bacteria are thought to have originated from the Americas where *X. fastidiosa* is confirmed to be present in both North America (Mexico, Canada & USA) and South America (Argentina, Brazil Paraguay, etc). The bacteria have since spread, with confirmed recordings in Europe (Italy, France & Germany) and in Iran and Taiwan.

The bacteria are moved through plant material and can be spread by the grafting of infected propagative material or transmitted by a sap sucking insect, where the bacteria are transferred from plant to plant. It is not thought to be spread by seed or pruning equipment. A common transmission of *X. fastidiosa* is between asymptomatic hosts and symptomatic plant species which makes management difficult.

A wide range of insects are also able to vector the bacteria, including any that feed on xylem fluid. The vector which poses the biggest threat to Australia is the Glassy-winged sharpshooter, already the most prominent vector in the United States but not yet established here. There is also potential for native and endemic insects (e.g. leaf hoppers, aphids, spittlebugs, etc) to become vectors of the bacteria if it becomes established in Australia.

Table 2. Timeline of global detection of *Xylella fastidiosa*

1880s:	Pierce's disease devastates vineyards of Southern California
1974:	Almond leaf scorch described
1987:	Citrus variegated chlorosis observed in Brazil. Later observed in Argentina
1995:	*X. fastidiosa* found to cause coffee leaf scorch in Brazil
1996:	Glassy winged sharpshooter is discovered in California, threatening wine regions
2000:	Complete genome sequence of *X. fastidiosa* published in *Nature*
Oct 2013:	Olive quick decline syndrome in Italy attributed to *X. fastidiosa*
Feb 2014:	Emergency measures adopted by the European Union
Mid 2015:	*X. fastidiosa* identified from ornamental plants in France
Nov 2015:	Australia implements emergency quarantine measures for *X. fastidiosa*
Jul 2016:	First detection of *X. fastidiosa* in Germany on oleander

SOURCE: Department of Agriculture & Water Resources.

Olive groves affected by *X. fastidiosa* in Italy. PHOTO CREDIT: Donato Boscia, CNR – Institute for Sustainable Plant Protection, UOS, Bari (IT).

TABLE 3. Effective vectors of *X. fastidiosa*

Scientific name	Common name(s)	Associated host disease
Acrogonia terminalis		Citrus variegated chlorosis
Cicadella viridis	Green leafhopper	Pierce's disease
Dilobopterus costalimai		Citrus variegated chlorosis
Draeculacephala minerva	Green sharpshooter	Pierce's disease
Graphocephala atropunctata	Blue-green sharpshooter	Pierce's disease
Homalodisca vitripennis	Glassy-winged sharpshooter	Pierce's disease
Oncometopia fasciali		Citrus variegated chlorosis
Philaenus spumarius	Spittlebug, meadow froghopper	Olive quick decline
Xyphon fulgidum	Redheaded sharpshooter	Pierce's disease

SOURCE: Department of Agriculture & Water Resources.

AUSTRALIAN STATUS

According to the Department of Agriculture and Water Resources (DAWR), the current status of Australia is *X. fastidiosa* is absent. There are phytosanitary measures in place to prevent entry of the bacteria, including the regulation of 89 plant families and country of origin risk status. Countries that are currently assessed as high risk include all countries in North and South America, Europe, India, Iran, Lebanon, Taiwan and Turkey. All other countries are considered low risk until a detection of *X. fastidiosa* is confirmed. Details on the current import status of plants and country of origin can be obtained from the BICON website (***https://bicon.agriculture.gov.au/BiconWeb4.0***).

There are no known control methods that can assist once a plant is infected with *X. fastidiosa*. International experience has shown that the most effective approach is to manage the vectors, such as sharpshooters, aphids and spittlebugs, which move from plant to plant transmitting the bacterium in their mouthparts. Effective insecticides are available to manage most sap sucking insects and sound spray rotations are known to be beneficial in managing resistance.

The economic impact of *X. fastidiosa* worldwide is significant. The bacteria costs the Californian citrus industry in excess of $100 million per year. In Europe the loss of olive groves, some over 1000 years old, has led to a 20 per cent increase in the cost of olive oil. The economic impact would be equally damaging if the bacteria became established in Australia.

IF YOU COME ACROSS A SUSPECT NEW PLANT PEST CALL THE PLANT PEST HOTLINE:

✆ 1800 084 881

Olive decline in Italy from October 2013 – March 2016. SOURCE: Department of Agriculture & Water Resources.

The DAWR is continuing to monitor the global situation regarding *X. fastidiosa* and learn from international partners fighting infestations. National surveillance is underway through DAWR and state biosecurity agencies, diagnostic standards are being developed and control options researched to ensure Australia is prepared for potential outbreaks.

The nursery industry is also working to prepare for *X. fastidiosa*. The *X. fastidiosa* Contingency Plan was updated in 2016 and fact sheets have been developed through two projects funded by the Nursery levy: NY15002 *Building the resilience and on-farm biosecurity capacity of the Australian nursery industry* and NY15004 *National Nursery Industry Biosecurity Program*.

LINKS TO RESOURCES

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

Bacterial Leaf Scorch fact sheet *http://www.nurseryproductionfms.com.au*

Glassy-winged sharpshooter fact sheet *http://www.nurseryproductionfms.com.au*

Pierce's Disease Contingency Plan *http://www.nurseryproductionfms.com.au*

For current import status of plant material refer to the DAWR website BICON *https://bicon.agriculture.gov.au/BiconWeb4.0*

PAST EDITIONS OF NURSERY PAPERS ARE AVAILABLE ONLINE on the Nursery & Garden Industry Australia website *http://www.ngia.com.au/Section?Action=View&Section_id=46*