

The olive quick decline syndrome

Xylella fastidiosa



Dr Vera Sergeeva

OliVerak

Biosecurity plans "How to Protect your Olive Grove"

Xylella fastidiosa

Xylella fastidiosa is a gram negative, fastidious, xylem-limited bacterium that causes a range of economically important plant diseases including citrus variegated chlorosis disease (CVC) of oranges and other citrus fruits. *X. fastidiosa* is also known to cause Pierce's disease, a lethal disease to grapevines.

The bacterium is spread by certain kinds of leafhoppers known as sharpshooters. While snacking, these insects carry the bacterial infection from plant to plant, transferring *X. fastidiosa* directly into the plant's xylem, the vascular tissues.

There, the bacteria multiply, clogging the plant's internal plumbing and blocking the flow of water to leaves. Trees and plants weaken, leaves discolor, and fruits appear prematurely, remaining small, hard and worthless. Other strains cause leaf scorching of woody perennials such as American elm, maple, mulberry, or plum.



Image source: <http://www.citrolima.com.br/images/xylella11.png>

Widespread bacterial infection has already destroyed thousands of olive trees across Italy's Puglia region, with numbers only forecast to rise sharply, adding to the economic effects of droughts in Spain and California.



Photo Courtesy: Donato Boscia, Istituto di Virologia Vegetale del CNR, UOS, Bari - Franco Nigro, Dipartimento di Scienze del Suolo, della Pianta e degli Alimenti, Università degli Studi di Bari - Antonio Guarino, Plant Protection Service, Regione Puglia .

Symptoms of quick decline (complesso del disseccamento rapido dell'olivo) observed in Puglia on olive trees. *Xylella fastidiosa*, *Phaeoacremonium spp.*, *Phaemoniella spp.*, and *Zeuzera pyrina* have been found in association with this disease.

An invisible killer is endangering olive trees in Puglia and threatens to spread to cultivations all over Italy, with the risk of affecting cherry, orange and almond trees, as well as oleanders. *Xylella fastidiosa* and is the first bacterium that hinders plant nutrition by obstructing xylem, i.e. the lymphatic tissue through which plants receive water and nutrients.



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The olive quick decline syndrome in south-east Italy

G.P. Martelli

Dipartimento di Scienze del Suolo, della Pianta e degli Alimenti, Università degli Studi Aldo Moro, Bari

The olive quick decline syndrome (OQDS) is a disease that appeared suddenly a few years ago in the province of Lecce, Salento peninsula (south-eastern Italy). The major incitant of the disease is *Xylella fastidiosa*, a quarantine pathogen of American origin whose unwelcome introduction in the area has created much disturbance because: (i) the dramatic damage suffered by the olive groves where the pathogen has established itself; (ii) the alarm that this finding has raised in a country (Italy) whose olive/oil industry is a primary asset, and in the European Union, which is facing the first confirmed record in its territory of this alien and much feared microorganism.

OQDS is characterized by the presence of leaf scorching and desiccation of twigs and small branches, that prevail first in the upper part of the canopy (Fig. A), then extend to the rest of the crown, which acquires a burned look (Fig. B). The more seriously affected plants are heavily pruned by the growers to favour new growth which, however, is scanty and desiccates in a short while. The skeletal-looking trees push a multitude of suckers from the base (Fig. C) and survive for some time, i.e. as long as the roots are viable.

As to disease incidence, a rough estimate indicates that the whole area where multiple and disperse OQDS foci occur amounts to about 230,000 hectares. However, the infected surface area given over strictly to olive (i.e. the totality of the symptomatic olive groves taken together) may not exceed 9,000 hectares, which accounts for about one million plants. These are huge numbers that are liable to increase over time, considering that the infection foci, which now have a scattered distribution, will tend to coalesce.

X. fastidiosa is a bacterium with an unusual epidemiology (plant-to-plant transmission occurs only via insect vectors), that infects a wide range of hosts (309 plant species belonging to 193 genera, according to a recent list issued by the European Food Safety Authority). It invades, multiplies and occludes the plant's xylem vessels, thus impairing water uptake. In the case of olive, the damage may be aggravated by the presence of fungi of different genera, *Phaeoacremonium* and *Phaemoniella* in particular, but also *Pleumostomophora* and *Neofusicoccum*, which colonize and necrotize the sapwood. Besides olive, the Salentian strain of *X. fastidiosa* infects in nature a number of woody (almond, cherry) and shrubby (oleander, broom, rosemary, *Acacia saligna*, *Polygala myrtifolia*, *Westringia fruticosa*, *Rhamnus elaternus*, *Myrtus communis*) hosts but not grapevines and citrus, as based on the absence of overt symptoms and the negative results of laboratory analyses of 380 individual vines and 350 citrus trees growing within, or next to heavily infected olive orchards.

A clue to the search for *X. fastidiosa* in OQDS-affected olives was given by: (i) the symptoms, which recalled very much the severe leaf scorching of fruit and shade trees induced by this bacterium, as described in the north American literature; (ii) the modality of disease spreading, which was compatible with that of *X. fastidiosa* infections.

The Salentinian strain of *X. fastidiosa* is readily and dependably detectable by serological (ELISA) and molecular (PCR) methods. It was isolated in culture from different hosts and identified as a genotype of *X. fastidiosa* subsp. *pauca*, genetically identical to an isolate of the same subspecies from Costa Rica, from where it may have been introduced into Apulia. The analysis of the complete genome sequence (a DNA molecule 2,507,614 bp in size) of the olive strain confirmed this identification.

Philaenus spumarius (meadow spittlebug), a froghopper quite common in the Salento area where it thrives on olive, was experimentally identified as the main vector. In fact, a very high percentage (in excess of 70-80%) of the spittlebugs captured on infected olives in summer 2014 were shown to carry the bacterium and were able to transmit it to an experimental (periwinckle) and the natural (olive seedlings) host.

Current knowledge tells that disease eradication and sanitation of *Xylella*-infected plants, olive included, are unfeasible. Thus, strategies are being enacted for restraining the spread of the pathogen and vector(s) within the boundaries of the currently infected zone by implementing a "containment plan" designed by a recently appointed government Commissioner. Cases of OQDS used to be confined to the province of Lecce until a short while ago, when a small focus has popped up in the neighbouring province of Brindisi. The new outbreak has forced to move north the zone which had been selected for a sort of "last stand" against the spreading of OQDS. The measures envisaged to this aim are mechanical weeding in spring, to kill as many juveniles as possible of the vector, which thrive especially on weeds, followed by insecticide treatments to olive trees, on which the adults move after moult and live happily. These measures are accompanied by the more drastic and unpopular one: uprooting the infected olive trees (many of them are several century-old giants) and the surrounding ones, in accordance with the requests of the EU. The hope is that this strategy will succeed if the envisaged measures are implemented quickly and thoroughly. Dealing with OQDS within the widely infected zone is another business, which requires targeted measures and much experimental work to be done.



Olive quick decline symptoms in the initial (A), advanced (B) and final (C) stages. The trees in C are pushing suckers from the base which, in the course of time, will decline and die with the tree.



Photo Courtesy: Donato Boscia, Istituto di Virologia Vegetale del CNR, UOS, Bari - Franco Nigro, Dipartimento di Scienze del Suolo, della Pianta e degli Alimenti, Università degli Studi di Bari Antonio Guario, Plant Protection Service, Regione Puglia

Symptoms of quick decline observed in Puglia on olive trees. *Xylella fastidiosa*, *Phaeoacremonium spp.*, *Phaemoniella spp.*, and *Zeuzera pyrina* have been found in association with this disease.





Courtesy: Donato Boscia, Istituto di Virologia Vegetale del CNR, UOS, Bari - Franco Nigro, Dipartimento di Scienze del Suolo, della Pianta e degli Alimenti, Università degli Studi di Bari - Antonio Guarino, Plant Protection Service, Regione Puglia

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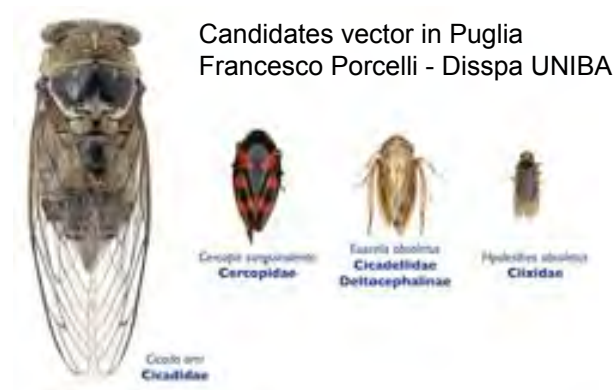
This bacterium is transmitted to olive trees through a particular species of insects – **spittlebugs** – and up to now no countermeasures have shown to be effective in stopping the dangerous epidemic that is ravaging a wide area of Puglia from Gallipoli to Santa Maria di Leuca.



Philaenus spumarius the pests transmitting the *X. fastidiosa* bacteria



The meadow spittlebug is among the pests transmitting the *X. fastidiosa* bacteria in Italy
Photo: NC State Parks



Candidates vector in Puglia
Francesco Porcelli - Disspa UNIBA



Homalodisca vitripennis

Photo credits: Russ Ottens, Uni of Georgia



Philaenus spumarius Photo credits: Sanja565658 via Wikimedia commons



The presence of larvae sputacchina
(hence the name "spumarius")

Grapevine dying of Pierce's disease



Photo courtesy of PD-GWSS/CDFA.

This has California researchers worried and baffled. The bacterium *Xylella fastidiosa* has been present in the state for more than 100 years and can sometimes be found in olive trees. Trials conducted by USDA and UC researchers from 2008 to 2011 showed that strains of the bacterium found in California did not cause disease in olives.



Photo: Rodrigo Krugner.

Adult glassy-winged sharpshooter, *Homalodisca vitripennis*, vector of grapevine Pierce's disease (*X. fastidiosa*) in California



Photo: J. Clark - University of California, Berkeley (US)

Green sharpshooter (female), *Draeculacephala minerva*, vector of grapevine Pierce's disease (*X. fastidiosa*)

Phony Peach

Caused by the *X. fastidiosa* bacterium

Phony Peach is a systemic disease caused by a xylem-limited bacterium, *Xylella fastidiosa*, it occurs in all established peach-growing areas in Florida. It is introduced in nursery stocks, in infected budwood, or from wild hosts. The phony peach bacterium is found in wild plum trees in Florida, but causes no observable damage to these plums. When transmitted to the peach by leafhoppers, it causes tree dwarfing, distorted small fruit, and poor fruit production. Before planting peaches, remove or kill all wild plums within a quarter mile of the orchard if possible. If peaches or nectarines are being propagated and budded onto rootstock, use T-budding rather than chip budding. Avoid using buds that contain woody material to limit transmission of the xylem-limited bacteria associated with phony peach disease. The acquisition of the *X. fastidiosa* bacteria appears to have no effect on the insect vector.³

The bacterium *X. fastidiosa* is spread primarily by a type of leafhopper known as sharpshooters. The major insect vector in the coastal plain of the southeastern U.S. is probably the glassy-winged sharpshooter, *Homalodisca vitripennis* (Fig. 1), but other xylem-feeding insects including froghoppers and spittlebugs are considered to be potential vectors.

Other leafhopper vectors include *H. insolita*, *Oncometopia* spp., *Graphocephala* spp. (Fig. 2) and *Draeculacephala* spp.



Fig.1. *Homalodisca vitripennis*, vector of Phony Peach Disease



Fig.2. A leafhopper, *Graphocephala* sp., that vectors *Xylella fastidiosa*



Almond leaf scorch caused by *X. fastidiosa*



Photo by M. Scortichini, Istituto Sperimentale per la Frutticoltura, Rome
Xylella fastidiosa (XYLEFA) - <https://gd.eppo.int>

Citrus variegated chlorosis (CVC): Typical spots caused by *X. fastidiosa* on sweet orange leaves.



Photo by Phoenix, Maricopa Co., Arizona, USA.

Nerium oleander infected with *X. fastidiosa*



Photo by Bugwoodwiki

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Bacterial leaf scorch of ornamentals caused by *X. fastidiosa*



Photo by Drew Zwart

Bacterial leaf scorch *X. fastidiosa* symptoms on pin oak leaves.



Photo by J.L. Serald

Leaf Scorch of elm *Ulmus americana* caused by *X. fastidiosa*



Thank you

OliVerak