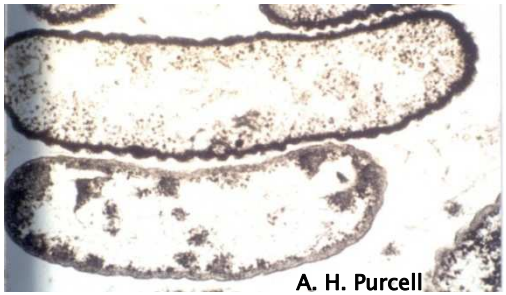


The world threat of *Xylella fastidiosa*

María M. López, Ester Marco, Javier Peñalver, Clara Morente, Adela Monterde

Instituto Valenciano de Investigaciones Agrarias (IVIA)

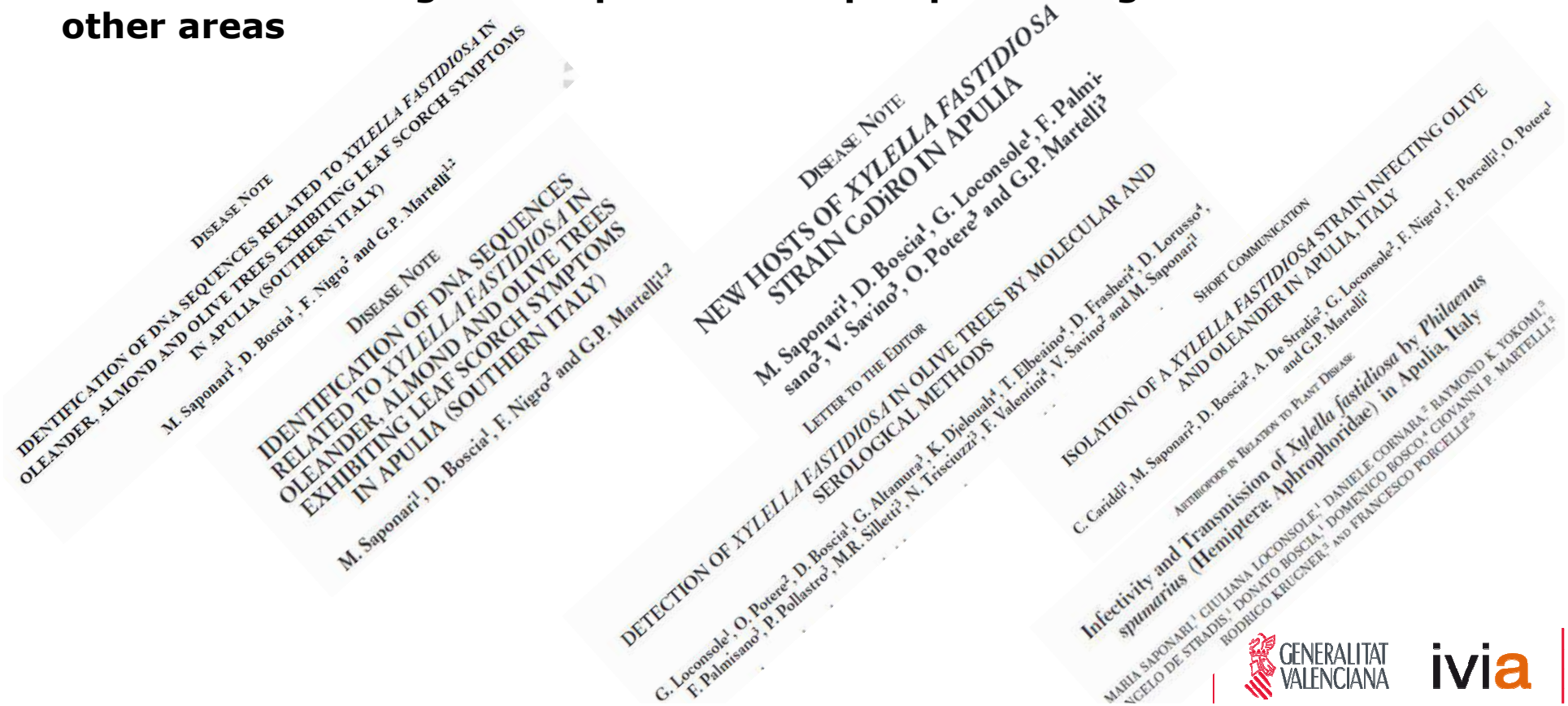
http://ivia.gva.es/

The A. H.Purcell premonition

A. H. Purcell. 1997. *Xylella fastidiosa*, a regional problem or a global threat? Journal of Plant Pathology 79, 2, 99-105.

"Previously unrecorded plant diseases in citrus and oleander caused by *Xylella fastidiosa* have rapidly spread, suggesting that vigilant phytosanitary measures outside America, should be maintained against its introduction".

Nearly twenty years later, *Xylella fastidiosa* is a world threat but **the outstanding work of our colleagues in Apulia will help in preventing the disease in other areas**



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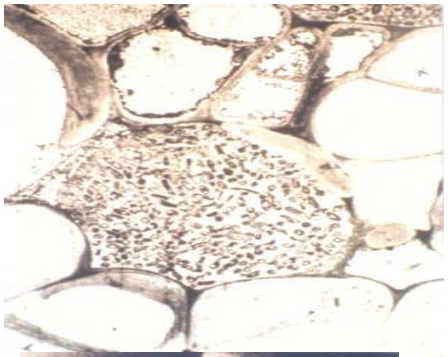
Xylella fastidiosa

- Xylem limited bacterium.
- Difficult isolation in culture media.
- Sequenced genome (2000).
- Hosts (359) EFSA, 2016.

- Grapevine: Pierce disease
- Citrus: Citrus variegated chlorosis
- Alfalfa: Alfalfa dwarf
- Almond: Almond leaf scorch
- Plum: Plum leaf scald
- Peach: Phony peach
- Vinca: Periwinkle wilt
- Coffee: Coffee leaf scorch



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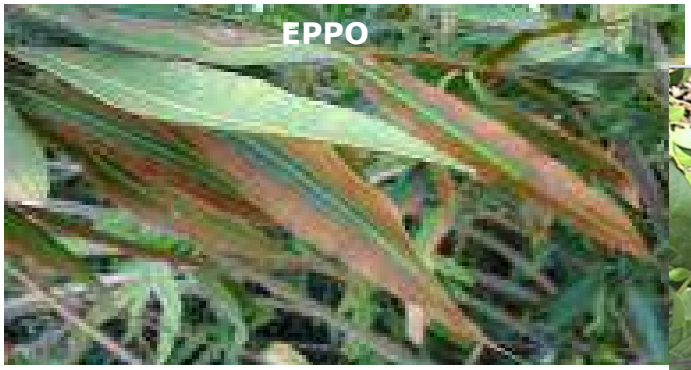
Hosts of *X. fastidiosa*

- According to the EFSA report (2016), there are **359 plant species** that have demonstrated to host this bacterium in natural or experimental conditions (infection with vectors confirmed by two detection methods), from 204 genera and 7 botanical families.

- Among them, **44 new species**, 15 new genera and 5 new families have been reported in the **Italian and French outbreaks in the last three years**.



SCIENTIFIC REPORT

APPROVED: 23 December 2015

PUBLISHED: 9 February 2016

doi:10.2903/j.efsa.2016.4378

Update of a database of host plants of *Xylella fastidiosa:* 20 November 2015

European Food Safety Authority (EFSA)

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X. fastidiosa is a high risk pathogen, causing harmful diseases in several countries

- *X. fastidiosa* is a **polyphagous pathogen** with new plant hosts discovered every year.
- The bacterium can have a **long period of latency** in the host, or even not show symptoms in contaminated plants.
- **Long list of vector species** reported: variable in different countries, amond local Cicadellidae, Cercopidae and Aphrophoridae species.
- Can adapt to **different climatic conditions** although low temperatures limit its dissemination.
- **Difficult control** of plants and vectors.

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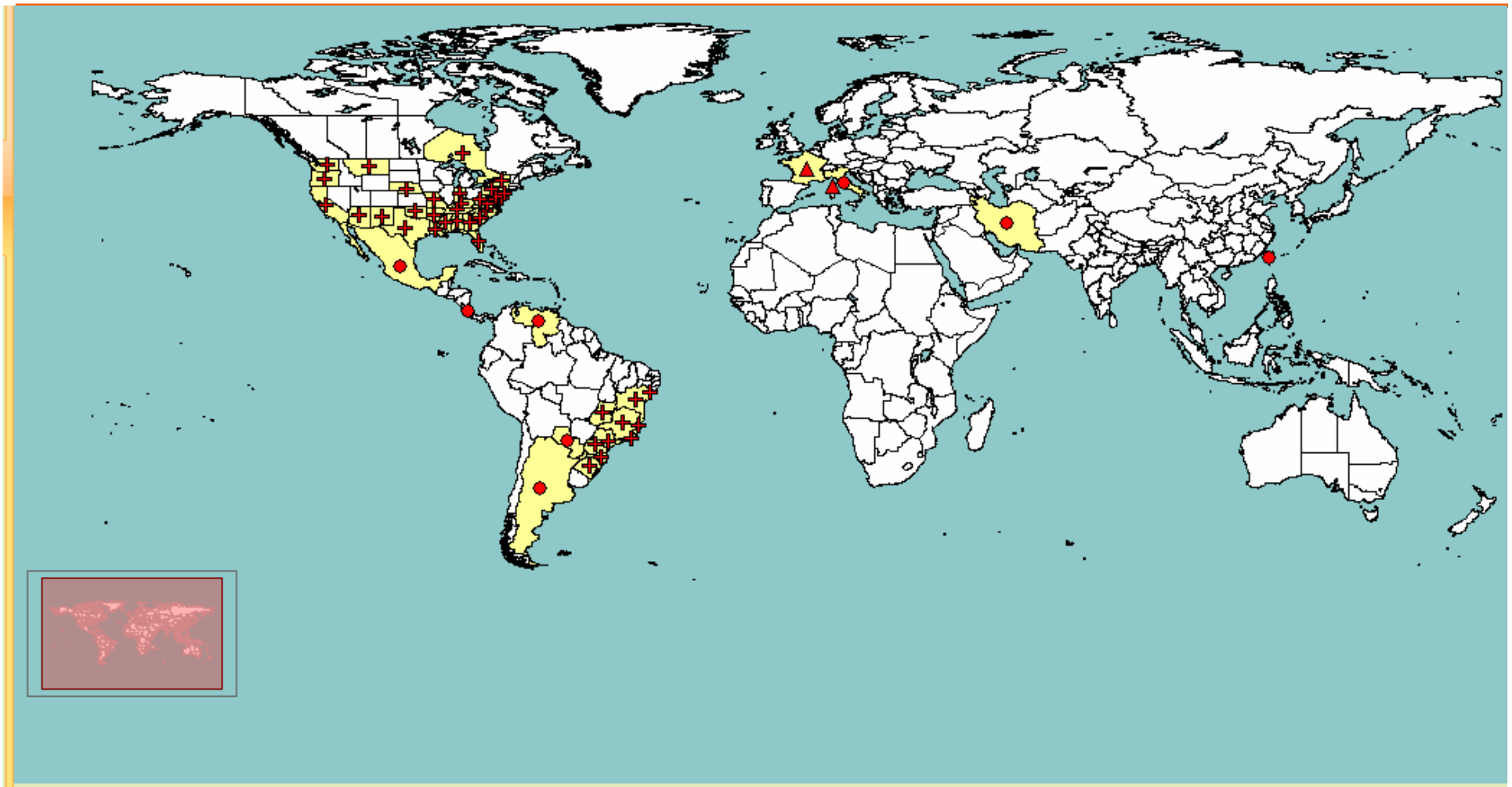

Legend

- Present (national record)
- Present (subnational record)
- Transient

Xylella fastidiosa
EPPO,PQR, 2016

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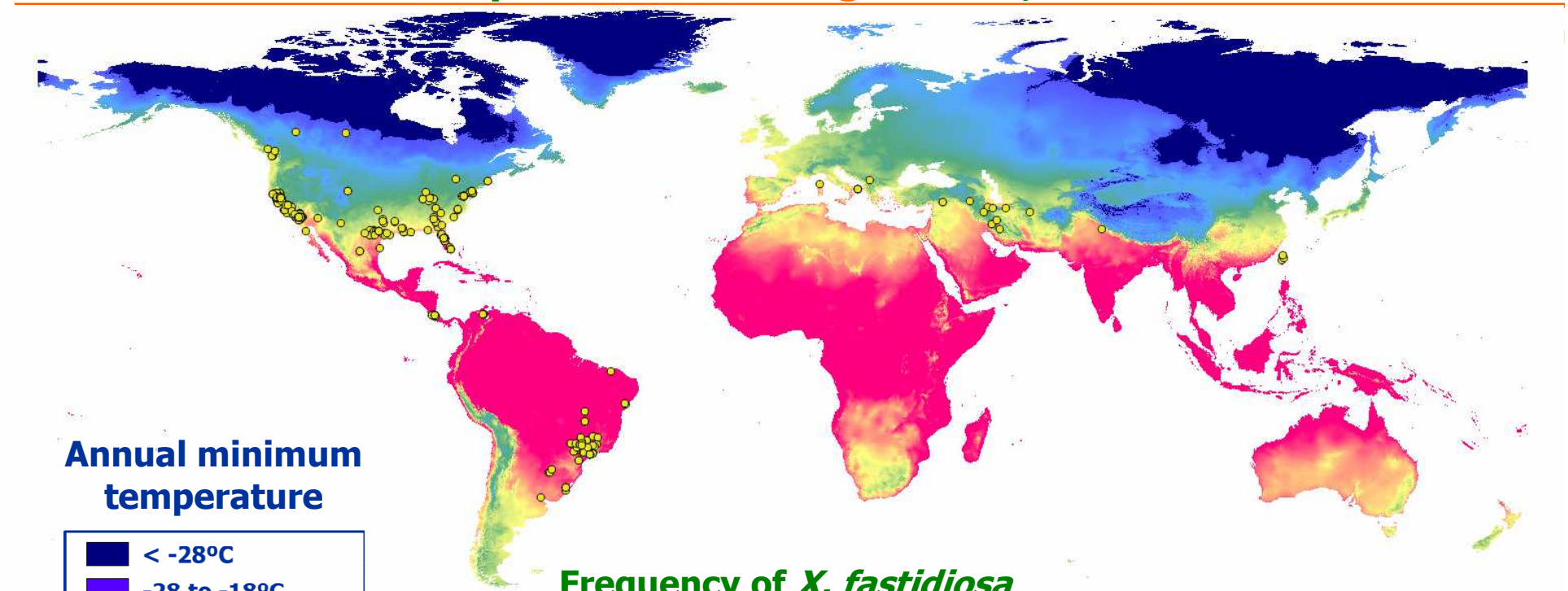
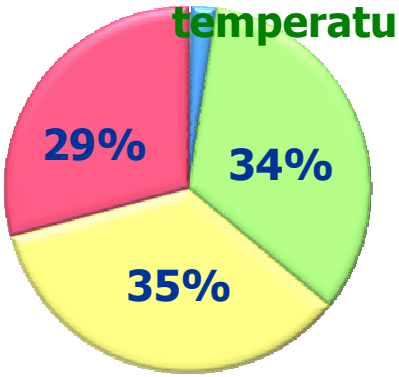
Potential for the establishment of *Xylella fastidiosa* based on annual minimum temperature according to EFSA, 2015



Annual minimum temperature

- < -28ºC
- -28 to -18ºC
- -18 to -8ºC
- -8 to 2ºC
- 2 to 12ºC
- >12ºC
- *Xylella fastidiosa*

Frequency of *X. fastidiosa* occurrence *vs.* annual minimum temperature



Occurs in zones with minimum annual temperature above -8ºC

Navas-Cortés, J.A. own elaboration; climatic data https://www.climond.org/

Potential for the establishment of *Xylella fastidiosa* based on annual minimum temperature according to EFSA, 2015

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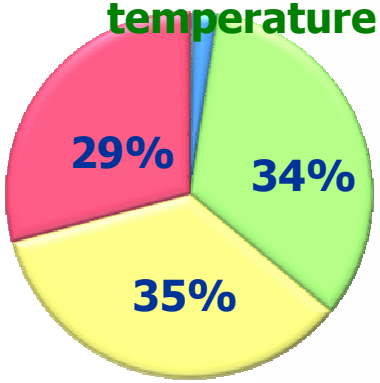

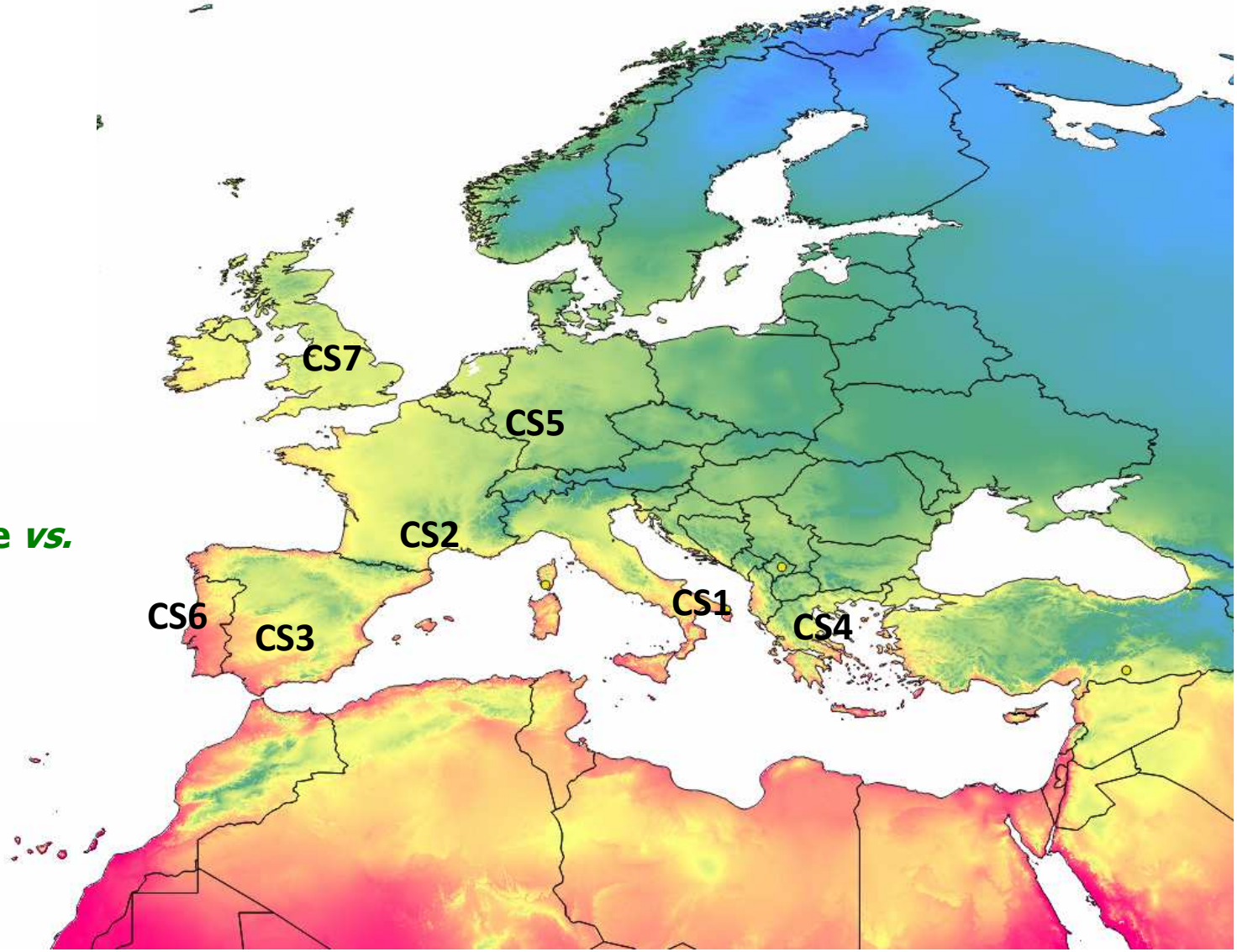

Navas-Cortés, J.A. own elaboration; climatic data https://www.climond.org/

Subspecies of *X. fastidiosa*

***X. fastidiosa* subsp. *fastidiosa*:**

Almond	*Prunus dulcis*
Alfalfa	*Medicago sativa*
Grapevine	*Vitis vinifera*

***X. fastidiosa* subsp. *sandyi*:**

Oleander	*Nerium oleander*

***X. fastidiosa* subsp. *multiplex*:**

Almond	*Prunus dulcis*
Oak	*Quercus sp.*
Liquidambar	*Liquidambar styraciflua*
Cercis	*Cercis canadensis*
Elm	*Ulmus americana*
Peach	*Prunus persica*
Apricot	*Prunus armeniaca*
Plum	*Prunus domestica*

***X. fastidiosa* subsp. *mori*:**

Mulberries	*Morus spp.*

X. fastidiosa* subsp. *taskhe

Chitalpa	*Chitalpa taskhentensis*

***X. fastidiosa* subsp. *pauca*:**

Coffee	*Coffea sp.*
Citrus	*Citrus sp.*
Olive	*Olea europea*

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Genetic variation

- **Recombination is frequent among strains of different subspecies**: risk of new variants with new characteristics:

- Origin of subspecies *fastidiosa*: Central America

- Origin of subspecies *pauca*: South America and introgression into subsp. *fastidiosa*

-In Brazil, *X. fastidiosa* subsp. *pauca*, causing diseases on citrus and coffee has been studied, concluding that only recently became pathogenic. It could have gained genes via interspecific recombination, facilitating a switch from native plants to cultivated hosts. The candidate donor was possibly *X. fastidiosa* subsp. *multiplex* that also causes plum leaf scald.

PIERCE DISEASE OF GRAPEVINES (PD)

- Disease described in California since 1880.

- Demonstrated as transmitted by vectors in 1940's and as caused by *X. fastidiosa* in 1978.

- Described in USA, Costa Rica, Mexico and Iran. Reported in Kosovo in 1998 but not found anymore.

- Annual losses in California evaluated in more than 30 million US$ per year, increased since the end of the 1990's because of the presence of the very efficient vector "glassy-winged sharpshooter" (*Homalodisca vitripennis*).

- Difficult chemical control of vectors (species from genera *Homalodisca*, *Graphocephala*, *Draeculocephala, Carneocephala* and other).

- Difficult control of the bacteria that form biofilms in the vessels of the plant.

- Not found currently in grapevine neither in the EU nor in the EPPO countries.

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PLUM LEAF SCALD

- *X. fastidiosa* subsp. *multiplex* cause plum leaf scald in USA and Brazil.
- Described in 1980's.
- Transmitted by several Cicadellidae.
- Currently do not cause important economic damages in any country.
- Not found in plum neither in the EU nor in the EPPO countries.

University of Florida

PHONY PEACH

- *X. fastidiosa* cause phony peach, reported in several states in USA.
- Symptoms differ from those of the other diseases caused by *X. fastidiosa*.
- Compact trees, short internodes, dark leaves and number and size of fruits reduced.
- More abondant populations of the bacteria in the roots than in the aerial part.
- Not found in peach neither in the EU nor in the EPPO countries.

Clemson University, South Carolina

ALMOND LEAF SCORCH (ALS)

- *X. fastidiosa* cause almond leaf scorch in USA.
- The disease has also been reported in Apulia, Italy.
- Important losses in California in the 2000's because of the presence of high populations of an efficient vector and high bacterial populations in grapevine.
- Two genotypes asociated to the disease in California:
  - *X. fastidiosa* subsp. *pauca*.
  - *X. fastidiosa* subsp. *fastidiosa*.

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CITRUS VARIEGATED CLOROSIS (CVC)

- This new citrus disease, caused by *X. fastidiosa* subsp. *pauca* was first reported in Brazil in 1987 and then described in Argentina.

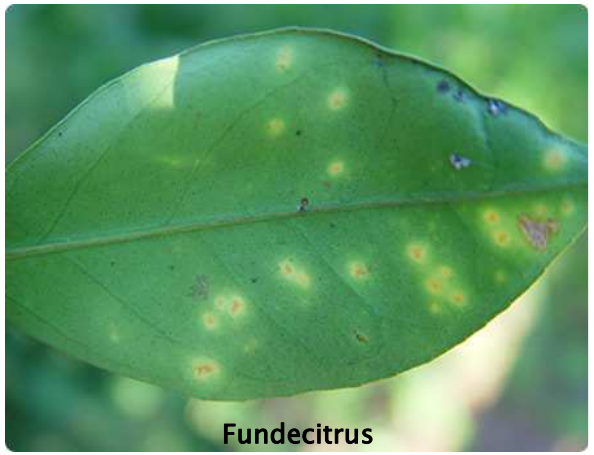
- Widespread in several states in Brazil and economic losses especially important in Sao Paulo state.

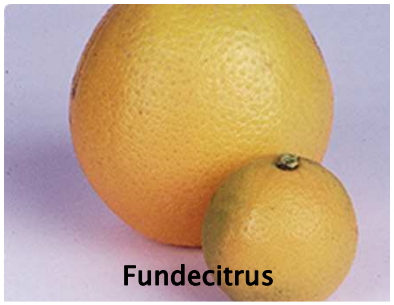
- Responsible of eradication of more than 120 million of trees in the 1990's before the detection of HLB.

- New vectors described (species of *Oncometopia, Dilobopterus, Acrogonia, Bucephalogonia* and other)

- Difficult control of both vectors and disease.

- Not found in citrus neither in the EU nor in EPPO area.





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OLIVE QUICK DECLINE SYNDROME (OQDS)

- First report of detection of *X. fastidiosa* in 2013 in Apulia, in olive plants.
- First confirmed detection of *X. fastidiosa* in Europe.
- *X. fastidiosa* in olive had been previously reported in California, but the damages were not economically important.
- Recently described in Argentina.
- Transmited by *Philaenus spumarius,* not previously reported as vector

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X. fastidiosa in olive in Italy

- There is an impressive amount of work performed by colleagues from Apulia, but in spite of their efforts, *X. fastidiosa* has distroyed in only few years many thousands of olive trees.

- The Italian experience should be the base to avoid similar tragedy in other countries.

Epidemiology of *X. fastidiosa*

- Disease transmitted by many vector species, no latent period. Bacteria persistently transmitted, once the adult vector has acquired the pathogen.
- Variable efficiency of transmission depending on the vector species and the host.
- Many xylem sap-sucking insects of different genera and species can act as vectors in different countries.
- Symptoms favoured by high temperatures (25-28ºC) and stressed conditions for the crop.
- The bacterium is present in roots and the aerial parts and form biofilms in the plant vessels, difficulting water and nutrient transport.

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Difficult control of *X. fastidiosa*

- The bacterium is very well protected in xylem vessels, **conventional chemicals** are not effective.

- The **vectors are numerou**s and their control requires integrated strategies.

- The **cultural practices**, pruning, fertilisation, etc. have shown variable results depending on the crop.

- **No resistant varieties** of commercial interest are available for many hosts.

Exclusion and eradication or contention are the main management options

COMMISSION IMPLEMENTING DECISION

of 13 February 2014

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

(notified under document C(2014) 726)

(2014/87/EU)

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 [1], and in particular the third sentence of Article 16(3) thereof,

Whereas:

(1) *Xylella fastidiosa* (Well and Raju) (hereinafter 'the specified organism') is listed in Section I of Part A of Annex I to Directive 2000/29/EC as a harmful organism not known to occur in the Union, the introduction of which into, and spread within, all Member States is prohibited.

(4) Italy reported that the inspections it had carried out showed no presence of the specified organism in the neighbouring provinces of Brindisi and Taranto.

(5) In response to a request by the Commission, the European Food Safety Authority, 'the Authority', adopted a statement on 25 November 2013 [3] which contains the following conclusions. The specified organism has probably a very broad range of host plants, including many cultivated and spontaneous plants common in Europe.

(6) The main entry pathway for the specified organism is the movement of plants for planting, excluding seeds. The pathway of infective vectors of the specified organism transported on plant consignments is also of concern. Fruit and wood are minor pathways with negligible likelihood of introduction. Seeds, cut flowers and ornamental foliage are minor pathways with low likelihood of introduction. The movement of infected plants for planting is the most efficient way for long-distance dispersal of the specified organism.

Looking back about the possibilities of *X. fastidiosa* introduction in the EU

- The probability of introduction of the bacterium with grapevines legally or ilegally imported from USA were high, especially since 1990's.

- Blueberry and raspberry that are also hosts of *X. fastidiosa* are frequently imported from USA.

- The grapevine, berries and imported material from third countries were not analysed in most of the EU countries, until 2015, but no introductions have been reported.

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Import of host plants of *X. fastidiosa*

- Quarantine pathogen with 359 hosts among fruit trees, ornamental and forest trees.

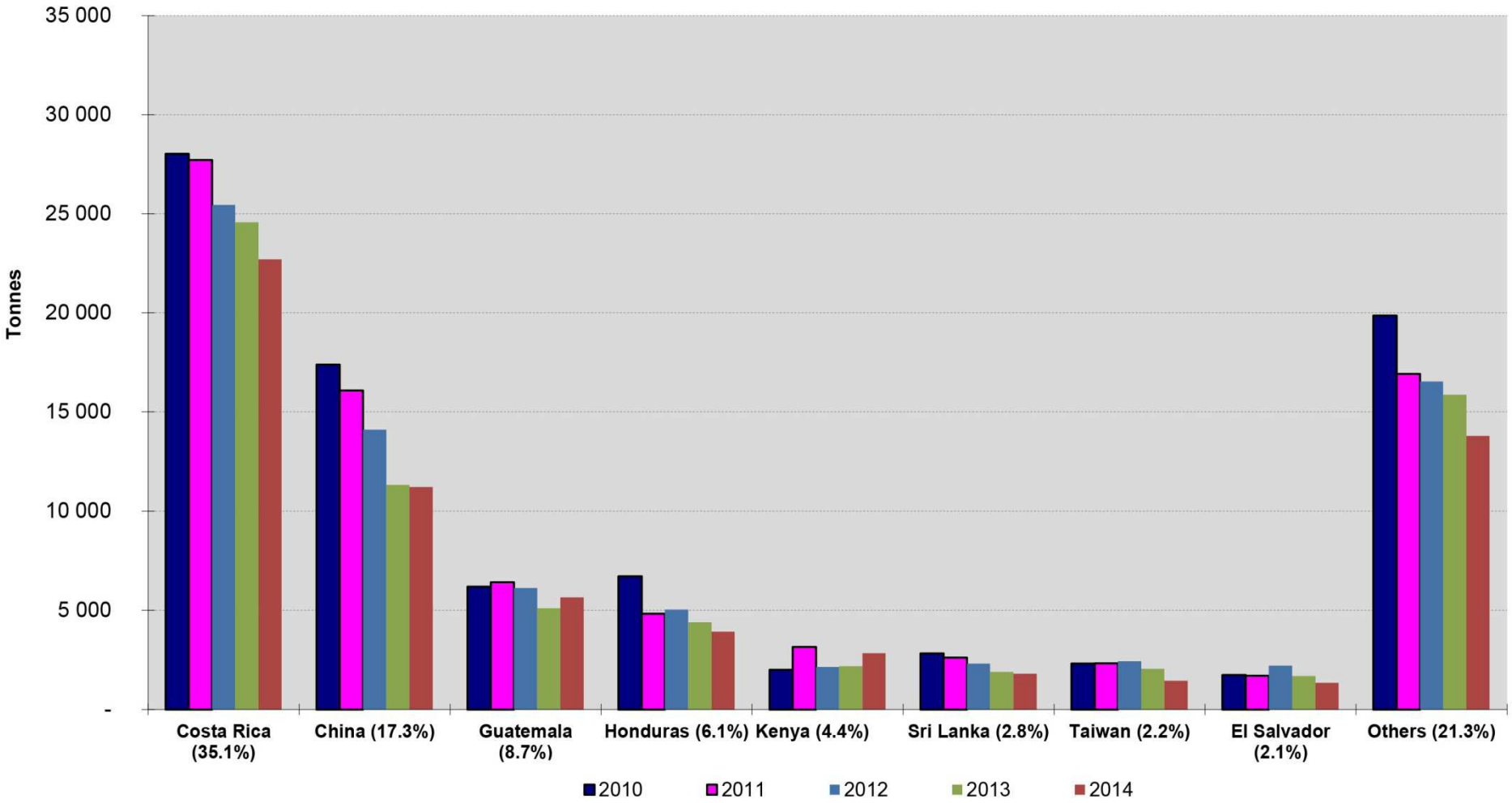
- The globalisation of plants trade has facilitated the import from exotic countries without evaluation of phytosanitary risks.

- In the majority of the countries, the phytosanitary certificates for export are provided without any analysis, just after visual inspection of the plants.

- The European Union (and probably many other countries) have **imported in the last ten years a large number of plants of *X. fastidiosa* hosts, from areas where the bacterium was presen**t and the plants were not specifically analysed for this pathogen.

Graph 4.5 Import of potted plants

(in tonnes, % = share in 2014)



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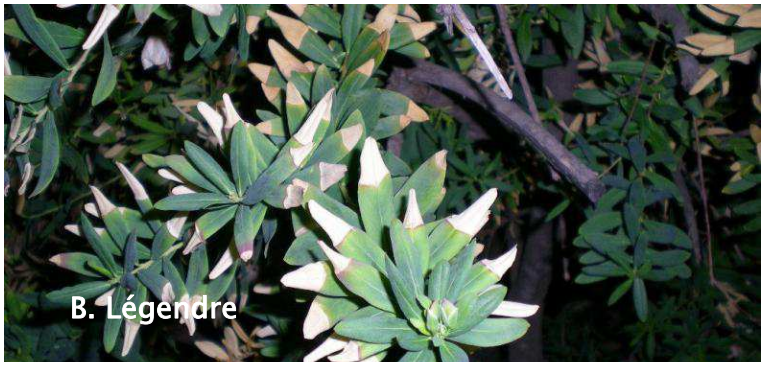
X. fastidiosa in *Nerium oleander* and *Polygala myrtifolia*

- Ornamental plants hosts of *X. fastidiosa* are very abondant in Mediterranean countries.

- Imported ornamentals from third countries were not analysed for *X. fastidiosa* until 2015.

- The sequence of the Italian **COdiRO strain from olive is similar to the one from oleander and coffee from Costa Rica** (*X. fastidiosa* subsp. *pauca*).
- ***Polygala myrtifolia* plants are the main host in French outbreaks** (*X. fastidiosa* subsp. *multiplex*).



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Interceptions of *X. fastidiosa* in coffee plants 2012-2015

- **Several subspecies of *X. fastidiosa* have been identified in coffee plants** with or without symptoms for ornamental or industrial use **imported by Austria, France, Italy, Germany, Slovakia and The Netherlands.**

- Plants were imported from Costa Rica, Ecuador, Mexico and Honduras in the last five years.

- **Demonstrated risk of imports of any plant host, not only olive, grapevine, citrus and fruit trees, but mainly ornamental plants.**

Interceptions of coffee plants in the UE (2011-2015)

Year	Country of Export	Commodity	Plant species	No. of interceptions
2014	Costa Rica	Intended for planting: already planted	*Coffea arabica*	4
	Honduras	Intended for planting: not yet planted	*Coffea arabica*	1
2015	Honduras	Intended for planting: already planted	*Coffea arabica*	1

Introduction (entry, establishement and dissemination) of *X. fastidiosa*

- **The introduction of *X. fastidiosa* in Italy and France is the paradigm of how this bacterium has been able of overcoming a legislation that supports international trade without accurate evaluation of all the possible phytosanitary risks.**

- In Italy, the bacterium was very probably present in plants not included in the EU legislation and consequently they were not analysed for the presence of the pathogen.

- Coffee and ornamentals are currently the plants with higher risk of introduction of the pathogen in new areas.

What we should learn about the European outbreaks *of X. fastidiosa?*

- Origin: many possible sources, especially from American countries.

- Large range of hosts. After being introduced with ornamentals, the bacterium can find new hosts, as olive in Italy or *Polygala myrtifolia* in France.

- Vectors: many potential vector species. In Italy the bacterium found a new efficient vector, *Philaenus spumarius,* not previously reported.

- ***X. fastidiosa* has demonstrated to be able to find many different hosts and vectors in new areas.**

X. fastidiosa is a global threat that requires global solutions

What can we do?

- **International organizations** (IPPC, EPPO, NEPPO): information, advice, protocols

- **EU and EFSA:**
  - Directives and standards
  - Support research in all the countries
  - Support phytosanitary services

- **Governments:**
  - Legislation
  - Preparation for rapid eradication
  - Support research, phytosanitary services and surveys

- **Phytosanitary authorities:**
  - Contingency plans and intensive surveys (all hosts in orchards, nurseries, gardens)
  - Sensitive methods of analysis
  - Development of new diagnostic/detection labs
  - Information to the mass media, public, growers, nurseries, etc.

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Conclusions

- The unexpected discovery of *Xylella fastidiosa* in Italy in 2013 and in 2015 in France has made more evident the **risk** that this pathogen represents **for** European **commercial crops, landscape trees and ornamentals**, but also for the other continents.

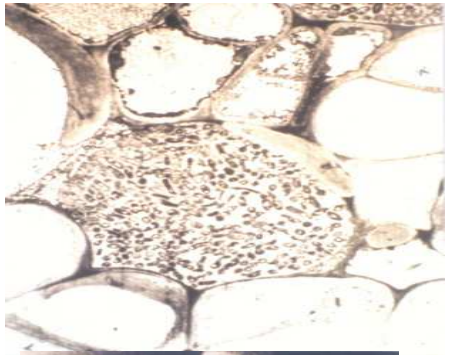
- **Bacteria and vectors are not limited by borders** and common actions and collaborative practical work are necessary.

- **Each country should prepare its own risk assessment, design a contingency plan in different scenarios** and be ready for a rapid eradication of an eventual introduction.

- The governments, Plant Protection services, phytosanitary inspectors, laboratories of diagnostic, nurserymen, growers, mass media and the public in general **should know the problem**, **identify the regional and local risk and take complementary preventive actions** against this pathogen because unfortunately, new outbreaks could be detected and all the countries should be prepared.

Thanks to Donato Boscia & Maria Saponari's group for their excellent work and to colleagues providing information

THANKS YOU FOR YOUR ATTENTION AND FOR YOUR PREVENTIVE WORK



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