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BEXYL
BEYOND XYLELLA

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ورشة عمل خطط الطوارئ كتمرين محاكاة عملي

Contingency Exercise Workshop

Xylella fastidiosa

Hammamet, Tunisia, 26 – 28 May 2025

Biology and ecology of *Xylella fastidiosa*

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IRHS

EMERSYS
Emergence, systématique et écologie des bactéries associées aux plantes

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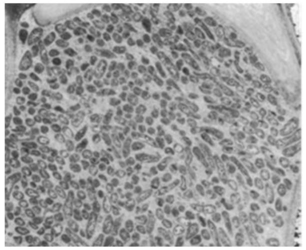
Xylella fastidiosa: a recent expansion of an old problem

First report of ‘*The California vine disease*’ by Newton Pierce in **1892**

First isolation in 1978

And formal description and naming of the agent responsible for Pierce’s disease *only in* **1987!**



Localized in **xylem vessels** of host plants => ***Xylella***

Fastidious *in vitro* growth => ***fastidiosa***

Pierce, Agr. Div. Veg. Path. Bul. (1892); Severin, Hilgardia (1949); Hopkins & Mortensen, Plant Dis. Rep (1971);
Hopkins & Mollenhauer, Science (1973); Mollenhauer and Hopkins, J. Bact. (1974); Davis et al., Science (1978); Wells et al., Int. J. Syst. Bacteriol. (1987)

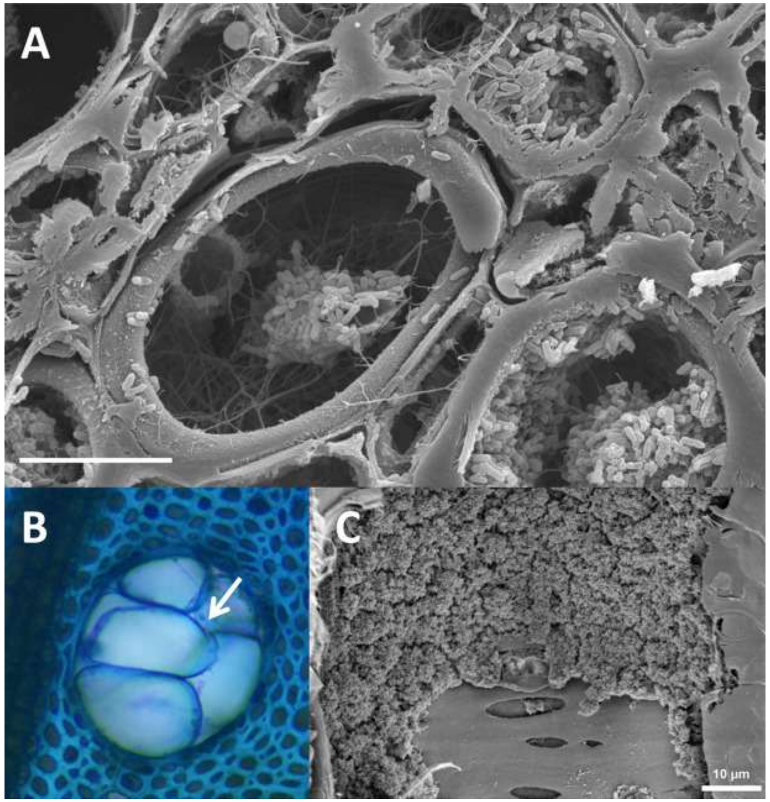
General characteristics of *Xylella fastidiosa*

- Gram -, γ proteobacteria

- Xylem-limited bacterium

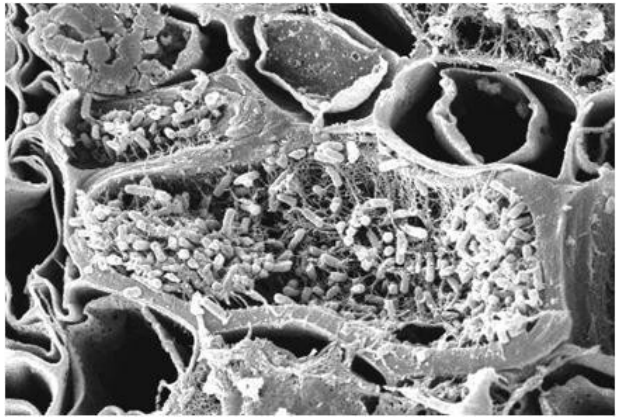
- Invades xylem vessels and produces biofilms
    - =>symptoms of water stress

Also consecutive to -an overproduction of defense compounds, such as pectins and tyloses, produced by the host plant in response to infection,
-and air bubbles that eventually form following insect bites and water stress => embolism



Rapicavoli et al., 2018

Xylella fastidiosa: a real threat for agriculture and landscape


E. W. Kitajima (ESALQ/USP/Brazil).

- Fastidious bacterium: long generation time (~1d) , long period of time between infection and symptom development
  => asymptomatic infections (>3 yrs) (EFSA, 2019)

- Xylem-limited bacterium forming biofilms
+ Production of plant defense compounds (tyloses, pectins, …) by the plant => embolism => symptoms of hydric stress: non-specific symptoms


UC Statewide IPM Project
© Regents, University of California

Xylella fastidiosa: a real threat for agriculture and landscape

Meadow spittelbug

Philaenus spumarius

- Transmitted by:
  - Sap-sucking insect vectors (sharpshooters: *Cicadellidae, Aphrophoridae, Cercopidae, Cicadoidae*)
    =>Short-distance dissemination
  - Infected plants for planting
    =>Short and Long distance dissemnination (international trade of plants for planting)

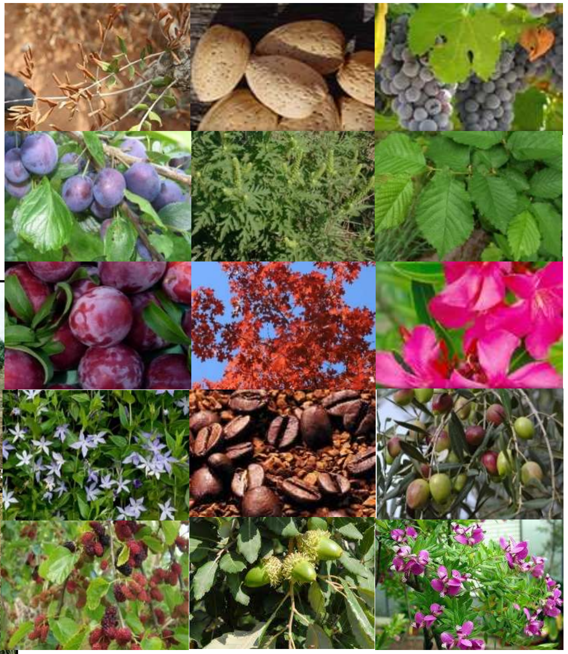
Neophilaenus campestris

Philaenus italosignus

Xylella fastidiosa: a real threat for agriculture and landscape

- Very large host range for the species at a whole:

713 plant species, 312 genera and 89 families (or 452 plant species, 204 genera and 70 families, two diff. detection methods), mostly perennial plants (EFSA, 2025)

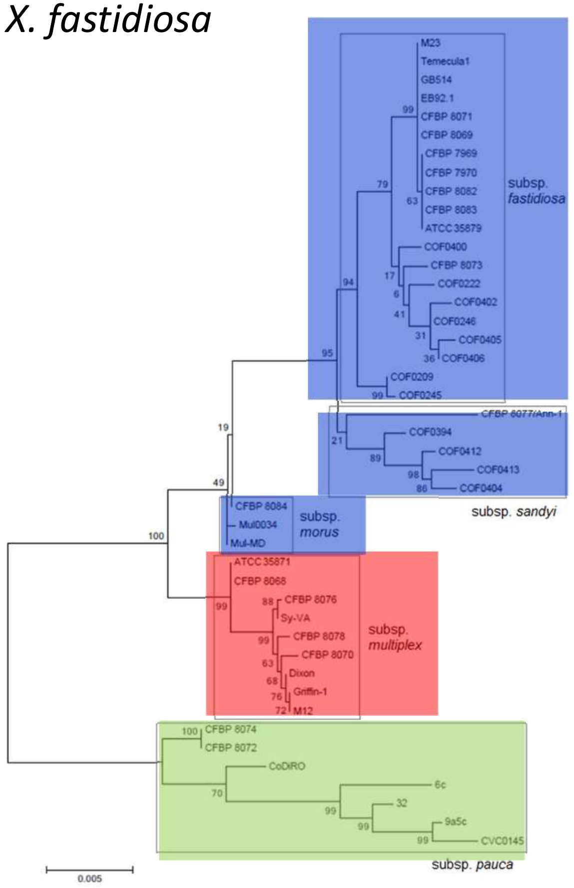


- More limited host range for each subspecies or ST, but yet ~30-40 plant species/ST

=> Numerous potential reservoirs

X. fastidiosa: a genetically diverse species

X. fastidiosa



- *fastidiosa*

Pierce's disease of grapevine, Almond LS,
Alfalfa dwarf, …
Maple LS, ….
….

- *sandyi*

Oleander LS

- *morus*

Mulberry
and
blueberry LS

- *multiplex*

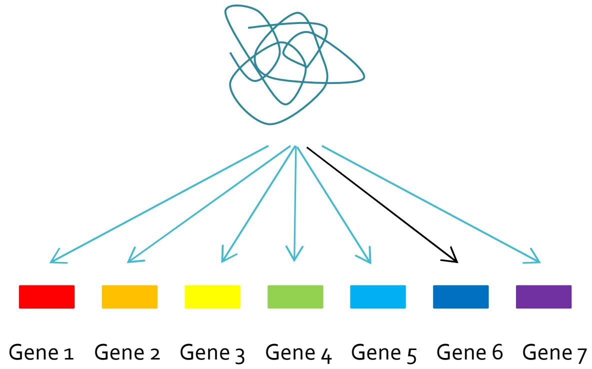
Almond LS, Phony peach disease,
oak LS, elm LS, plane LS, acer LS,
Polygala LS, …..

- *pauca*

Citrus Variegated Chlorosis
Coffee LS “crespera disease”
Olive Quick Decline Syndrome

LS: Leaf Scorch

MultiLocus Sequence Analysis / Typing, MLSA/MLST



Sequencing of internal fragments of HouseKeeping Genes
Slow evolution & Neutral selection

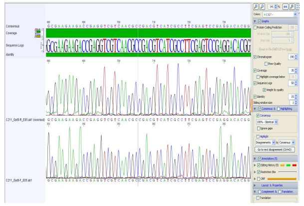
For Xf: 7 HKG: *cysG, gltT, holC, leuA, malF, nuoL, petC*

4,161 bp

Standardized
Reproducible
Discriminative
Portable

http://pubmlst.org/xfastidiosa/

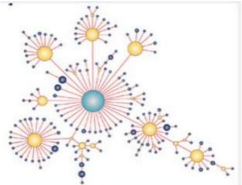
But yet expensive and labor-consuming => cgMLSA/MLST

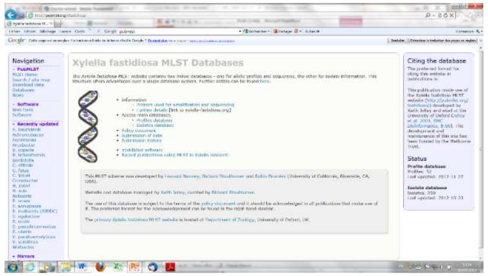


1. MLSA: sequence analysis and comparison=> phylogeny, recombination

2. MLST: Assignation of allele numbers to sequences => « Sequence Type » => Clonal complexes, founder ST, …

	🟥	🟧	🟨	🟩	🟦	🟦	🟪	ST
Alleles N°	37	33	33	33	33	33	33	67





Xylella fastidiosa 9a5c : The first genome sequence of a plant pathogenic bacteria to be released. It was in 2000.

13 July 2000

International weekly journal of science

nature

www.nature.com

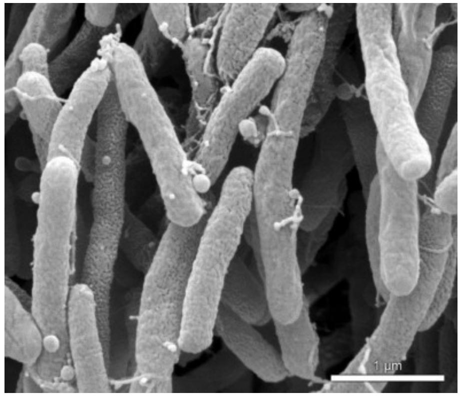
Citrus pathogen sequenced

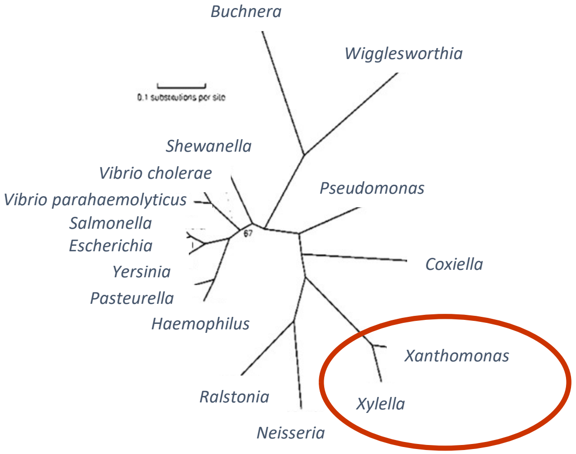
Isotope geology
Strange sulphates

AIDS
Mbeki responds to critics

Molecular logic
Chemistry meets computing

nature jobs
focus on biochemistry





Berg and Goldberg, 2005

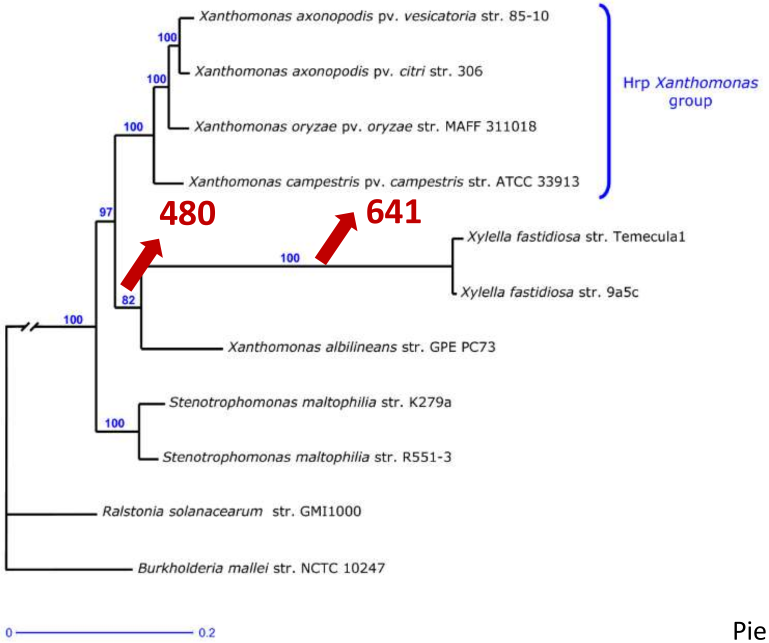
Some crucial traits of *X. fastidiosa*

Small genome size : Genome reduction

~2.5 Mb
1121 lost genes in comparison to Xcc

Narrow and nutrient-limited niches: xylem and insect foregut

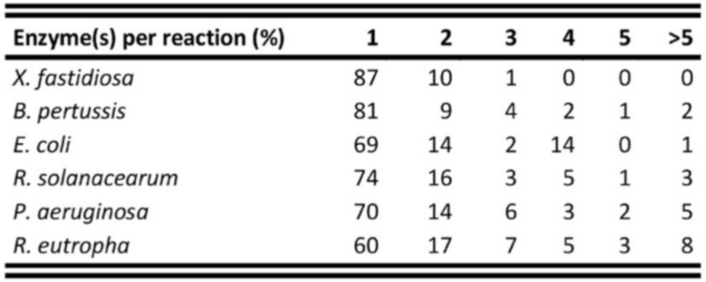
Frequent bottlenecks associated with insect transmission



Pieretti *et al.*, 2009

-absence of functional redundancy

=> Minimalist metabolic network that lacks robustness

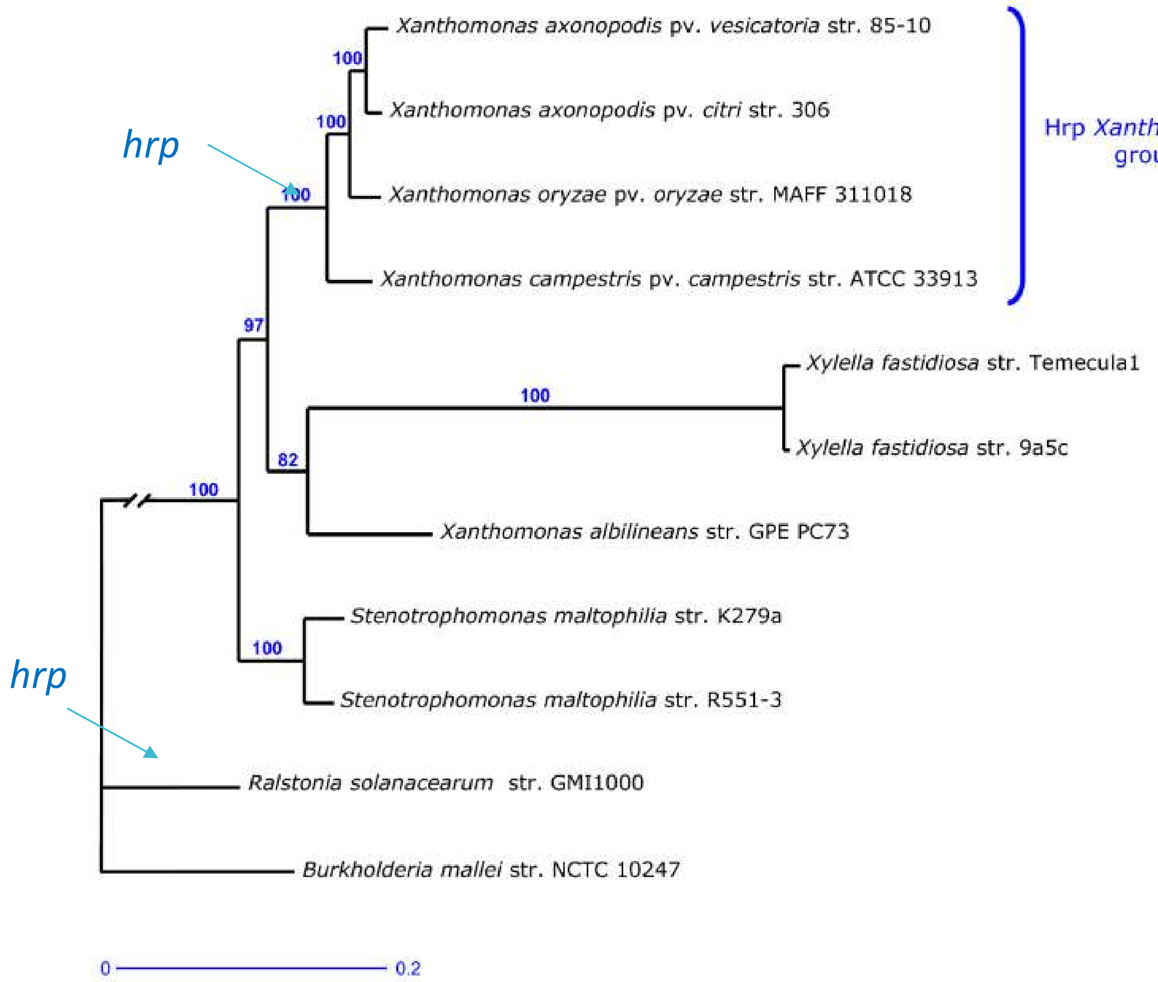


Enzyme(s) per reaction (%)	1	2	3	4	5	>5
X. fastidiosa	87	10	1	0	0	0
B. pertussis	81	9	4	2	1	2
E. coli	69	14	2	14	0	1
R. solanacearum	74	16	3	5	1	3
P. aeruginosa	70	14	6	3	2	5
R. eutropha	60	17	7	5	3	8

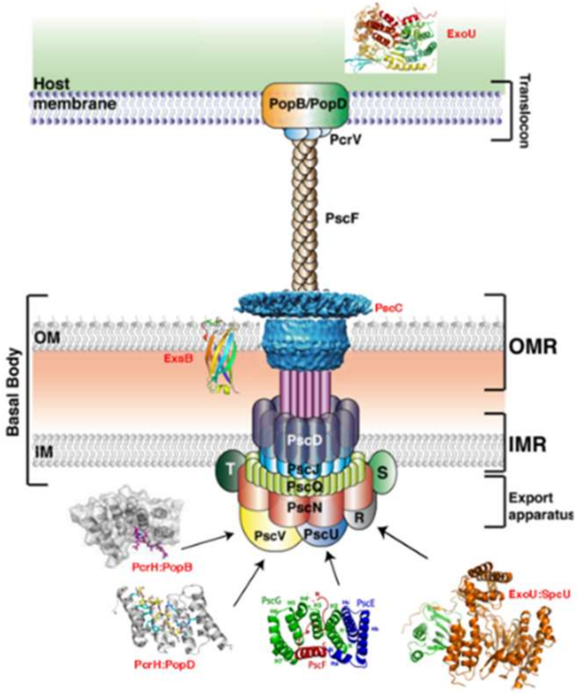
Gerlin *et al.*, 2020

Some crucial traits of *X. fastidiosa*

No T3SS, no T3Es



Hrp *Xanthomonas* group



Pieretti *et al.*, 2009

Some crucial traits of *X. fastidiosa*

Motility

No flagellum

Type IV pili: twitching motility

Attachment and biofilm formation

Type I pili

Afrimbrilar adhesins (Hfx)

EPS (*gum)*

Plant Cell Wall Degrading Enzymes

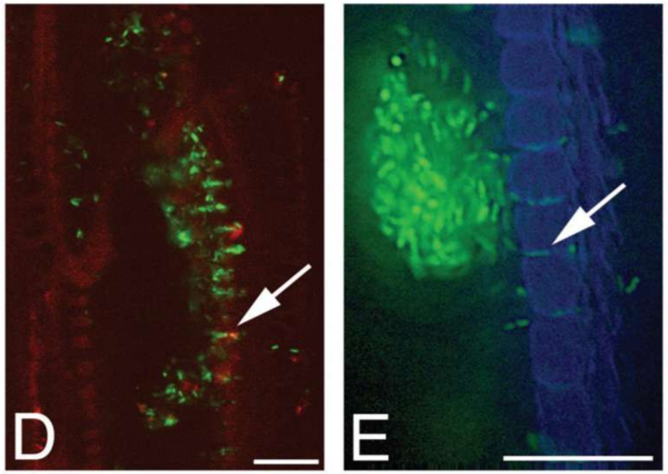
3 β-1,4 endoglucanase (EngXCA) highly efficient for cellulose binding and degradation

Cellobiohydrolase (CbhA)

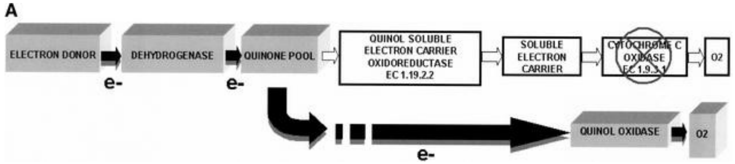
Polygalacturonase (PglA) involves in pit membrane degradation

Other enzymes : LesA (Nacimento et al., 2016)

Limited aerobic / No anaerobic respiration least energy-efficient type of aerobic respiration



→ **Efficient xylem colonization**

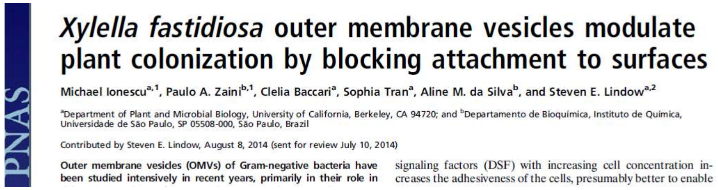


cytochrome o (bo) ubiquinol oxydase

Plant colonization and insect transmission are mutually exclusive processes

Regulation of pathogenicity factors: *rpf* cluster encodes the DSF (Diffusible Signal Factor), which perception and signal transduction leads to virulence trait expression

Chatterjee S, et al. 2008.
Annu. Rev. Phytopathol. 46:243–71



PNAS

Xylella fastidiosa **outer membrane vesicles modulate plant colonization by blocking attachment to surfaces**

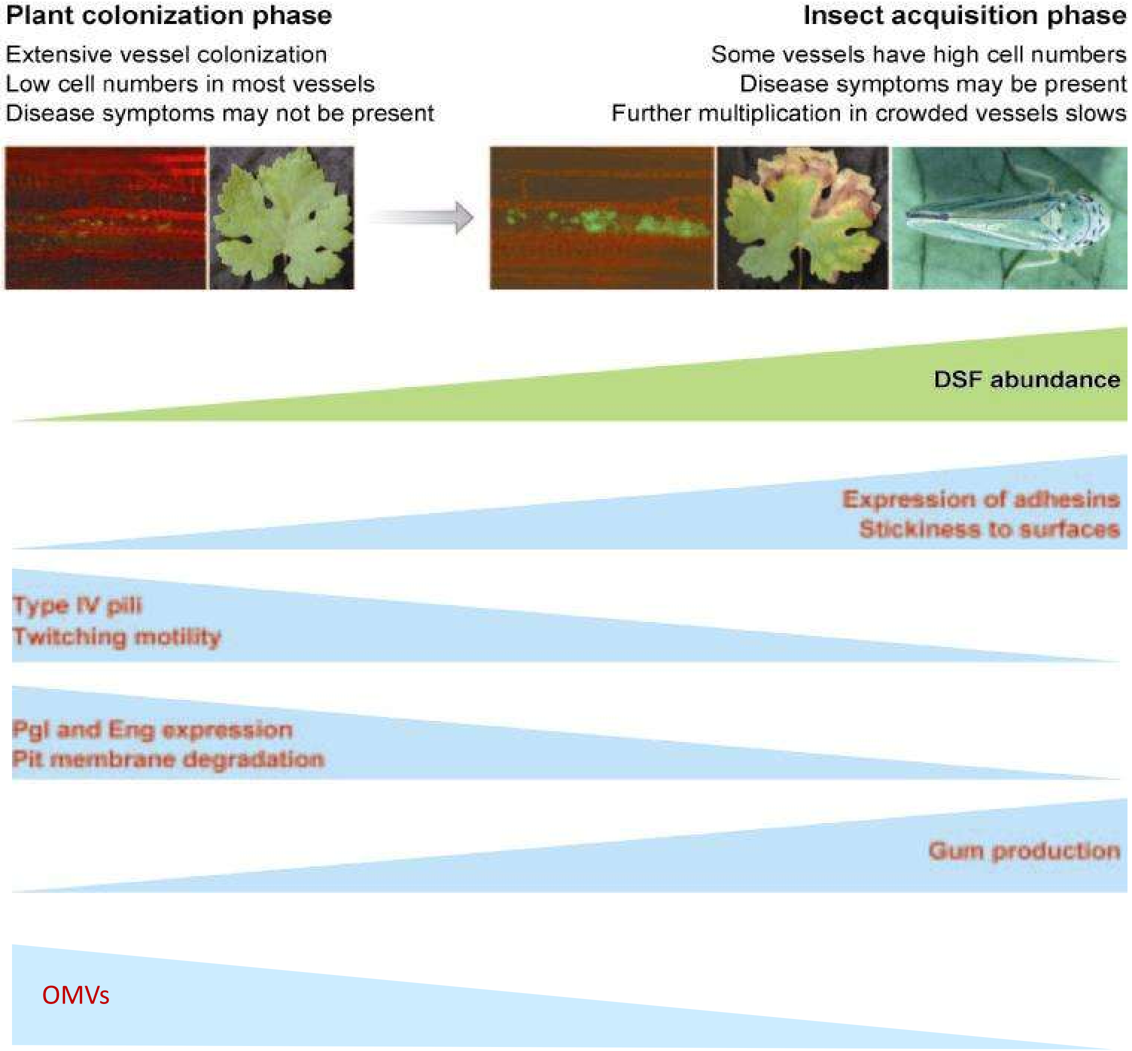
Michael Ionescu[a,1], Paulo A. Zaini[b,1], Clelia Baccari[a], Sophia Tran[a], Aline M. da Silva[b], and Steven E. Lindow[a,2]

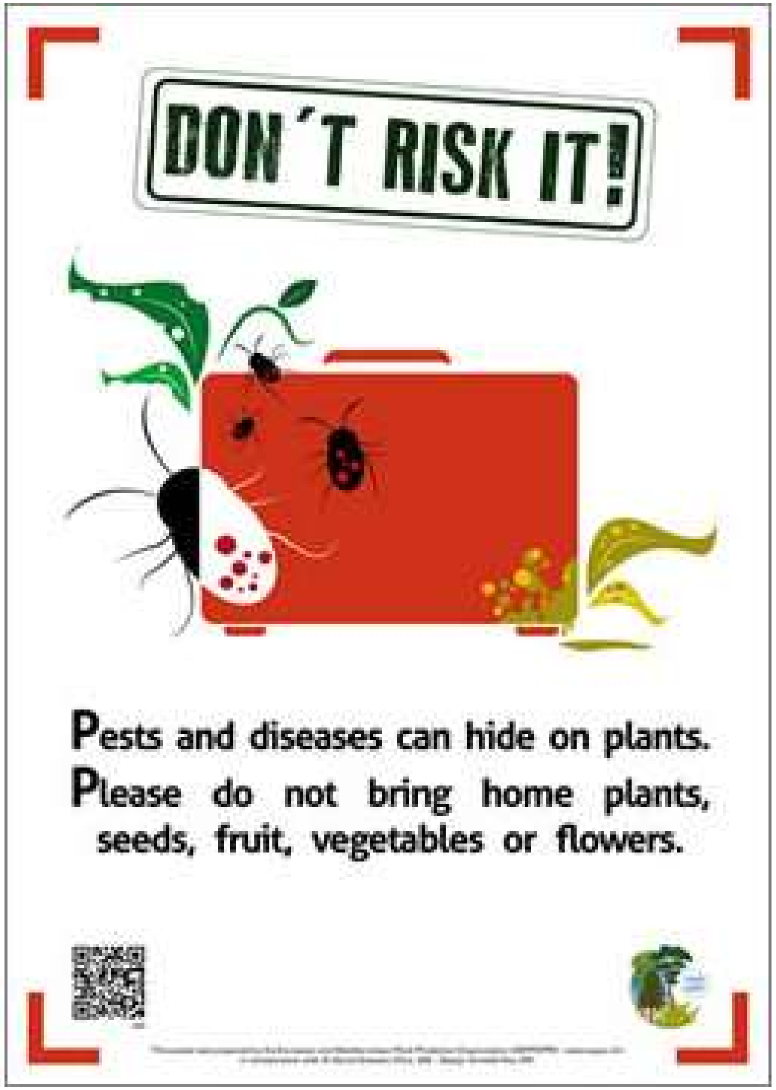
[a]Department of Plant and Microbial Biology, University of California, Berkeley, CA 94720; and [b]Departamento de Bioquímica, Instituto de Química, Universidade de São Paulo, SP 05508-000, São Paulo, Brazil

Contributed by Steven E. Lindow, August 8, 2014 (sent for review July 10, 2014)

Outer membrane vesicles (OMVs) of Gram-negative bacteria have been studied intensively in recent years, primarily in their role in

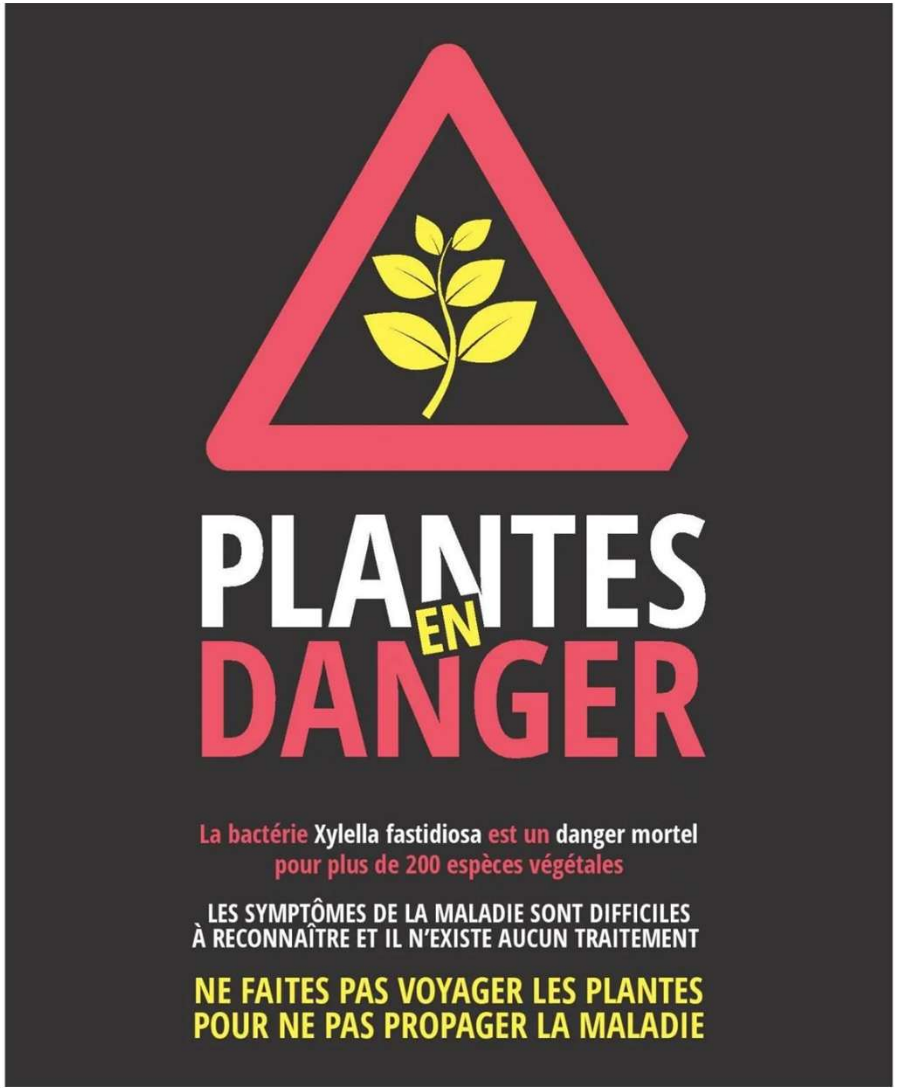
signaling factors (DSF) with increasing cell concentration increases the adhesiveness of the cells, presumably better to enable





DON´T RISK IT!

Pests and diseases can hide on plants. Please do not bring home plants, seeds, fruit, vegetables or flowers.



PLANTES EN DANGER

La bactérie Xylella fastidiosa est un danger mortel pour plus de 200 espèces végétales

LES SYMPTÔMES DE LA MALADIE SONT DIFFICILES À RECONNAÎTRE ET IL N'EXISTE AUCUN TRAITEMENT

NE FAITES PAS VOYAGER LES PLANTES POUR NE PAS PROPAGER LA MALADIE