European Research on *Xylella fastidiosa* H2020 funded projects

2015 - 2019

POnTE Pest Organisms Threatening Europe

XF ACTORS

Xylella Fastidiosa Active Containment Through a multidisciplinary-Oriented Research Strategy

2016 - 2020

Maria SAPONARI

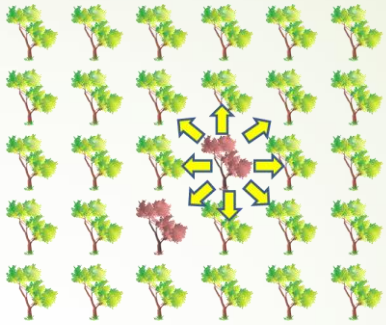
Institute for Sustainable Plant Protection, CNR Bari (Italy)

IPSP

Xylella fastidiosa

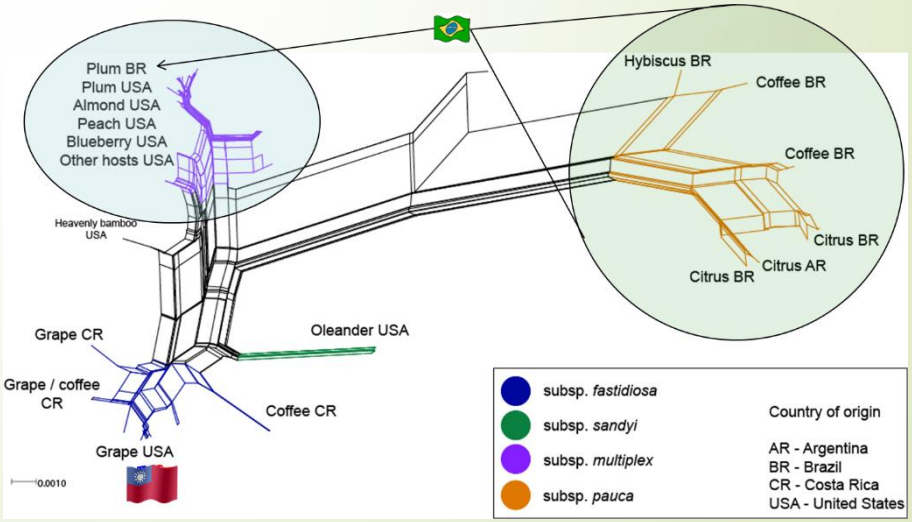
- Xylem-limited bacterium

- Insect vectored - xylem sap-feeding insects



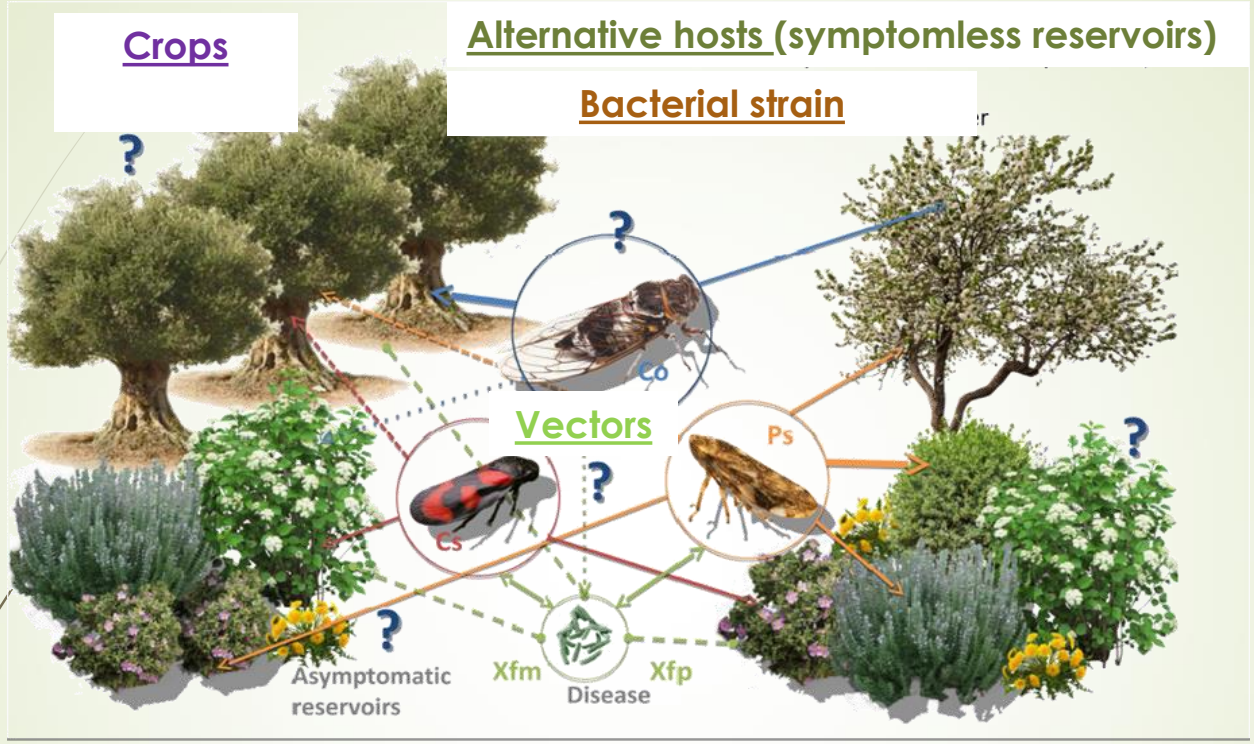
- >560 plant species
- Several severe diseases

Subspecies - geographic distribution – host specificity



Courtesy Prof. Almeida

X. fastidiosa diseases have very COMPLEX biotic and abiotic interactions



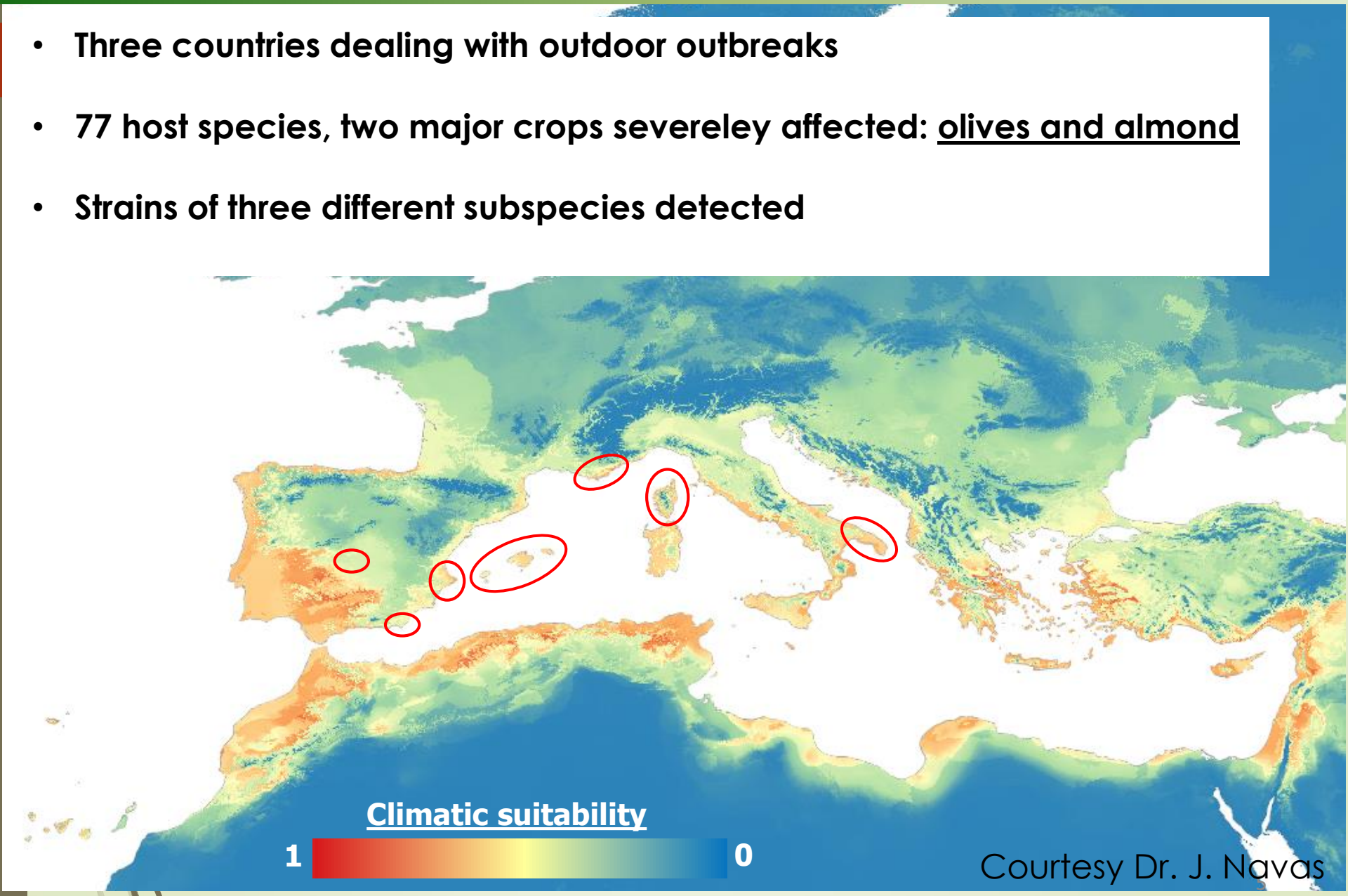
- ✓ environment (e.g. temperature)
- ✓ vector ecology
- ✓ pathogen ecology
- ✓ host plant ecology
- ✓ outcome of various interactions
- ✓ disease management

Risk reduction options

- Prevention
- Surveillance (Early detection)
- Removal/Reductions sources of inoculum
- Vector controls
- Use Xf-free plants
- Thermoterapy (grapes)

Current distribution of Xylella in EU

- **Three countries dealing with outdoor outbreaks**
- **77 host species, two major crops severeley affected: <u>olives and almond</u>**
- **Strains of three different subspecies detected**



Courtesy Dr. J. Navas

First idetification of XF = consequence of the finding of a new severe olive disease

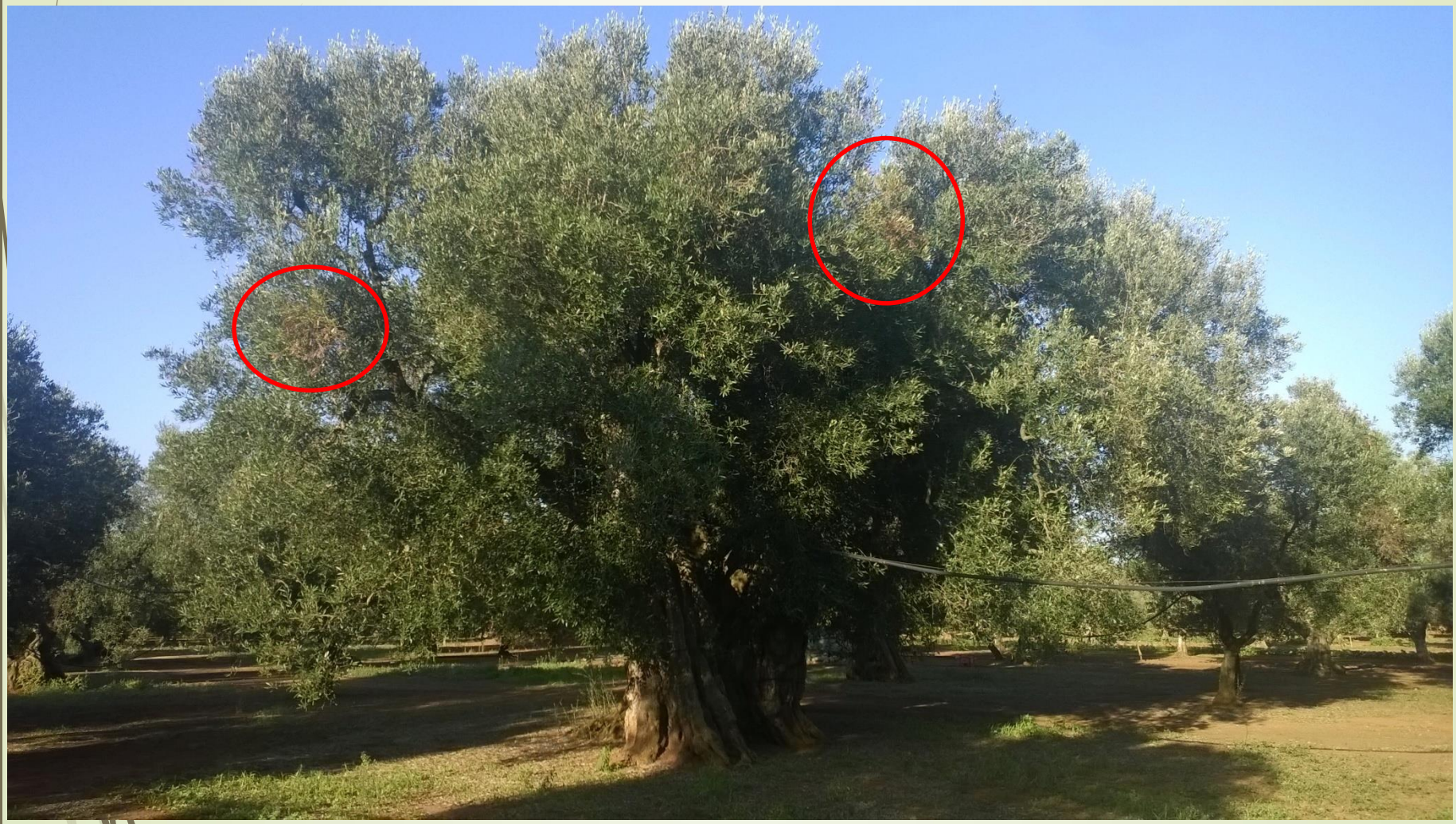
Disease spread, symptom progression and severity


Olive trees showing quick decline syndrome at advanced stage

Gallipoli (Lecce), October 2013

Gallipoli (Lecce), April 2016

Gigante di Alliste (1500 anni)
30 Settembre 2014



July 2016

Young trees

One size doesn't fill all

ONE SIZE
FITS ALL

MADE TO
MEASURE

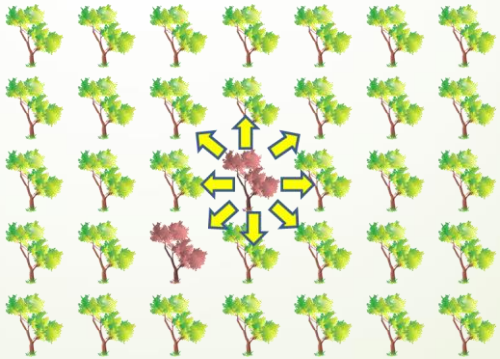
?

?

?

?

Vector(s)



Host(s)

Spread

CONTROL

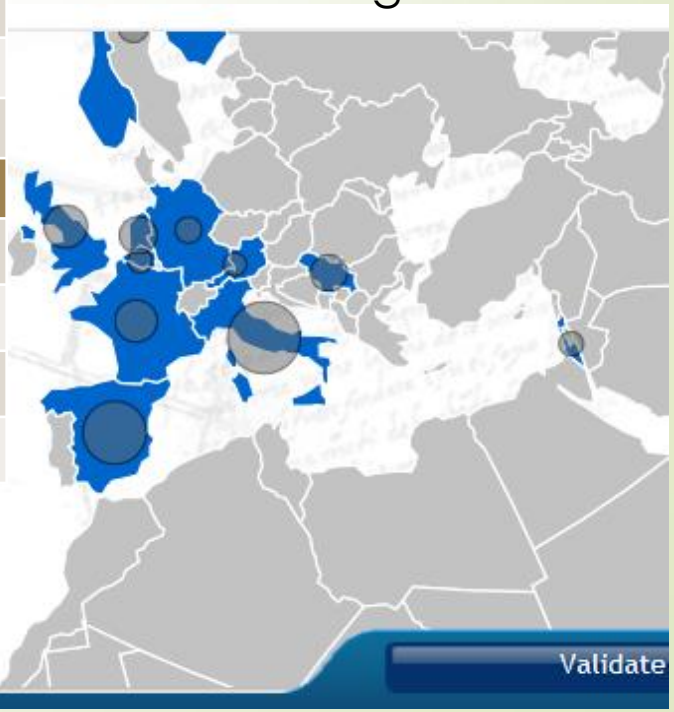
Partnership

www.ponteproject.eu

POnTE
PestOrganisms
ThreateningEurope

EU COUNTRIES	
ITALY	CNR-IPSP, UNIBA-DiSSPA , AGRITEST, ACLI RACALE
FRANCE	INRA, ANSES, VILMORIN
SPAIN	CSIC-ICA, CSIC-IAS, IVIA-AC, IVIA-PPBC, CITOLIVA, AGR VILLENA
BELGIUM	AUREA IMAGING
NETHERLANDS	WU, CERTIS EUR
AUSTRIA	BFW
UK	SG-SASA, FORESTRY RES AG, A L TOZER
GERMANY	LOEWE, PRC
FINLAND	LUKE
NON-EU COUNTRIES	
COSTA RICA	UCR
ISRAEL	ARO VOLCANI
SERBIA	UB-FA
NORWAY	NIBIO

Plant pathologist
Bacteriologists
Entomology
Micologists
Agricutural engneering
Seed producers
Associations of growers



13 COUNTRIES – 25 PARTNERS

14 COUNTRIES – 29 PARTNERS

EU COUNTRIES	
ITALY	CNR-IPSP, UNIBA-DiSSPA , CREA, CEMCC, CIVI-Italia, Enbiotech Srl
FRANCE	INRA, CIHEAM, EPPO
SPAIN	CSIC, IVIA, IFAPA, AINIA
BELGIUM	IVLO, JRC
NETHERLANDS	NVWA, NAKTUINBOUW
GREECE	BPI
UK	NERC, USAL, RUSSEL IPM
GERMANY	JKI
SWEDEN	IFOAM
PORTUGAL	IPB
NON-EU COUNTRIES	
COSTA RICA	UCR
BRAZIL	IAC
TAIWAN	NTU
USA	UC BERKELY

MAIN OBJECTIVES OF THE PROJECTS

- **DEVELOP KNOWLEDGE**

- **ANSWER TO IMPORTANT EPIDEMIOLOGICAL QUESTIONS** (PATHWAY OF INTRODUCTIONS AND DISEASE SPREAD)

- ***PRACTICAL SOLUTIONS AND MEANS FOR PREVENTION AND CONTROL***

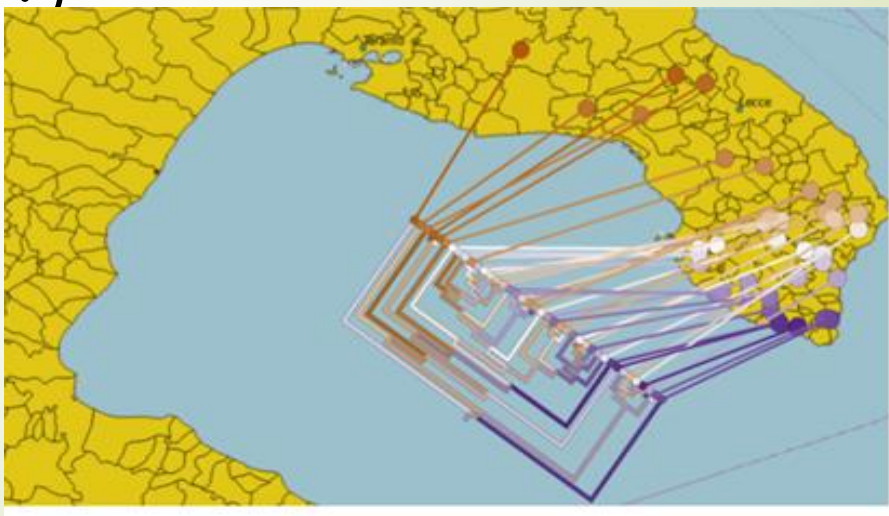
BACTERIUM

Determined its role (OQDS) and pathogenicity

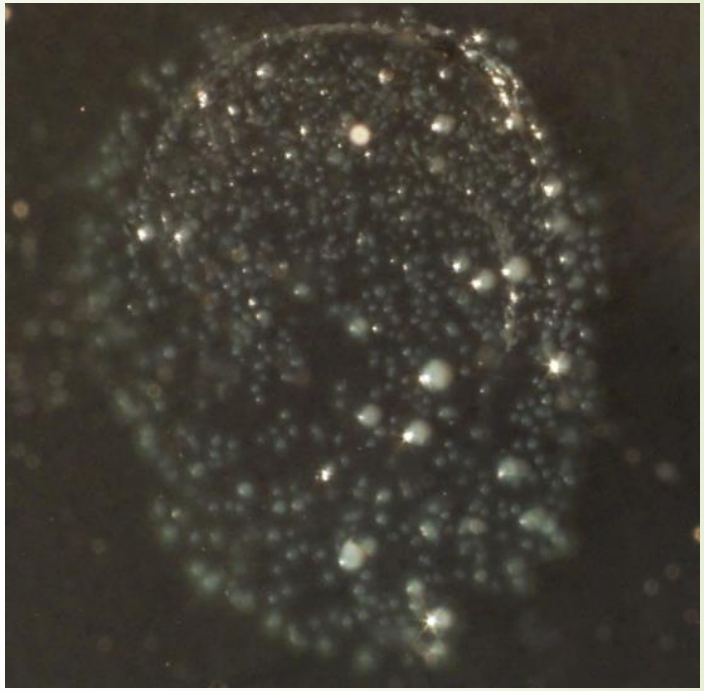
Sequenced its full genome:

- clarified the pathway of introduction (central America)
- Possibility to understand how the bacterium is spreading (wave-jumps?)

Implications for the control measures



Koch's postulates fullfilled



Pathogenicity:

- PROTOCOL TO SCREEN CULTIVAR SUSCEPTIBILITY
- ASSESS THE IMMUNITY OF THE SPECIES («DE-LISTING» - MOVEMENTS OUTSIDE DEMARCATED AREA)

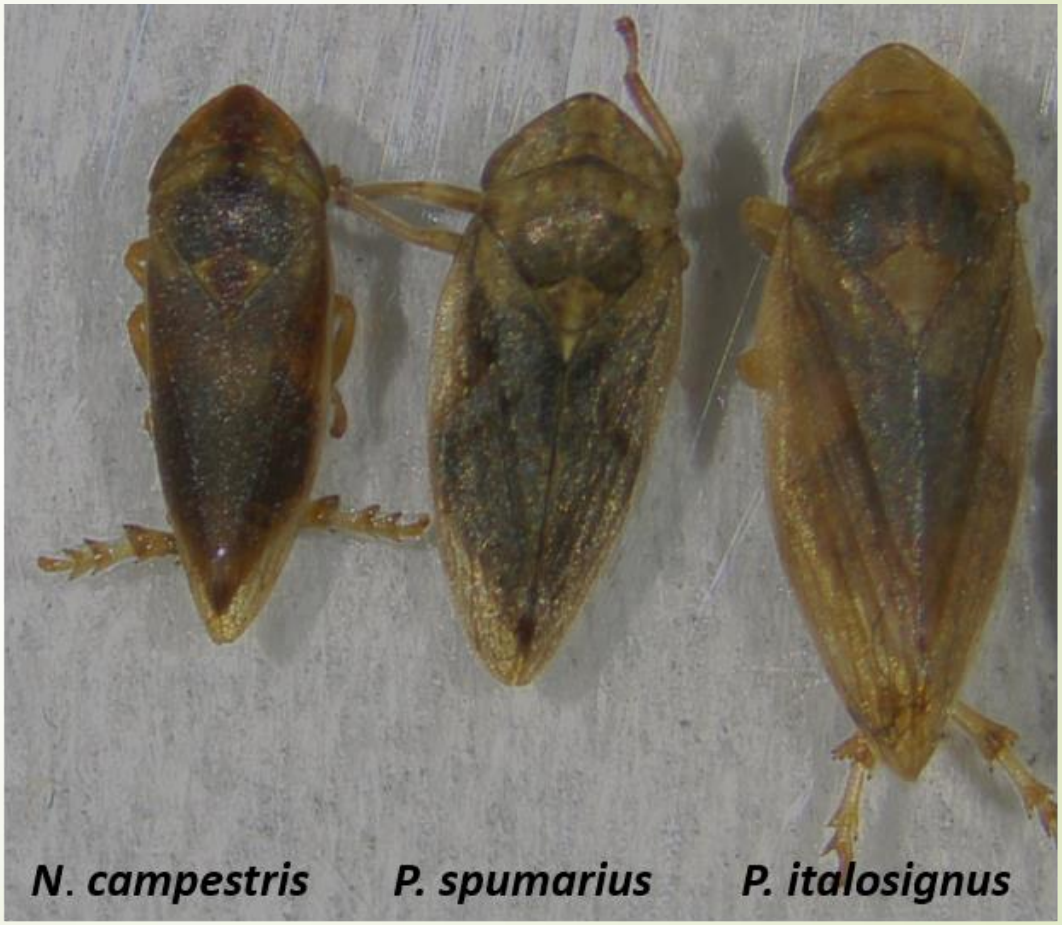



Vectors: the role of spittlebugs

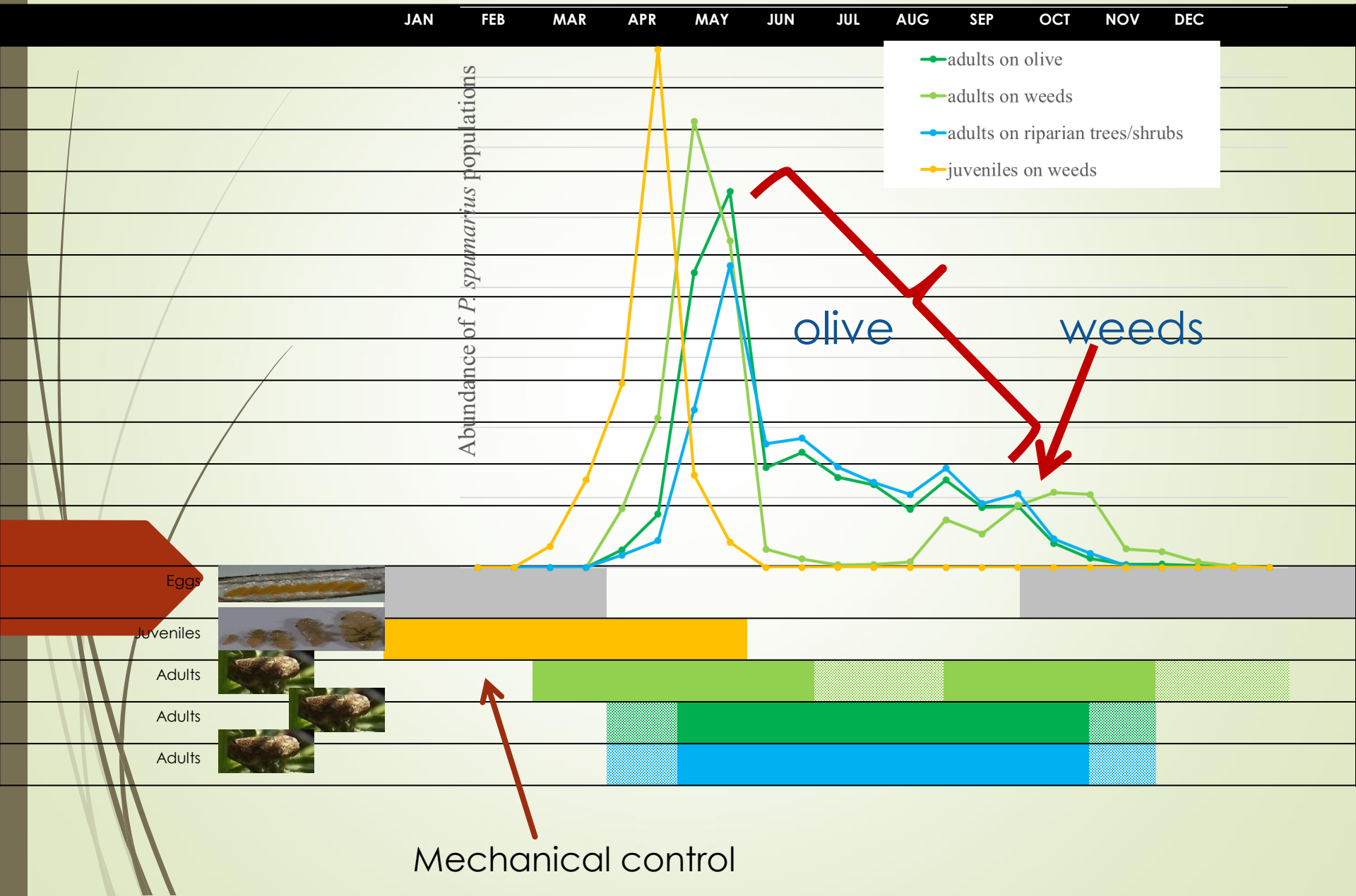
2014-2017

Philaenus spumarius
- Predominant species
- Major vector species

! Control !



Biological cycle of P. *spumarius* in Apulia



HOSTS: OLIVES

➨HOST RESISTANCE

FIELD EVIDENCE

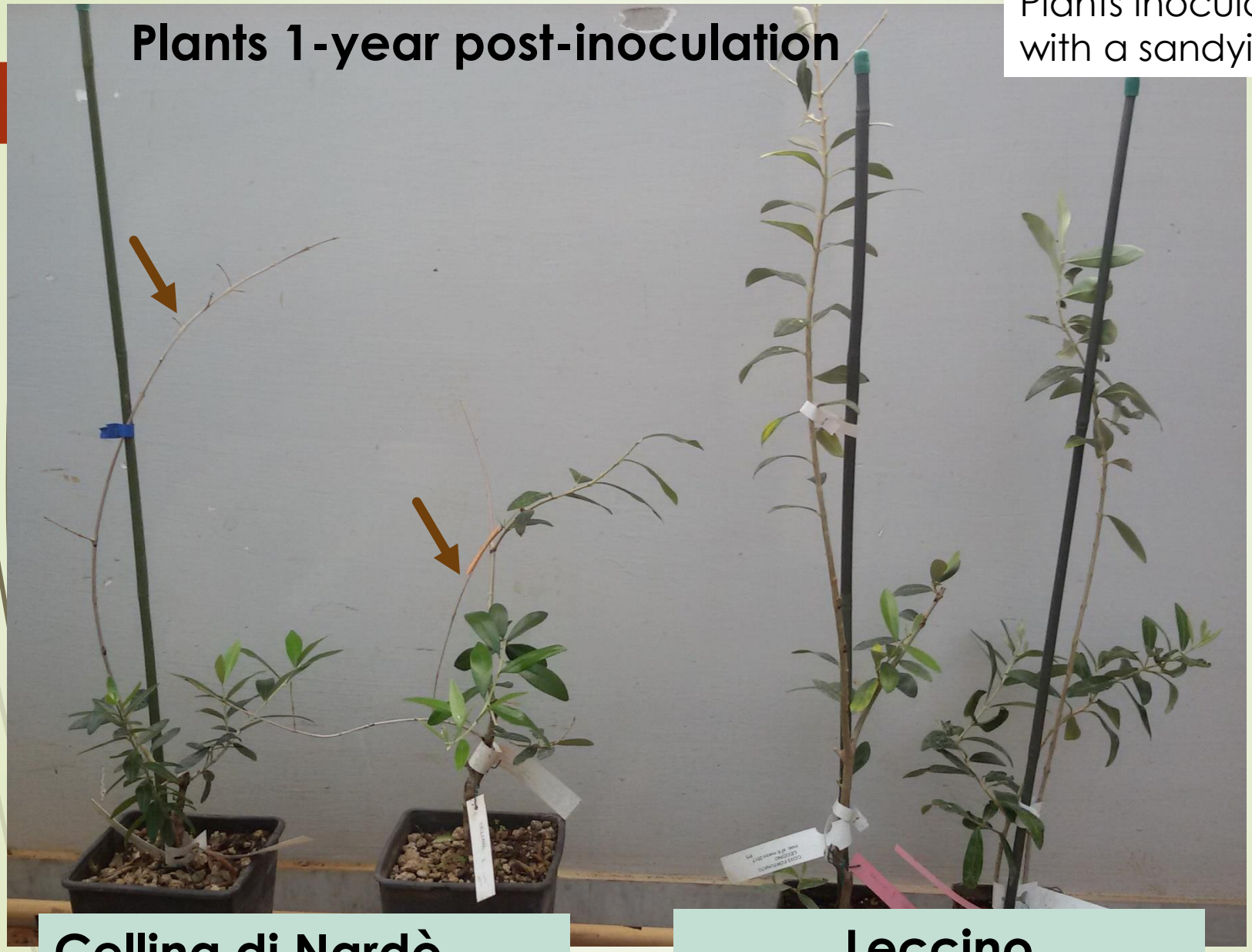
IS THIS SOMETHING CONSTITUTIVE OF THE VARIETY?

ARE THERE OTHER VARIETES RESISTANT OR TOLERANT?

IS THIS SPECIFIC FOR CERTAIN STRAIN-CULTIVAR COMBINTIONS?

Plants 1-year post-inoculation

Plants inoculated with a sandyi strain



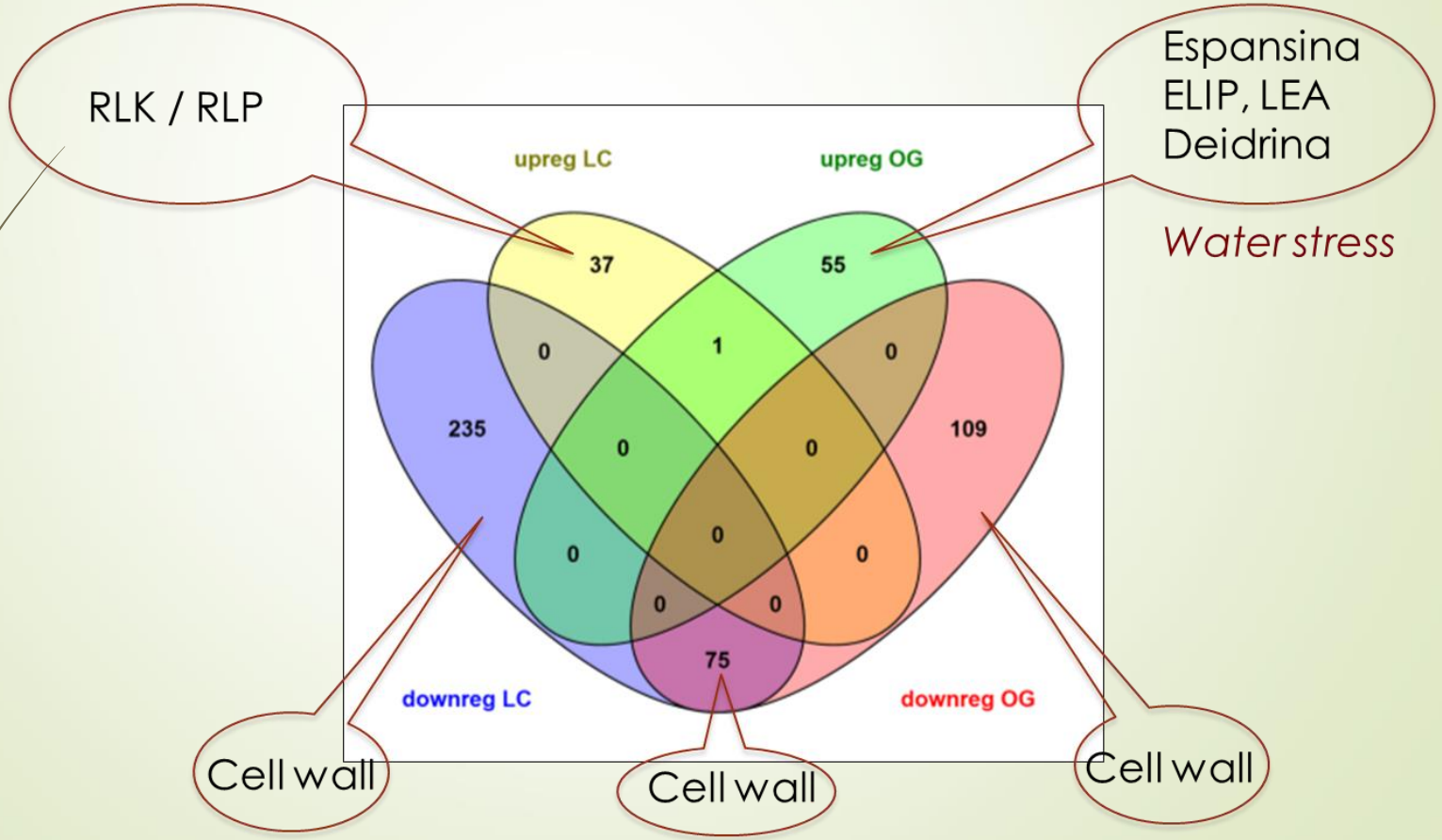
Cellina di Nardò

Leccino

Arrows indicate dessicated

MOLECULAR STUDIES: TRANSCRIPTOMES

- 2 CULTIVARS IDENTFIED WITH TRAITS OF RESISTANCE
- RESISTANCE= HARBOR LOWER BACTERIUM = LOWER VECTOR TRANSMISSIBILITY
- LECCINO UPON INFECTIONS ACTIVATES GENES AGAINST XF
- OGLIAROLA ACTIVATES WATER STRESS GENES



These studies support the evidence that genetic resistance exists in olive

- Large program of screening for olive cultivars

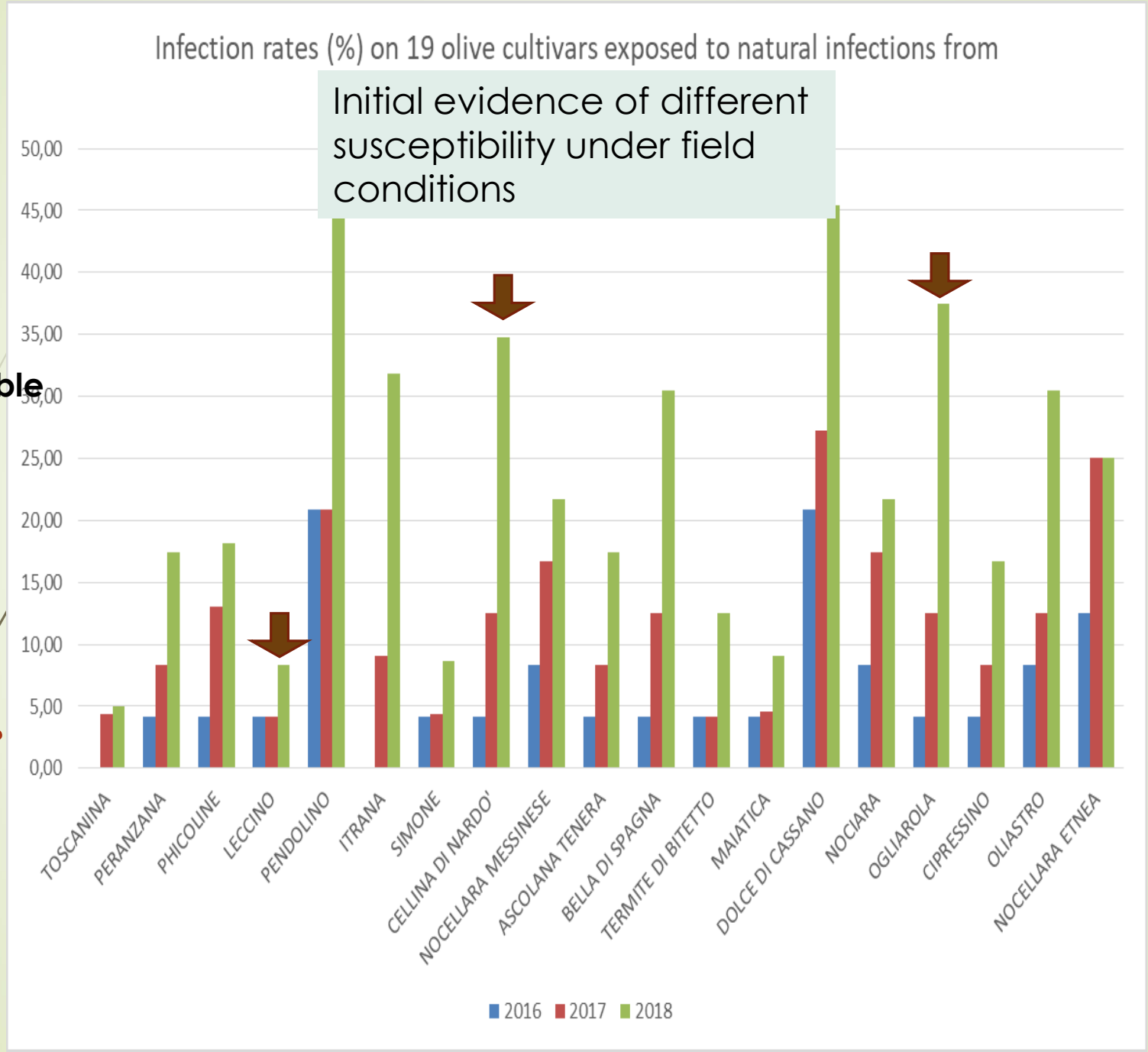
WORLD COLLECTION IN CORDOBA

- **60 SELECTIONS SENT IN ITALY – SCREENING AGAINST THE PAUCA STRAIN**

- **FROM ALL OVER THE MEDITERRANEAN COUNTRIES**

Controls:

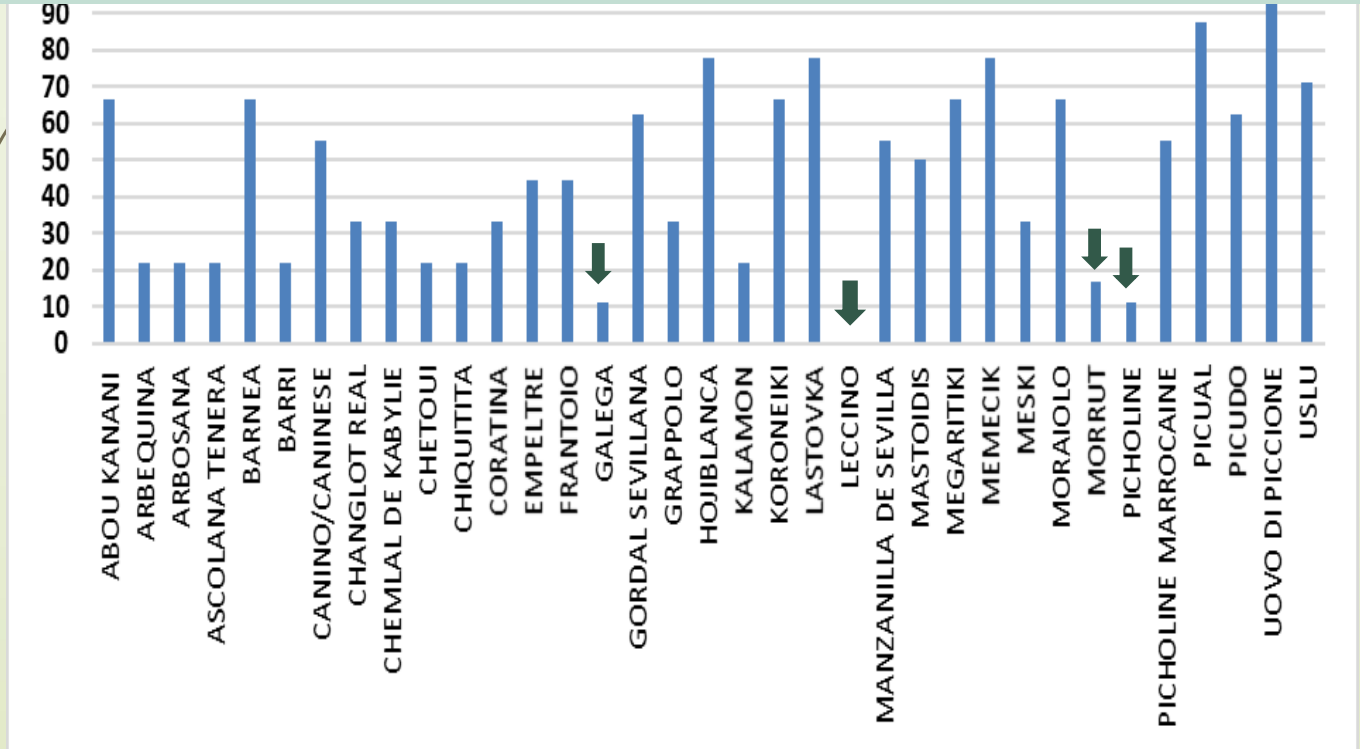
- **Susceptible**
- **Resistant**



Task 6.5 Artificial inoculations (started in 2017 in progress)

Differences in the rate of plant colonization are detected, but longer period of observations and testing are necessary

% of inoculated plants in which the bacterium could be detected at approx. 10cm above the points of inoculation after 6-months



SELECTION OF WILD GENOTYPES WITH PROMISING PHENOTYPES

- Search in the highly infected area of symptomless olive trees

COMPLEMENTARY WORK IN SPAIN: SCREENING AGAINST MULTIPLEX STRAIN

ivia
instituto valenciano
de investigaciones agrarias

iFAPA
JUNTA DE ANDALUCIA

CSIC
Consejo Superior de Investigaciones Científicas
IAS

Alfafara
Arbequina
Frantoio
Picual

Field plots in Ibiza and Mallorca

Alicante – olives Xf-free

STRAIN DIFFERENT FROM THE ITALIAN

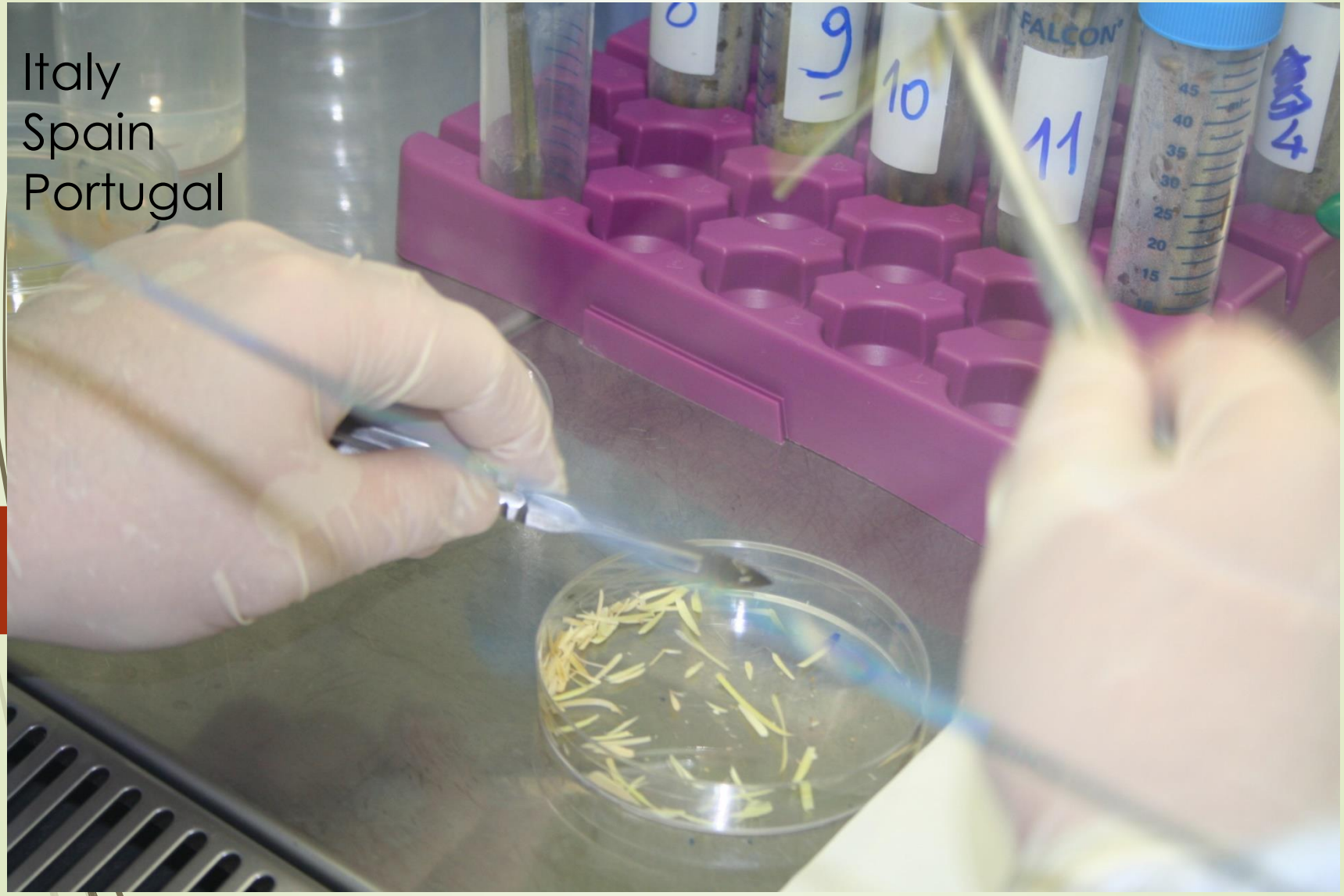
«CONSTRAINS AND HOPE»

- FACILITIES FOR SCREENING TESTS
- OLIVE GENOME (FARGA, ANNOTATION STILL UNDER IMPLEMENTATION)
- IDENTIFY GENETIC MARKERS FOR THE RESISTANCE
- PROVIDE TO GROWERS INFO ON RESISTANCE TO XF

OTHER STUDIES FOR THE CONTROL OF THE PATHOGEN IN THE HOSTS

- MICROBIOME – ENDOPHYTES (are they involved in the resistance?)
  - **PARABURKHOLDERIA PHYTOFIRMANS**
- Antimicrobial PEPTIDES
- Bacteriophages (not successfull yet)

Characterizazion of the microbial community in olive plants under different conditions



USE OF MICROBIAL ANTAGONIST

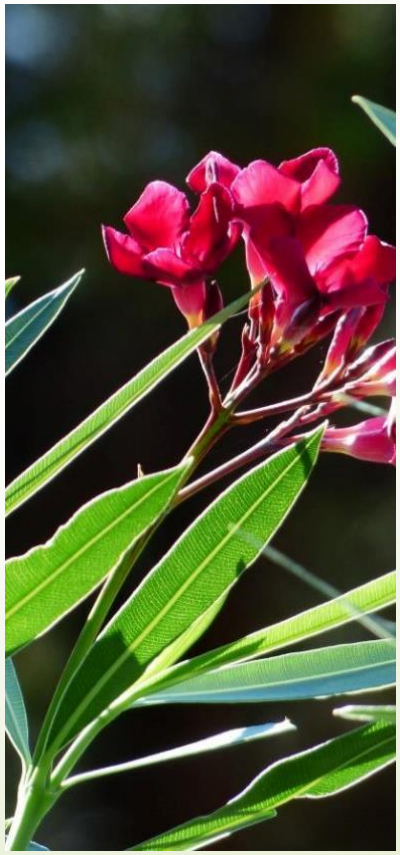
PLANT GROWTH-PROMOTING RHIZOBACTERIUM

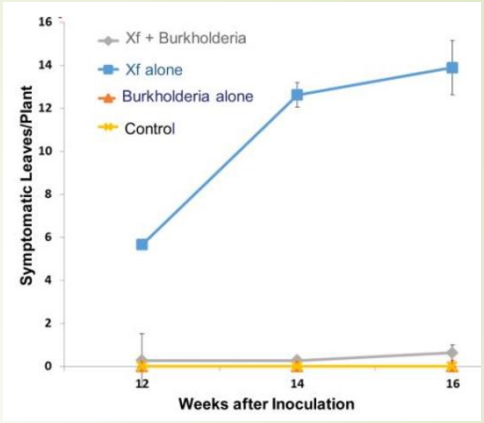
STIMULATION OF PLANT GROWTH

IMPROVEMENT OF TOLERANCE TO ABIOTIC STRESS

REDUCTION OF PLANT DISEASE SUSCEPTIBILITY

PROVED SUCCESSFUL FOR BIOLOGICAL CONTROL OF
PIERCE'S DISEASE IN GRAPEVINE





Inoculations in olives and oleander

↓

Host colonization and persistence

↓

Field experiments March 2018:

- **Curative treatment**
- **Prevention/pre-immunization**

CONTROL OF THE VECTORS

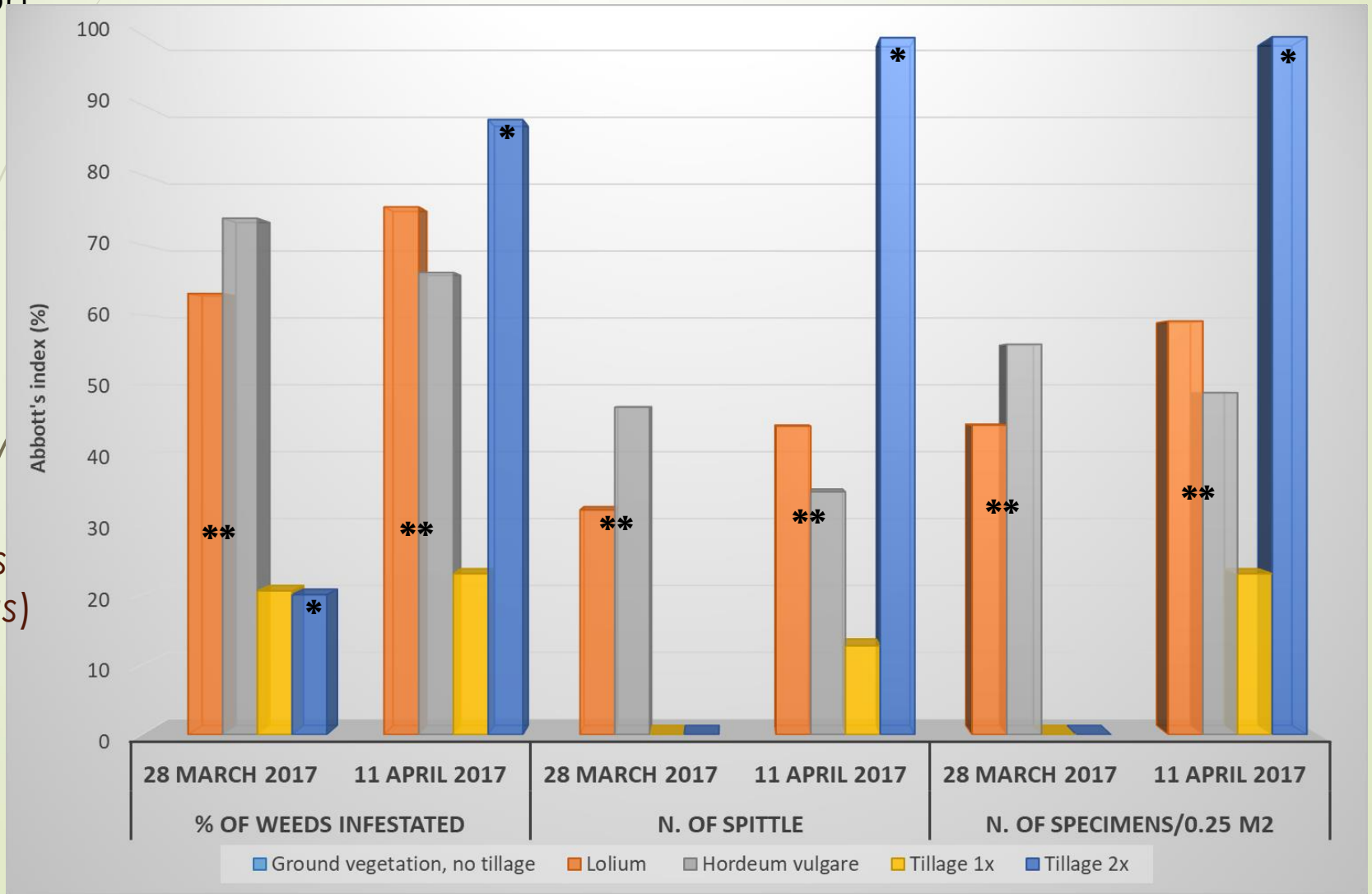
- COVER CROPS – JUVENILE REDUCTION
- BORDER TRAP PLANTS
- TESTING FORMULATES
- SEARCHING FOR PARASSITOIDS AND PREDATORS
- Trapping (acoustic signal)

***Tilling the soil** twice (winter and spring) provided the best results - reduction of spittle/specimens

****Sowing poaceae** (*Lolium* and *Hordeum)* contributed to reduce incidence of infestation

TESTING COVER CROP to reduce juveniles

(i.e. non-host of *Philaenus spumarius*)



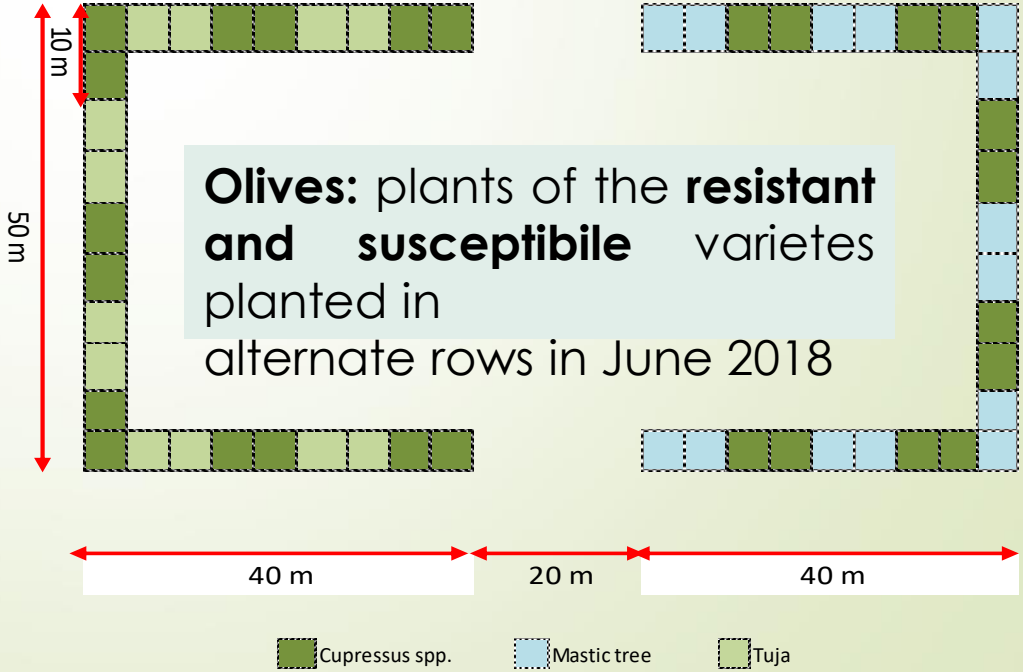
Task 7.3 – *Evaluation of border plants as trap plants in olive orchards for the reduction of adults density population of P. spumarius* (P1: CNR-IPSP/CRSFA)

Non-host Xf *pauca*, ST53

XF ACTORS

Xylella Fastidiosa Active Containment Through a multidisciplinary-Oriented Research Strategy

(**Thuja**, ***Cupressus*** spp. and **lentisk**) used in alternate rows and in different combinations, to set 3 field trials in the contaminated area.

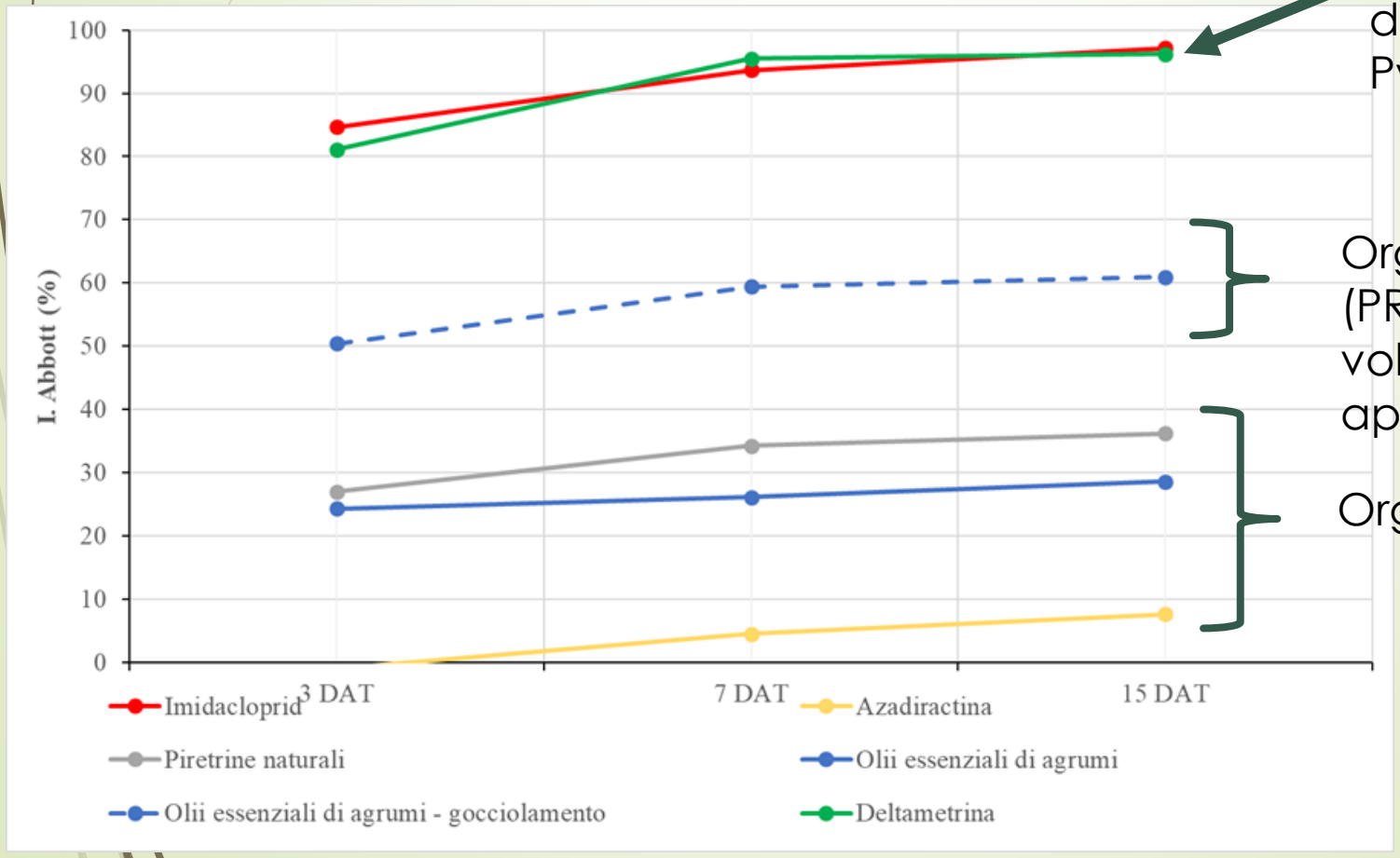


These data on efficacy of different chemicals and formulations to control *P. spumarius* showed that neonicotinoids performed better than the other products.

XF ACTORS

Xylella Fastidiosa Active Containment Through a multidisciplinary-Oriented Research Strategy

Example of the results in one of the trials



Neonicotinoids and Pyrethroids

Organic (PREVAM), high volume of application

Organic

POnTE PestOrganisms ThreateningEurope

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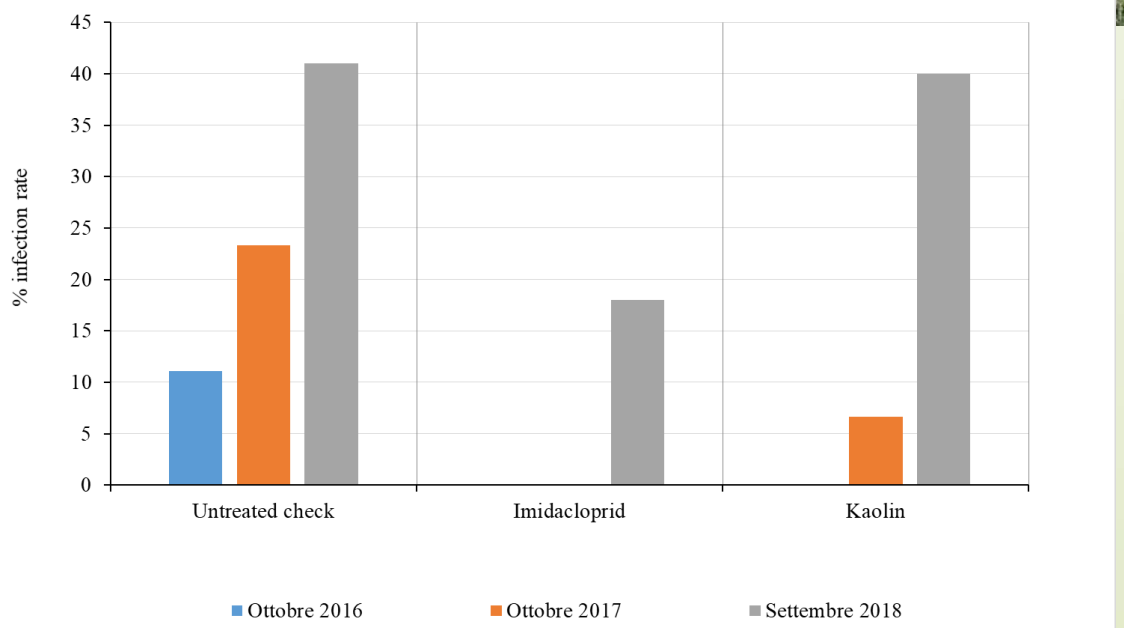
Xylella Fastidiosa Active Containment Through a multidisciplinary-Oriented Research Strategy

Application of kaolin to reduce the spread of the infections in olives

New plantation in the contaminated area

Periodic surveys and sampling



PREVENTION

- Early detection
- Producing Xf-free plants

REMOTE SENSING SUPPORTING EARLY DETECTION

nature plants

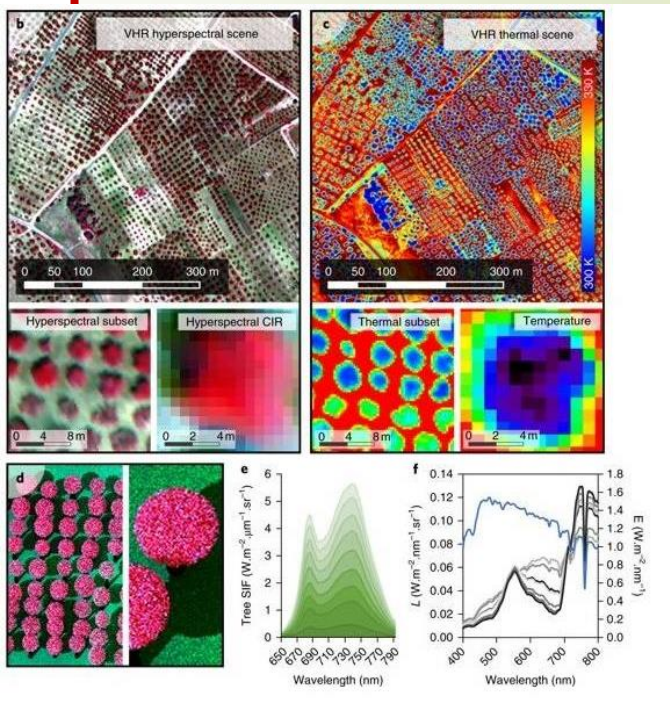
LETTERS

https://doi.org/10.1038/s41477-018-0189-7

Previsual symptoms of *Xylella fastidiosa* infection revealed in spectral plant-trait alterations

P. J. Zarco-Tejada[1*], C. Camino[2], P. S. A. Beck[1], R. Calderon[2], A. Hornero[2,3], R. Hernández-Clemente[3], T. Kattenborn[4], M. Montes-Borrego[2], L. Susca[5], M. Morelli[6], V. Gonzalez-Dugo[2], P. R. J. North[3], B. B. Landa[2], D. Boscia[6], M. Saponari[6] and J. A. Navas-Cortes[2]

JRC
EUROPEAN COMMISSION



INITIATIVE within the project XF-ACTORS

VSPP Voluntary System Preventing Pests

- Is proposed in addition to EU regulation
- Focus on *Xylella fastidiosa*
- Later to be extended to other pests

Naktuinbouw – CIVITALIA - EPPO

Nursery productions under protected conditions

Technical specifications

Implementation of the project

48

Engagement of fruitful collaborations with local stakeholders

Implementation of the project

- **Delivery of science-based information to stakeholders:** several technical meetings with field visits have been organized (NPPO representatives, growers associations/organization, private companies: Bayer, Agromillora, Todolivo)

Dissemitation – Capacity building

- **Workshops and training (diagnostics of the bacterium and insect vectors**

Dissemitation - Exploitation of the results

- **Working group for the revision of the DP**
- **Working experts for the update of the EFSA scientific opinion**

efsa
European Food Safety Authority

European Research on Xylella fastidiosa

2nd Joint Annual Meeting

Valencia (Spain) | 23-25 October 2018

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Surveillance and early detection of *Xylella fastidiosa*

Genomics, epidemiology and vectors

Developing disease control strategies

Contributions of the H2020 projects
POnTE and **XF-ACTORS**

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National and International projects
Research network > 30 Institutions