Food and Agriculture Organization of the United Nations

International Workshop on ***Xylella fastidiosa***
& the Olive Quick Decline Syndrome (OQDS)

19-22 April, 2016

International Plant Protection Convention
Protecting the world's plant resources from pests

State of the art of the research on *X. fastidiosa* in Apulia

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CIHEAM IAM BARI

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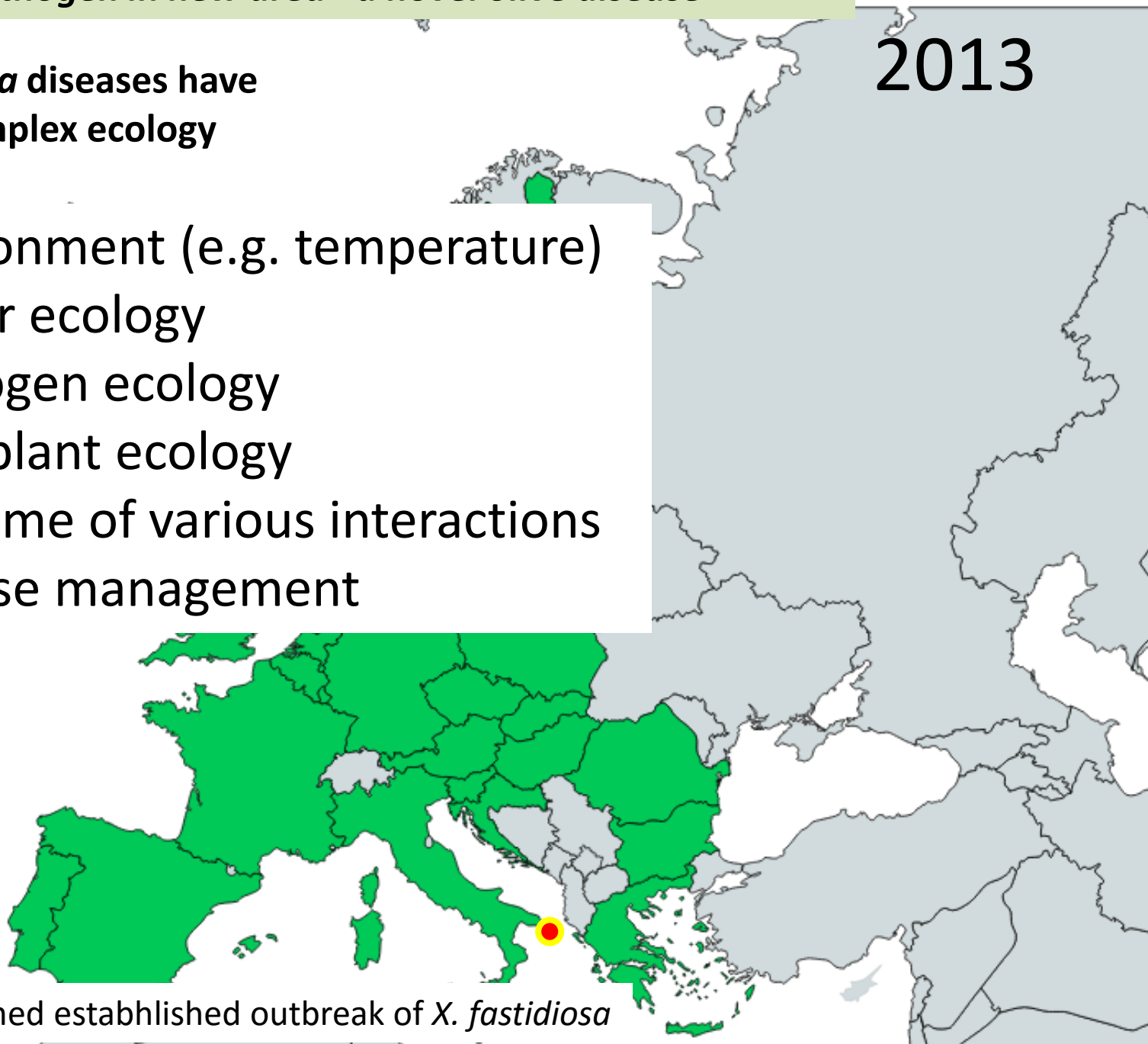
Exotic pathogen in new area - a novel olive disease

2013

***X. fastidiosa* diseases have very complex ecology**

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

?



First confirmed establhished outbreak of *X. fastidiosa*

2013 Questions and Research gaps

***Xylella fastidiosa*:**

- **Isolation**
- **Genotype**
- **Host range**
- **Temperature limitations**
- **Diagnostic procedures for Mediterranean- and European-wide surveys**

Olive disease:

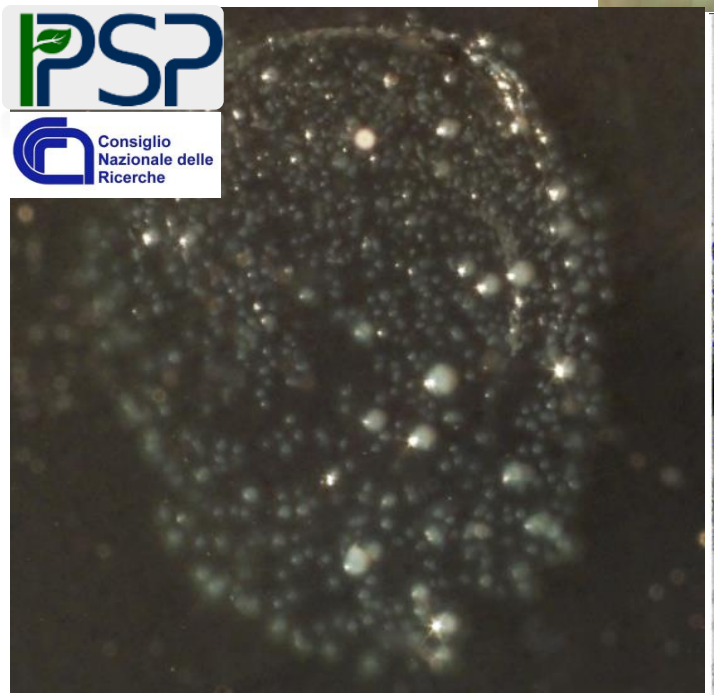
- **Etiology**
- **Incubation and latent periods**
- **Potential vector species, ecology of vectors**
- **Transmission biology/ecology**
- **Behavior of vector species on olives**
- **Spatial and temporal patterns of disease spread**
- **Primary vs secondary spread**

Effective surveillance and containment programs

2014

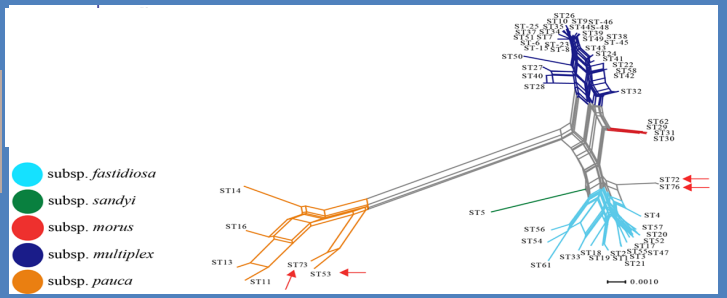
- **Isolation and cultivation of Xf strain CoDiRO from diseased plants (olive, oleander, etc.)**

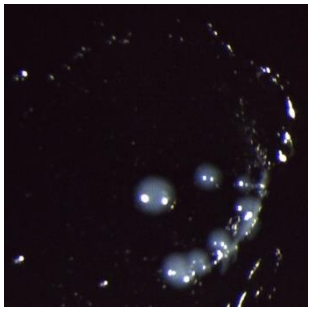
Collaboration with US and Brasilian researchers



Pathway of entry – potential host plants

A) Genetics





Isolation

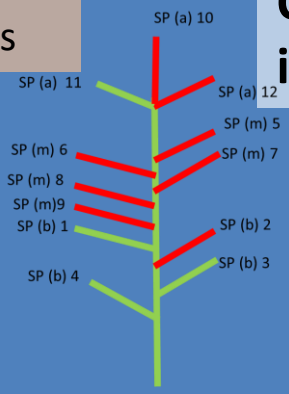
Critical research advances

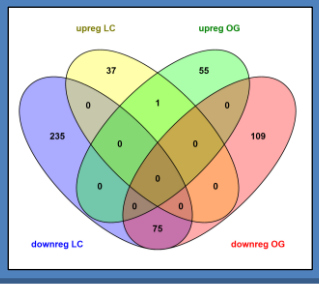
Reduce uncertainties for PRA

B) Host range and pathogenicity of the strain

Effective surveillance and containment strategies

C) Host-pathogen interactions





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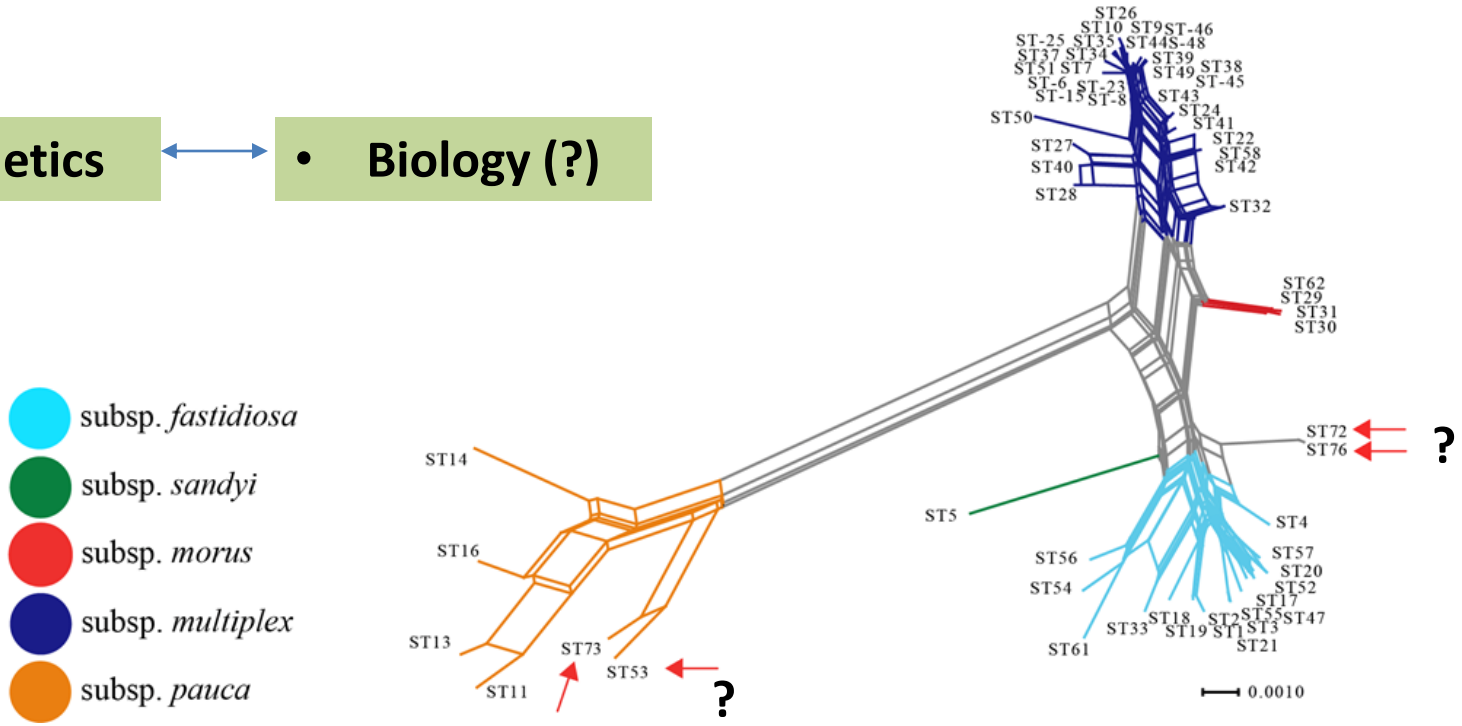
Recent interceptions in EU

MULTILOCUS SEQUENCE TYPING – MLST

- **Genetics** ⟷ **Biology (?)**



- There is also a significant amount of genetic diversity being introduced in EU
- There is still limited knowledge of phylogenetic and biological diversity of *X. fastidiosa*

Loconsole et al., 2016 - EJPP

X. fastidiosa - strain CoDiRO

ST53 – INFECTIONS ON OLEANDER AND COFFEE IN COSTA RICA (Nunney et al., 2014)

ST53 – INFECTIONS ON NEW XF HOST PLANTS IN APULIA

Assessment on the pathogenicity of Xf-CoDiRO

Experimental validation of the host range

Mechanical inoculation

Host plants
Olive (Coratina, Frantoio, Leccino, Cellina di Nardo', seedlings)
Oleander
Vitis vinifera (Cabernet Sauvignon)
Prunus spp (12 cultivars)
Polygala myrtifolia
Citrus *spp.*
Quercus *ilex*

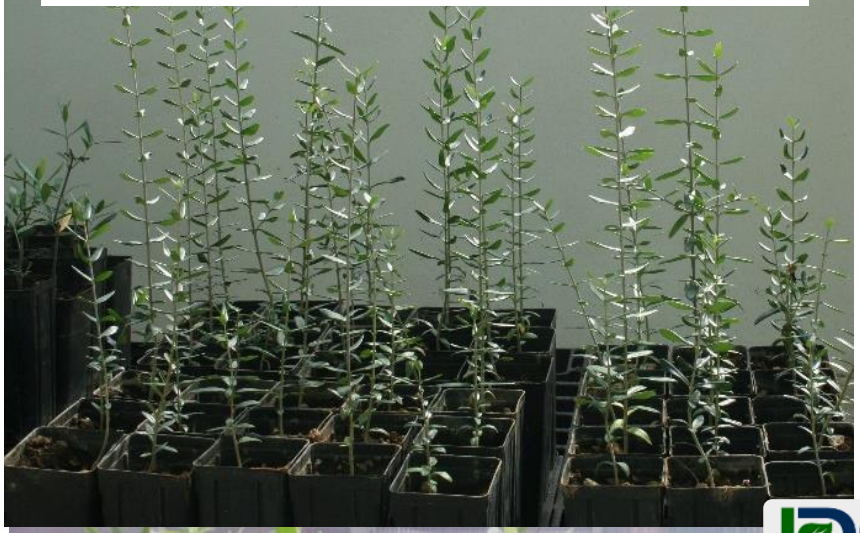
EFSA Pilot project on Xylella fastidiosa to reduce risk assessment uncertainties- NP/EFSA/ALPHA/2014/07)

efsa
European Food Safety Authority

Host range and pathogenicity of the CoDiRO strain

Olive - 4 cultivars

seedlings



Young grafted/self rooted plants

2-years old plants

Needle-inoculations

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Host range and pathogenicity of the CoDiRO strain

Tests were conducted with or without the control of the temperature

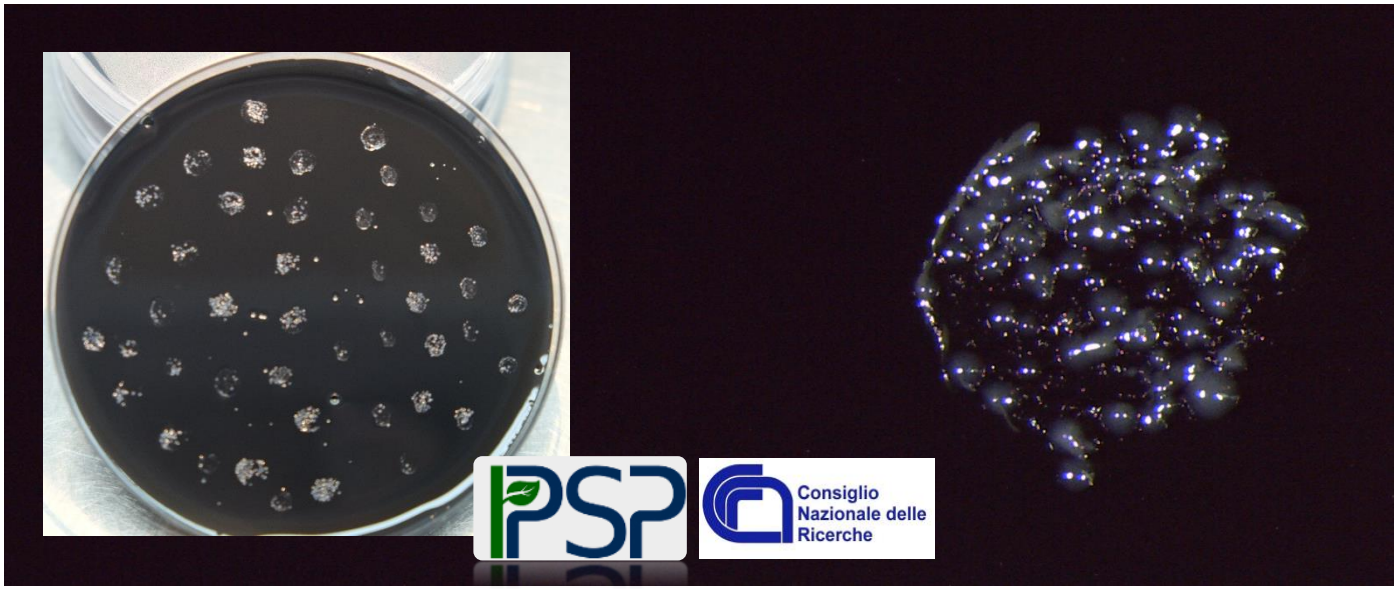
Green-house

Screen-house

RESULTS: Mechanical inoculations on olives

- Systemic infections √
- Symptoms √
- Re-isolation √
- Differential cultivar response √

- Temperature influence



Symptoms in the systemically infected plants (Cellina)

Symptoms in the systemically infected plants (Leccino)

18/2/2016

9/3/2016

Symptoms in the systemically infected plants (Leccino)

18/2/2016

25/2/2016

Symptoms started to appear in the distal portion of the inoculated shoot

Symptoms started to appear in the distal portion of the inoculated shoot

Symptoms in the systemically infected plants (Cellina)

8/1/2016

10/2/2016

Symptoms in the systemically infected plants

Cellina di Nardo’

Leccino

Symptoms in the systemically infected plants: difference in cultivar phenotype

Cellina di Nardo’

Leccino

Symptoms in 2-years old Cellina (8 mo. p.i)

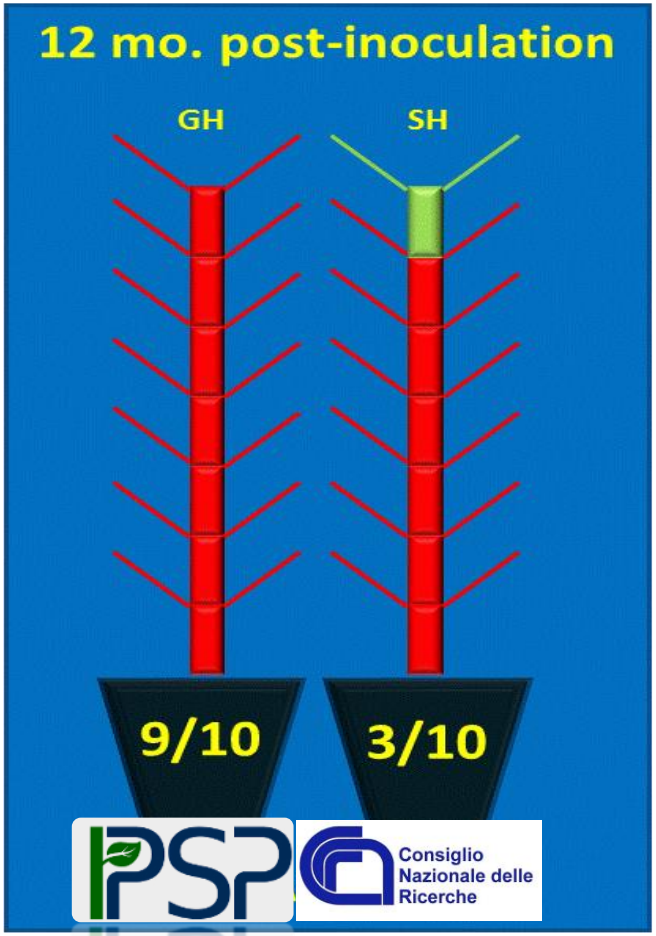
Symptoms in 2-years old Cellina (8 mo. p.i)

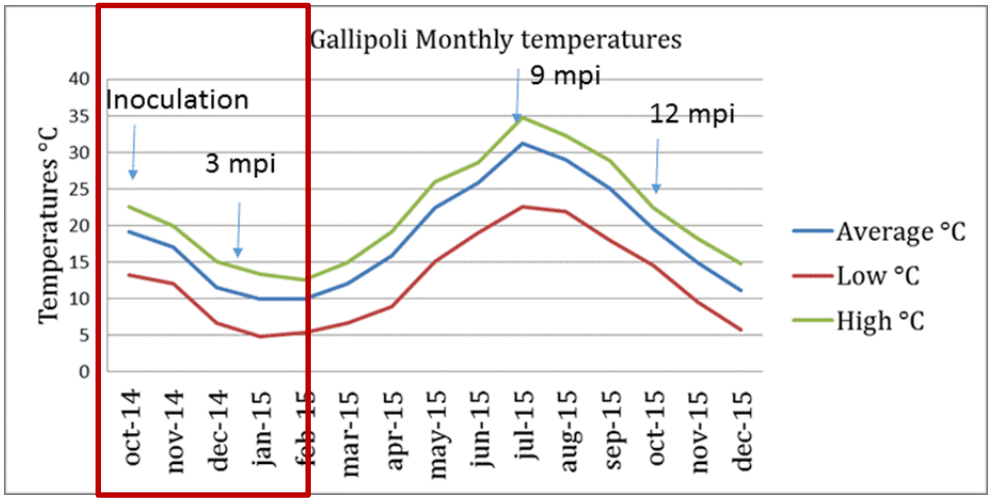
Symptoms in 2-years old Cellina (8 mo. p.i)

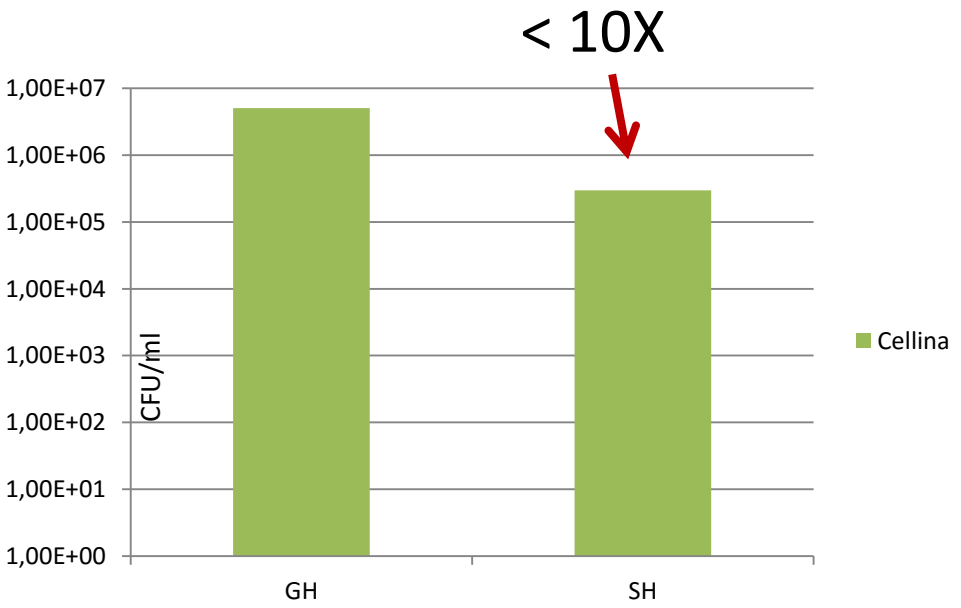
Comparative tests in greenhouse - GH (26-30C) and screenhouse - SH

Results for the Cellina di Nardò

Low rate of systemic infections (3/10)
No symptoms developed yet







RESULTS: Mechanical inoculation on oleander

10/10 plants successfully infected

RESULTS: Mechanical inoculation on *Polygala myrtifolia*

5-6 mo.p.i

12-14 mo.p.i

Symptoms in systemically infected *Polygala myrtifolia*

Non-inoculated controls

Mechanical inoculations
Vitis vinifera and *Quercus ilex*

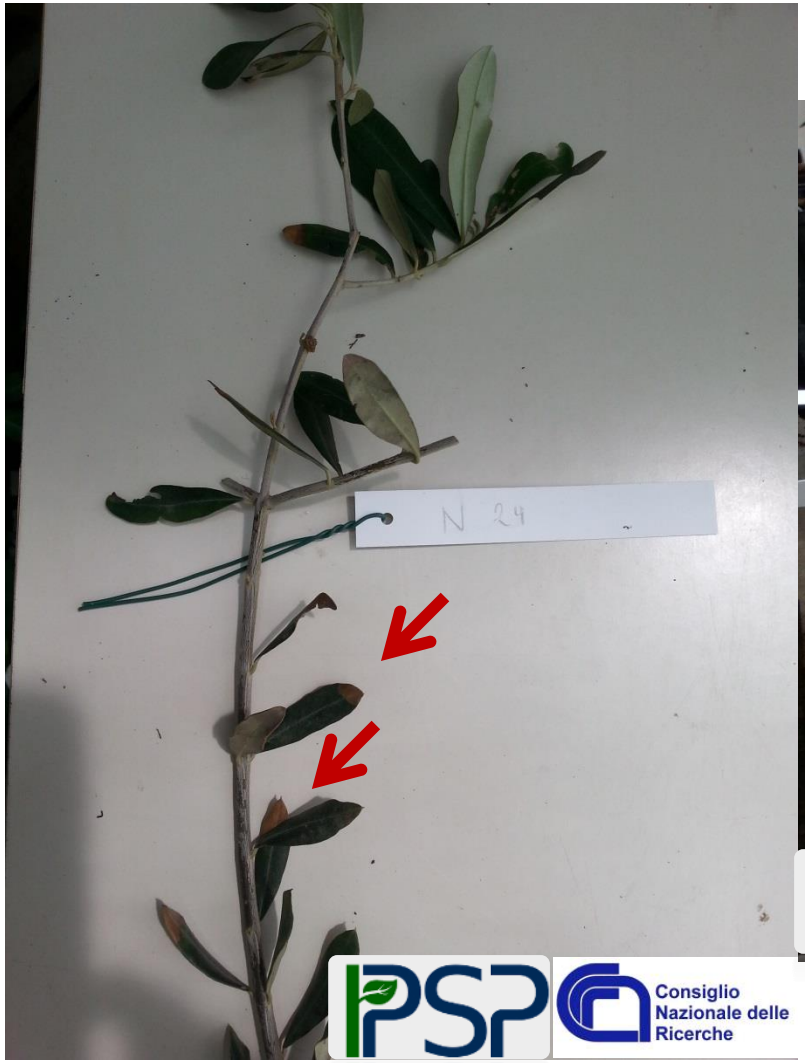
No systemic infections detected
No re-isolation
No symptoms

Mechanical inoculations
Citrus spp.

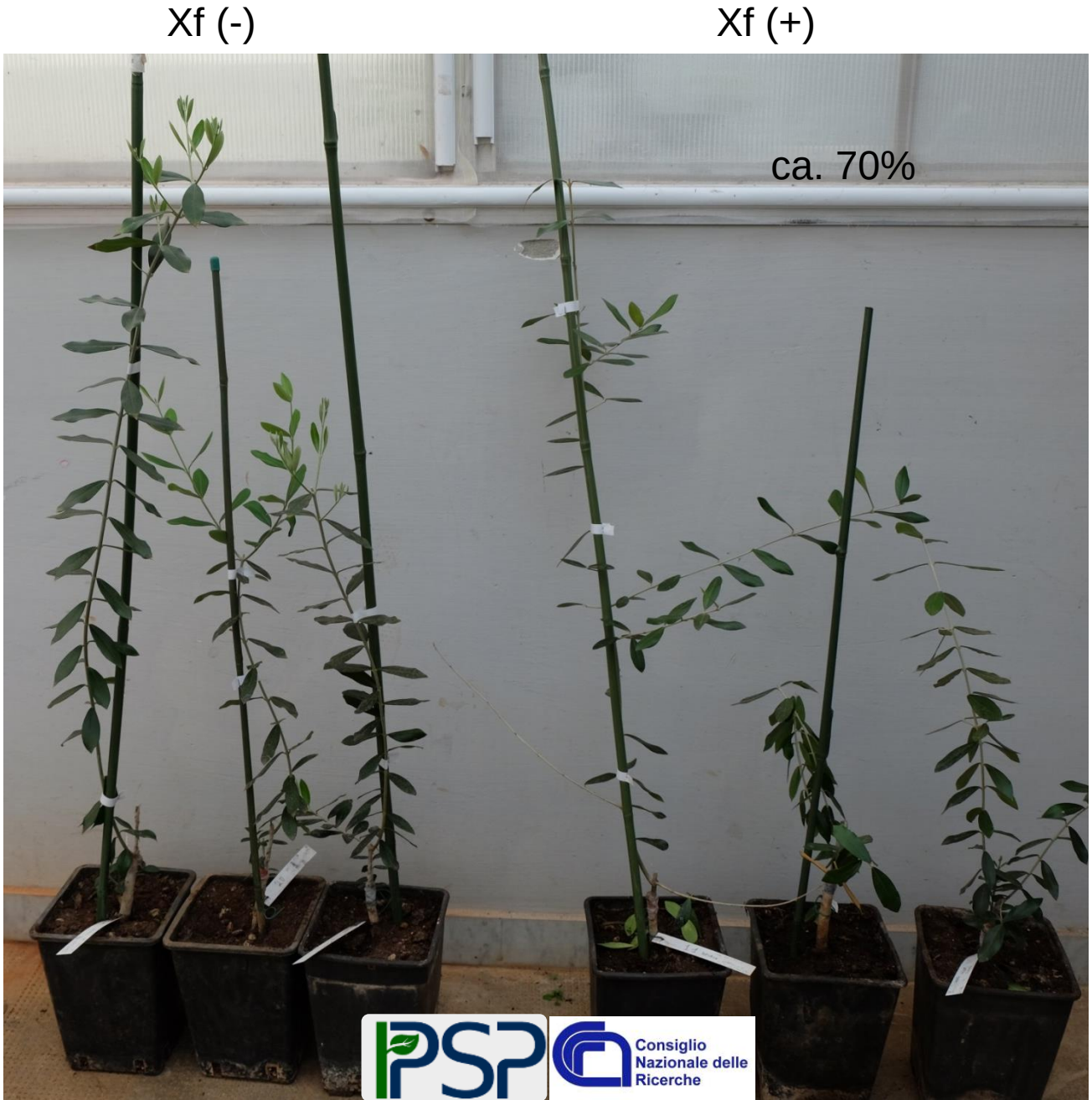
Coffee strain ↔ CVC strain

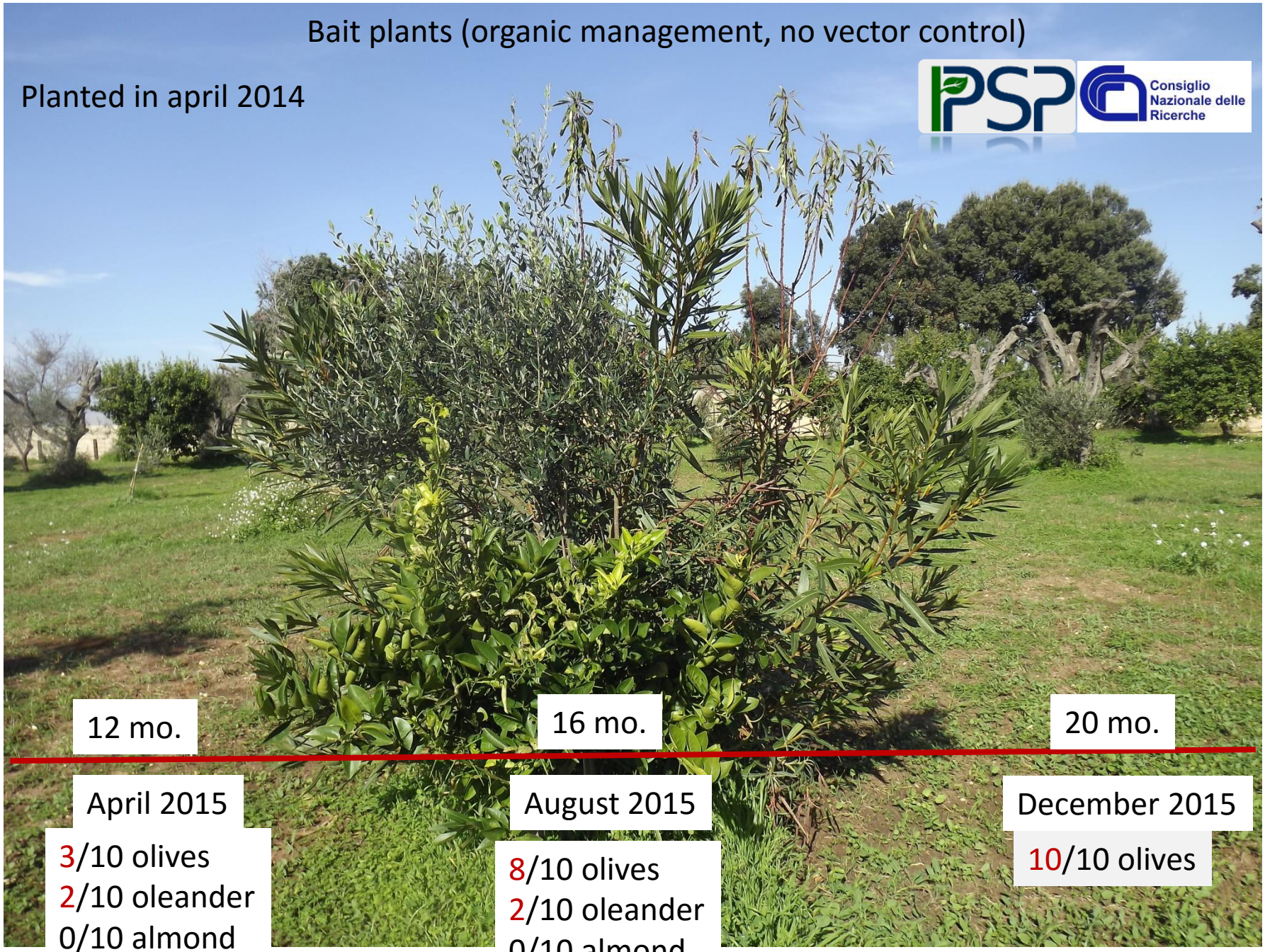
No systemic infections detected
No re-isolation
No symptoms

Graft-transmission (scions from field infected trees grafted on Xf-free rootstocks)

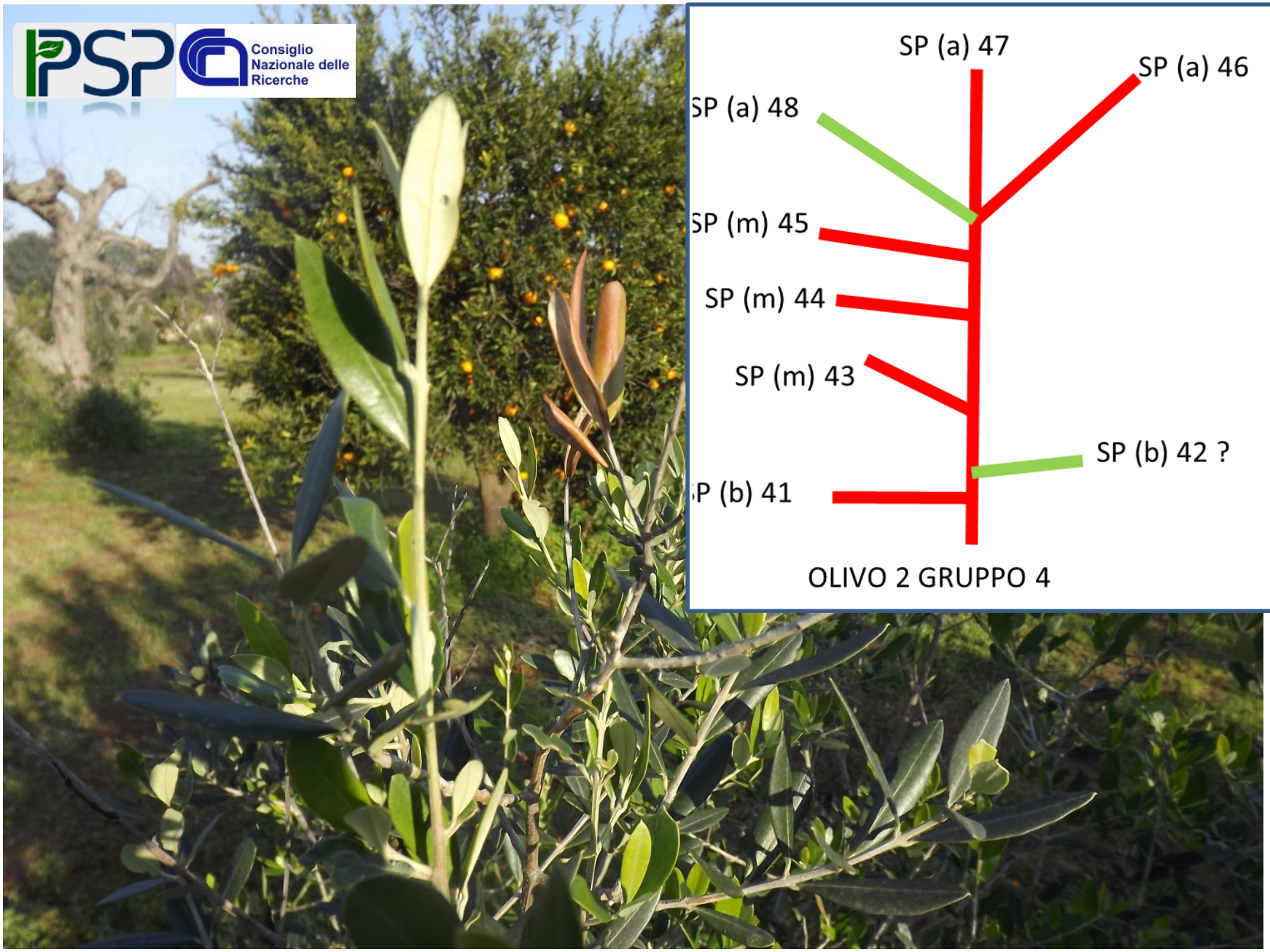


Graft-transmission (scions from field infected trees grafted on Xf-free rootstocks)




Bait plants (organic management, no vector control)
Planted in april 2014
Consiglio Nazionale delle Ricerche
12 mo.
16 mo.
20 mo.
April 2015
3/10 olives
2/10 oleander
0/10 almond
0/10 citrus
August 2015
8/10 olives
2/10 oleander
0/10 almond
0/10 citrus
December 2015
10/10 olives

December 2015 (20 mo. after planting)



10 Olive cultivars planted in April 2015

9 months after planting (exposed for one season to infective vectors + caged vectors)

Symptomless

Species	Cultivar	Positive/total	% Positive
Olea europaea	Arbequina	14 / 23	60,87
Olea europaea	Arbosana	14 / 24	58,33
Olea europaea	Cellina di Nardò	14 / 24	58,33
Olea europaea	Cima di Melfi	13 /24	54,17
Olea europaea	Coratina	9/ 18	50,00
Olea europaea	Frantoio	9/ 24	37,50
Olea europaea	Koroneiki	16 /23	69,57
Olea europaea	Leccino*	4 / 24	16,67
Total for olives		91 / 186	**48,92**
Prunus dulcis	Supernova, Tuono	0/12	0,00
Prunus avium	Ferrovia, Bigarraeu Moreau	1/ 12	8,30
Citrus sinensis	Navellina	0/24	0,00
Quercus ilex		0/ 12	0,00
Nerium oleander		**3 / 18**	**16,67**
Polygala myrtifolia		**5 /13**	**38,46**
Vitis vinifera	Negramaro, Chardonnay, Italia, Primitivo	0 /45	0,00

Overall results in GH and field experiments

- Olives, oleander and myrtle-leaf milkwort do support systemic infections of *X. fastidiosa* subsp. *pauca* strain CoDiRO; The mechanical inoculated plants showed symptoms resembling those observed in the field **So far Cellina di Nardo' has been identified has the most susceptible cultivar**
- Young plants of olives exposed to natural infections: 100% were infected after 2 seasons of exposure to infective vectors
- **Under field condition, young olive plants started to show symptoms after 16-18 months from planting (exposed for 3 season to infective vectors).**
- Oleander is the host species that was more efficiently and rapidly colonized upon mechanical inoculation, the bacterium was consistently detected in the roots
- ***P. myrtifolia*** **was the host plant associated with rapid symptom development and high natural transmission by vectors occured**

Major outcome of the studies on the biology

- **Bacterium** + **Olives** → **Symptoms**

"Key tool" for implementing any effective strategies for reducing the impacts of the bacterial infections

- **Studies of differential olive cultivar-response to infections**
- **NAC applications**
- **Nanoparticles and other formulations**
- **DSF - Virus-mediate expression of *rpfF* genes**
- **Bacteriophages**

Research collaborations

UC BERKELY – California Prof. Almeida – Prof. Purcell – Prof. Lindow

Vector transmission, genetics and DSF

Brasil - Dr. Helvecio della Coletta Filho and A. De Souza

Biology, CoDiRO-GFP-mutant, resistance/tolerance, NAC

California - Dr. R. Yokomi, Dr. R. Krugner, Dr. E. Civerolo

Vectors, diagnosis

University of Turin- Prof. D. Bosco

Vector transmission and ecology

UNIVERSITA DEGLI STUDI DI TORINO

Acknowledgment

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