



Food and Agriculture
Organization of the
United Nations



ورشة عمل خطط الطوارئ كتمرين محاكاة عملي

Contingency Exercise Workshop

Xylella fastidiosa

Hammamet, Tunisia, 26 – 28 May 2025

The BeXyl Project

Juan A. Navas-Cortés



An EU funded research project to
move Beyond the *Xylella* emergency
in Europe



Funded by
the European Union



Scope of the call: key elements

Multi-actor Approach

Understand drivers of
spread & establishment
including Climate
Change

Develop effective
surveillance methods
and strategies for early
detection

Target EU quarantine/priority pest
Present or not in the EU
Affecting agriculture and/or Forestry
Xylella fastidiosa

Develop economically
& environmentally
friendly sound solutions
(biocontrol) and IPM

Analyse social,
economical and
ecological impact of
spread & establishment

International cooperation with
affected countries

Beyond Xylella, integrated strategies for mitigating *Xylella fastidiosa* impact in Europe (BeXyl)

Who we are?

31 partners from 14 countries

| | | | | | |
|--|--|--|---|---|--|
|  <p>institut valenciano de investigaciones agrarias IVIA - Instituto Valenciano de Investigaciones Agrarias https://ivia.gva.es</p> |  <p>UNIVERSIDAD DE CORDOBA UCO - Universidad de Córdoba https://www.uco.es</p> |  <p>UdG - Universidad de Girona https://www.udg.edu/ca/</p> |  <p>Consiglio Nazionale delle Ricerche CNR - Consiglio Nazionale delle Ricerche https://www.cnr.it/</p> |  <p>UNITO - Università di Torino https://www.unito.it/</p> |  <p>UNIVERSITÀ DEGLI STUDI DI BRESCIA UNIBS - Università degli Studi di Brescia https://agrofood.unibs.it/</p> |
|  <p>INRAE - Institut National de Recherche pour l'Agriculture, l'Alimentation et l'Environnement https://www.inrae.fr/</p> |  <p>AUBURN AGRICULTURE AU - Auburn University https://auburn.edu/about/</p> |  <p>UC - University of California berkeley.edu</p> |  <p>ARO VOL - Agricultural Research Organization Volcani Institute https://www.volcani.institute.info</p> |  <p>LMU-Ludwig Maximilian Universität München https://www.lmu.de</p> |  <p>AIT Austrian Institute of Technology https://www.aict.ac.at</p> |
|  <p>NIB - Nacionalni Institut za biologijo https://www.nib.si/</p> |  <p>APTA IAC - Agência Paulista de Tecnologia dos Agronegócios-Instituto Agronômico http://www.apta.sp.gov.br/</p> |  <p>UCR - Universidad de Costa Rica - Center for Research in Tropical Diseases https://www.ucr.ac.cr/</p> |  <p>CRSFA - Centro Ricerca Sperimentazione e Formazione in Agricoltura https://www.crsfa.it/</p> |  <p>IFAPA - Instituto de Investigación y Formación Agraria https://www.unibacardaluca.es/agricultura-y-forestal/ifapa/invest/en</p> |  <p>ENA - European Nurserystock Association https://www.enaplants.eu/</p> |
|  <p>EPPD - European and Mediterranean Plant Protection Organization https://www.eppo.int/</p> |  <p>IRFAP - Institut de recerca i formació agrària i pesquera https://irfap.es/</p> |  <p>ACIES BIO https://www.aciesbio.com/</p> |  <p>RG Projects https://www.rg-projects.es/en/</p> |  <p>UNAPROL https://www.unaprol.it/</p> |  <p>AIBE https://www.agromillora.com/</p> |
|  <p>SMS - Surrender Media Solutions https://www.surrendermedia.com/</p> |  <p>INTA https://www.argentina.gob.ar/inta</p> |  <p>JRC - Joint Research Centre - European Commission https://joint-research-centre.ec.europa.eu</p> |  <p>UOM - University of Melbourne https://www.unimelb.edu.au/</p> |  <p>FCRA - Forest Research https://www.forestresearch.gov.uk/</p> |  <p>BGCI - Botanic Gardens Conservation International bgci.org</p> |

Beyond *Xylella*, integrated strategies for mitigating *Xylella fastidiosa* impact in Europe (BeXyl)

28 Beneficiaries from 142 countries:

Xf present:

Argentina, Brazil, Costa Rica, USA, France, Italy, Spain /// Israel

Xf absent:

Slovenia, Austria, Belgium, Germany

3 Associated Partners:

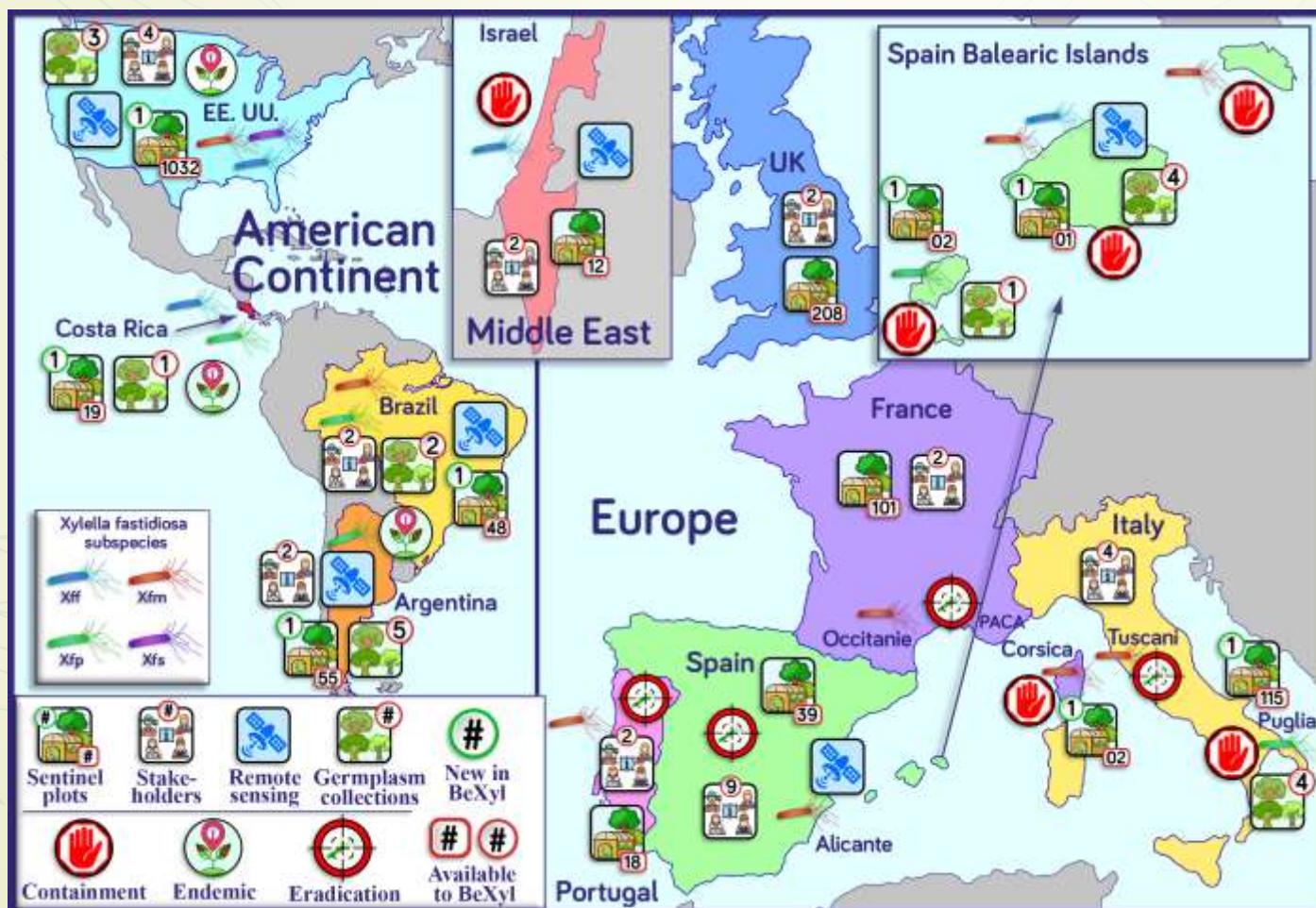
Xf absent:

UK, Australia

Coordinator



Blanca B. Landa



4 years
(September 2022-
August 2026)
7 million €

Beyond *Xylella*, integrated strategies for mitigating *Xylella fastidiosa* impact in Europe (BeXyl)

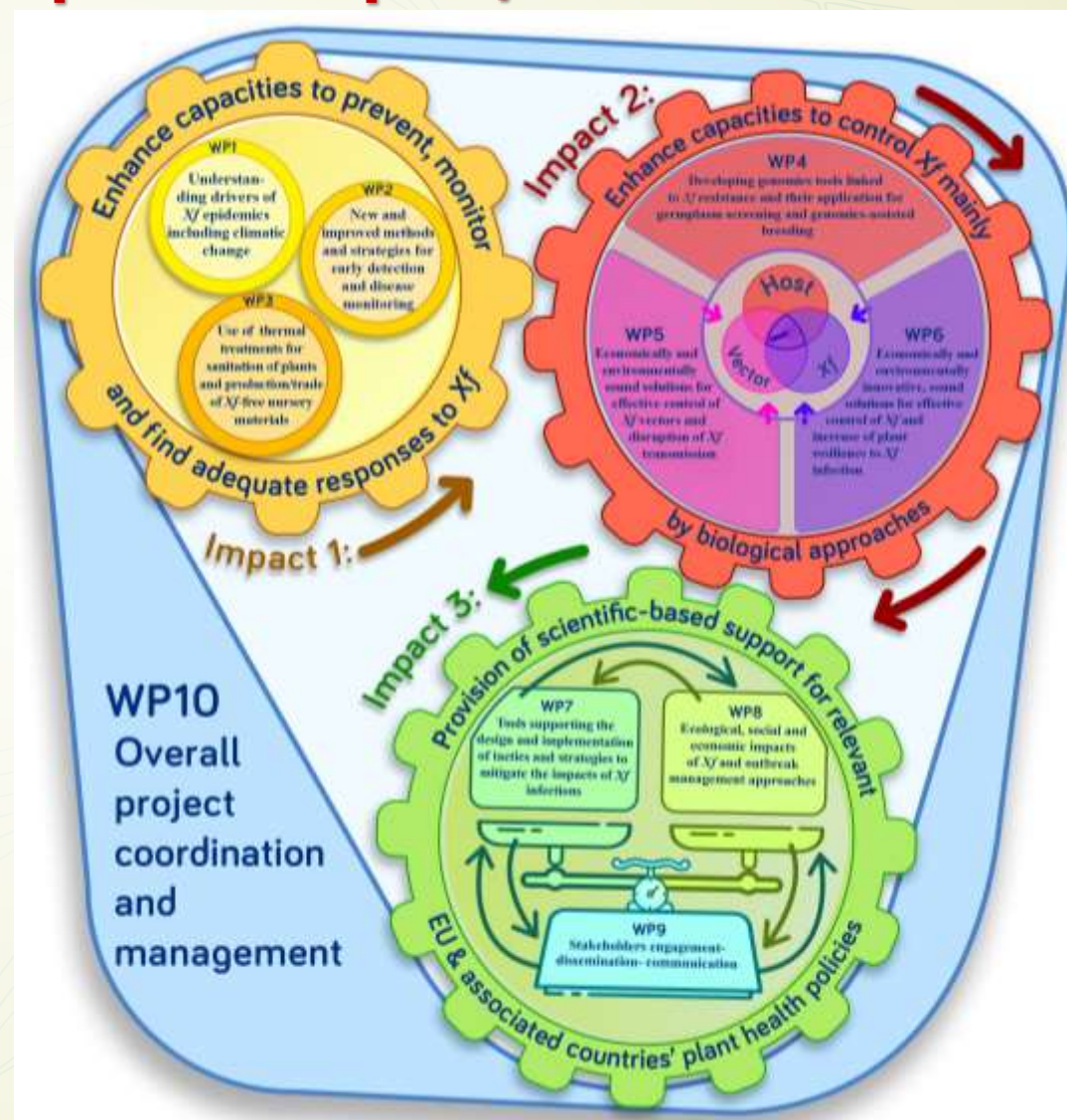
Project WorkPlan vs Expected Impact/Outcome

BeXyl final aim is to better tackle new *X. fastidiosa* introductions in Europe and to develop and implement tailored Integrated Pest Management (IPM) strategies to mitigate the impacts of current outbreaks, helping the agricultural and forestry sectors to remain productive and sustainable at long-term

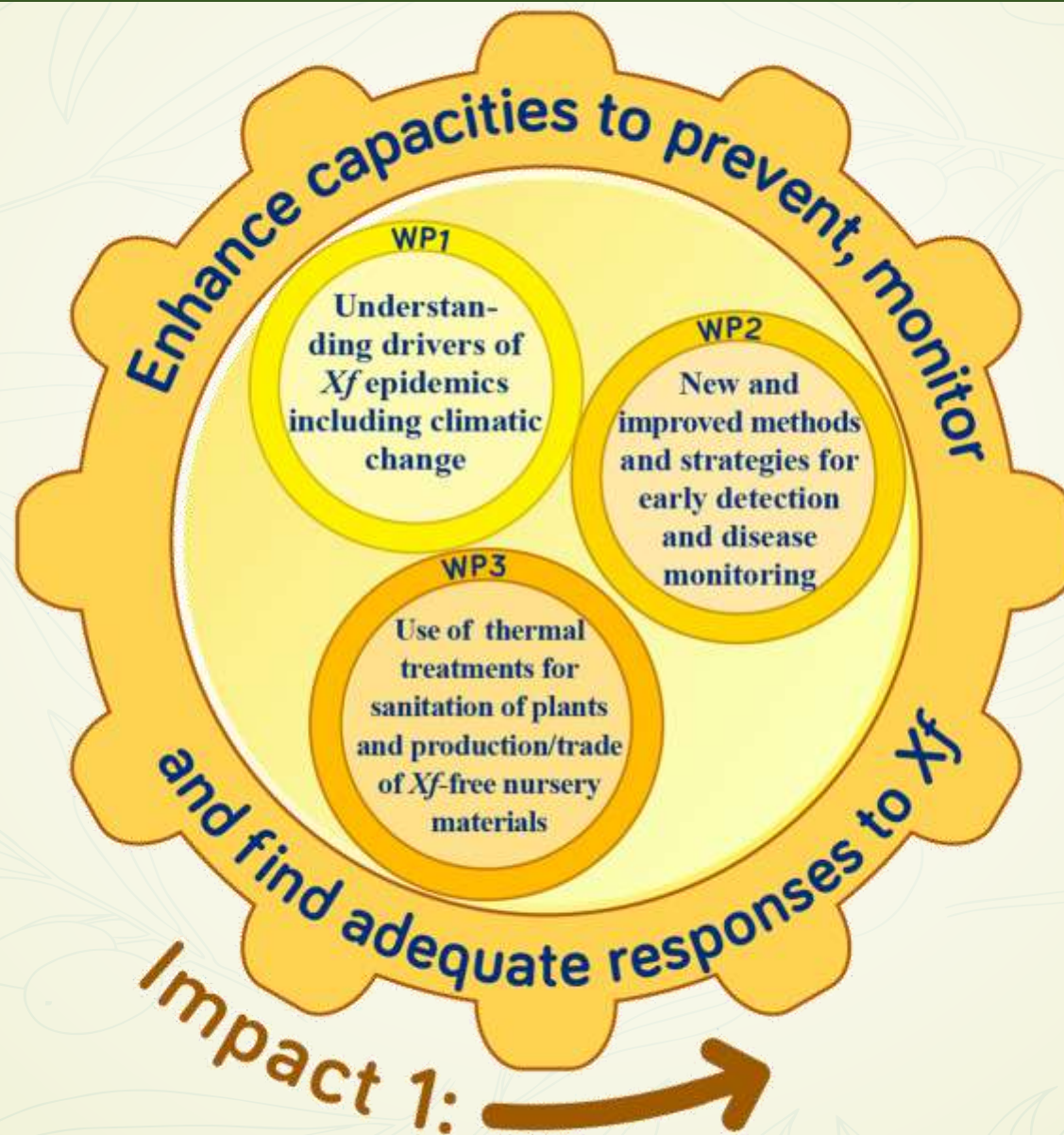


Olive Quick Decline
a priority

...
Other crops,
ornamental
and forestry
plants



Beyond *Xylella*, integrated strategies for mitigating *Xylella fastidiosa* impact in Europe (BeXyl)



Enhance capacities to prevent, monitor and find adequate responses to Xf

WP1

Understanding drivers of Xf epidemics including climatic change

WP2

WP3

- Sentinel plots across Europe and the Americas: Apulia (Italy), Corsica (France), Mallorca (2) and Córdoba (Spain), Alabama (USA), Minas Gerais (Brazil), San José (Costa Rica), La Rioja (Argentina), (Portugal) with a standardized design to monitor *X. fastidiosa* across different ecological settings.



- Participation confirmed from BGs in: Brazil, Colombia, Ecuador, Guatemala, Argentina

Strain **Subsp.** **ST**

| | | |
|----------------|-------|----|
| XYL1961 | pauca | 80 |
| CoDiRo | pauca | 53 |

Inoculation points (IP) **A (5-10 cm from IP)** **B (15-20 cm from IP)**

➤ **Monitoring pathogenicity and colonization of Xf strains**

➤ **Sampling of stem of 3 months post inoculation**

Further positive forestry plant 3 months after inoculation

| Species | XYL1961 | CoDiRo | Uninoculated |
|-----------------------|---------|--------|--------------|
| Jumperus sp. | ~10 | ~15 | ~10 |
| Quercus flex | ~10 | ~15 | ~10 |
| Fraxinus angustifolia | ~10 | ~15 | ~10 |

Uninoculated plants

| Species | XYL1961 | CoDiRo | Uninoculated |
|-----------------------|---------|--------|--------------|
| Jumperus sp. | ~10 | ~15 | ~10 |
| Quercus flex | ~10 | ~15 | ~10 |
| Fraxinus angustifolia | ~10 | ~15 | ~10 |

Positive **Negative**

- Vector studies mainly aimed to understand transmission dynamics

1d. Field surveys of insect vectors in Israel

- Potential vectors search - **4 species** found in Israel

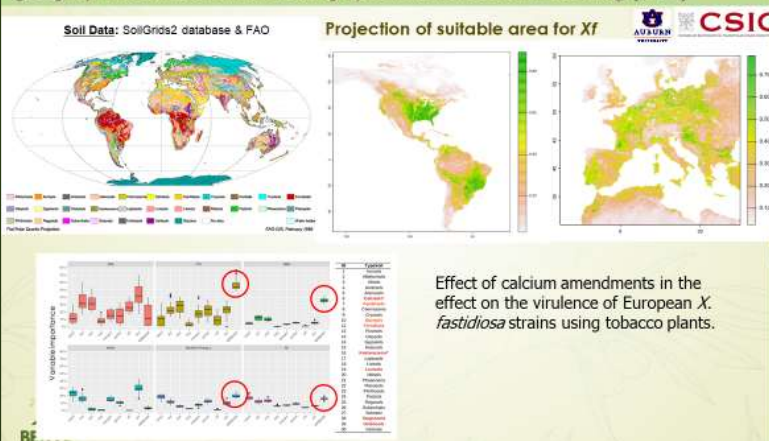


1e. Field surveys of insect vectors in Argentina

- Identification of potential Xf vectors and transmission experiments



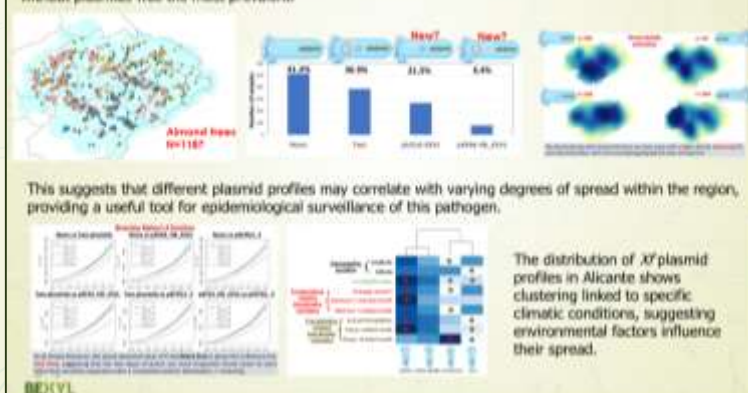
Unraveling at global scale the role of soil edaphic properties and soil type on geographic distribution of *Xf* using Species Distribution Modeling (SDM)



Effect of calcium amendments in the effect on the virulence of European *X. fastidiosa* strains using tobacco plants.

Use of plasmid profiles in epidemiological surveillance of *Xf* outbreak in the Valencian Community, Spain.

The analysis of 1,239 plant samples across 20 different host species revealed that the XF genotype without plasmids was the most prevalent.



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Task 1.3. Population biology and genomics of *Xf*: Traits and host adaptation

➤ **Genome sequencing activities:** Isolation of new strains from diverse hosts in Israel, USA, Costa Rica, Argentina and Spain. Using both long- and short-read DNA sequencing allowed obtaining about 400 *Xf* genomes.

Studies on natural competence involved the use of 200 *Xf* strains.



➤ **Population biology studies:** Focused on identifying traits linked to climate and host adaptation, by analyzing the genetic diversity of *Xf* across South, Central and North America.



New *Xf* outbreak in Spain affecting olive

- January 2024. Sencelles, Mallorca island, identified by MLST as *X. fastidiosa* subsp. *pauca* ST53
- Detected in olive and wild olive, oleander, lavender and *Rhamnus alaternus*
- Limited distribution
- At to December 2024: 264 positives (60% *pauca*)
- 10% coinfection *pauca*/multiplex
- 0,4% coinfection *pauca*/*fastidiosa*



Task 1.4. Host-pathogen-vector interaction of relevant *Xf* strains under current & future changing climate

Task 1.4.1. Unraveling host-pathogen interactions of relevant *Xf* strains and host species under changing temperature, CO₂ and water regimes

To study the response of an artificial *Xf* infection (*Xf* subsp. *fastidiosa* ST1) in grapevine to two climate change scenarios

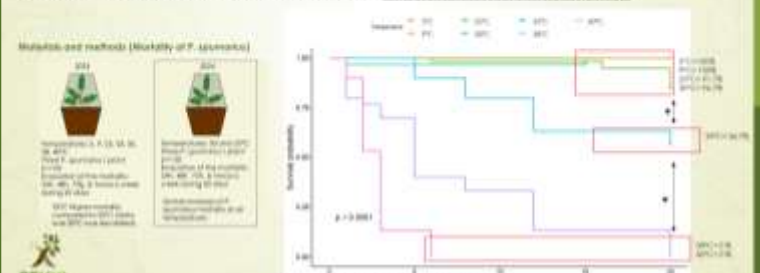
- 3 levels of CO₂: 400, 550, 750 ppm
- 3 Temperature: 24, 28, 32 °C
- 2 level of irrigation → Field capacity and half
- qPCR to detect the bacteria
- Leaves at 2 months after inoculation

| P. OB | Cultivar | Irrigation | Frequency | Mean of detection (%) | Mean of detection (%) |
|--------|-----------------|------------|-----------|-----------------------|-----------------------|
| 30-150 | Sauvignon blanc | 100% | 75 | 79.3 | |
| | | 50% | 82% | 75 | 79.3 |
| | | 25% | 100% | 100 | 81.3 |
| | Syrah | 100% | 100 | 100 | 86.1 |
| | | 50% | 100% | 100 | 86.1 |
| | | 25% | 100% | 100 | 86.1 |
| 27-100 | Sauvignon blanc | 100% | 75 | 79.3 | |
| | | 50% | 82% | 75 | 79.3 |
| | | 25% | 100% | 100 | 81.3 |
| | Syrah | 100% | 100 | 100 | 86.1 |
| | | 50% | 100% | 100 | 86.1 |
| | | 25% | 100% | 100 | 86.1 |
| 34-400 | Sauvignon blanc | 100% | 100 | 100 | 86.1 |
| | | 50% | 100% | 100 | 86.1 |
| | | 25% | 100% | 100 | 86.1 |
| | Syrah | 100% | 100 | 100 | 86.1 |
| | | 50% | 100% | 100 | 86.1 |
| | | 25% | 100% | 100 | 86.1 |

Task 1.4.2. The impact of temperature changes on vector-transmission and spread of *Xf*

Impact of different temperatures on survival of *Philaenus spumarius*

- Temperature significantly impacts the survival of *P. spumarius*:
- Survival drops sharply as temperatures increase.
- Cooler temperatures (5°C–30°C) maintain high survival rates
- Survival is reduced to 57% at 35°C and no survival at 38°C and 40°C



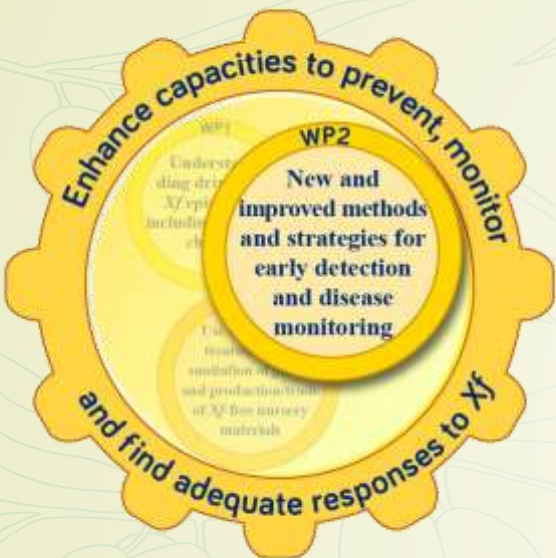
Task 1.4.2. The impact of temperature changes on vector-transmission and spread of *Xf*

To determine how varying low temperatures affect *Xylella fastidiosa* acquisition and transmission in olives by examining bacterial multiplication, gene expression, and potential molecular adaptations, with plans to extend testing to additional species or olive cultivars.


- Exposure of *Xfp*-ST53-infected olives to different range of temperatures to assess the impact on:
 - Bacterial multiplication and molecular pathways
 - Acquisition/transmission efficiency
- Experiments will focus on low temp → influence on acquisition/transmission
- Extend the trial to at least one more species or olive cultivar (to be defined based on infected sources available)
- Investigate the molecular changes occurring on the bacterial side: changes in the expression of key genes involved in its multiplication and transmission (cell adhesion/attachment: i.e. *csp1*; *pil*, *fim*, *hsl*, *xad*, but also *cvac*)



Beyond *Xylella*, integrated strategies for mitigating *Xylella fastidiosa* impact in Europe (BeXyl)

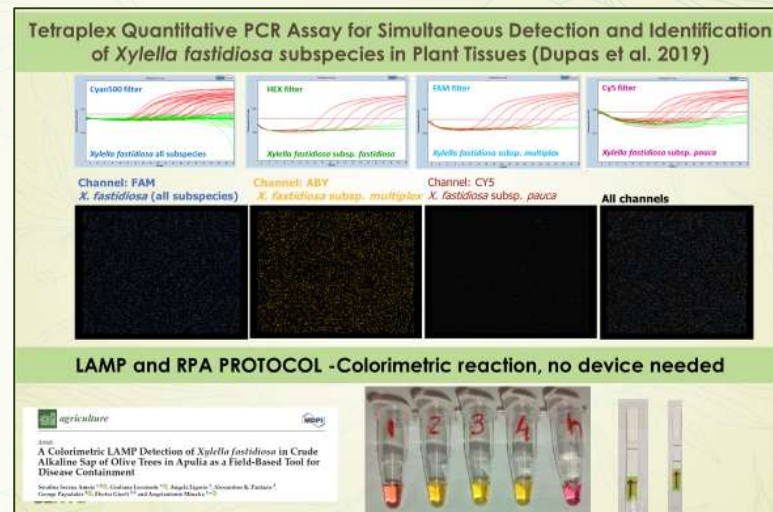


Task 2.1. Black light traps to collect adults of *P. spumarius* and estimate *Xf* infection status




- **Black light traps** with a wavelength of **365 nm** (2023) and **415 nm** (2024)
Associated with:
 - **yellow** (1) (2023-2024)
 - **tin foil** (2) (2024) and **sticky traps**
 - **Sticky traps** (3) without light source, used as control (2023-2024).

Task 2.2. Molecular approaches for quantification, typing and in situ detection of *Xf*



Task 2.4. Early-stage plant phenotyping of asymptomatic *Xf* infections



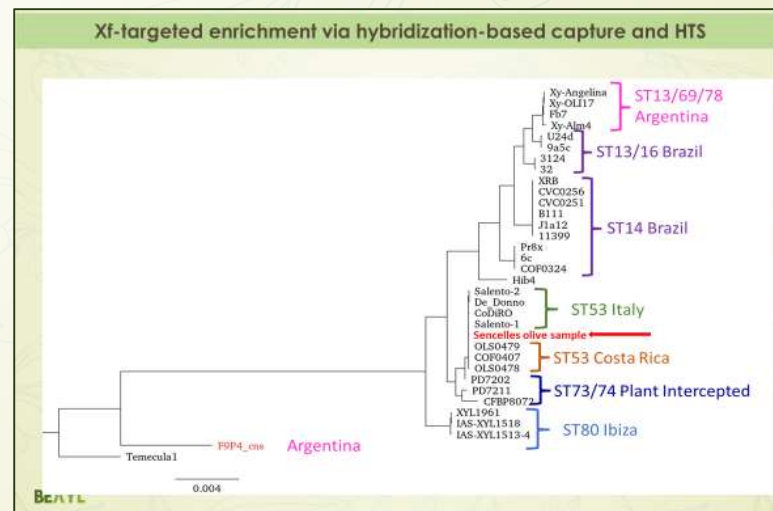
01 Prepare facilities and equipment **02 Capture of hyperspectral imaging** **03 Image preprocessing** **04 Feature extraction and spectral analysis** **05 Data analysis** **06 Interpretation of results** **07 Visualization and decision making**

01 Hyperspectral scanning sensor VNIR range (400-1000 nm) 271 bands/3.5 mm/pixel

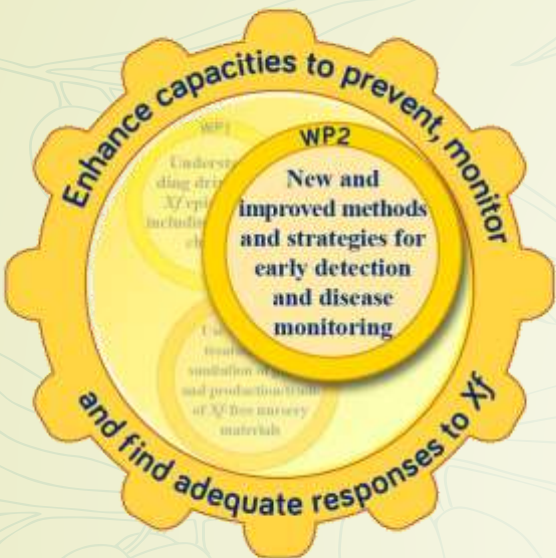
| 02 Host | Cultivars | Xf strains | Images | Time (months) |
|----------------------|-----------|------------|--------|---------------|
| <i>Olea europaea</i> | 11 | 3 | 316 | 12 |

03 i. Hyperspectral image calibration
ii. Spectral resampling

04 i. Creation of regions of interest (ROIs)
ii. Application of supervised neural algorithm
iii. Extraction of vegetation spectral signatures per olive plant



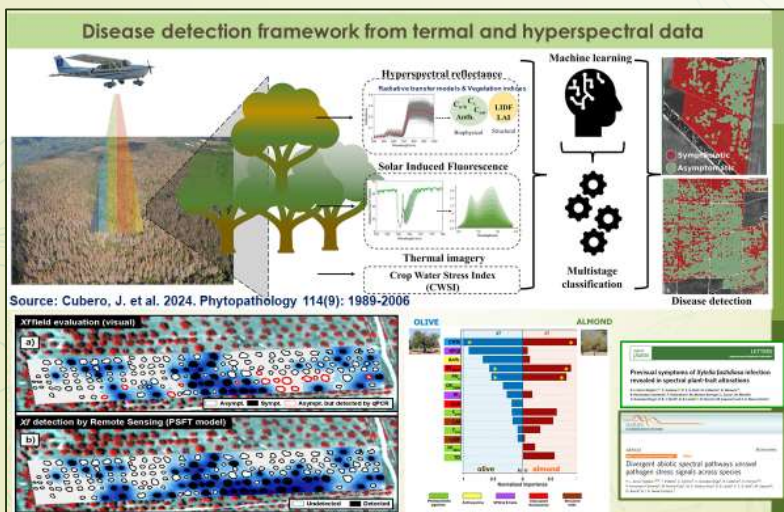
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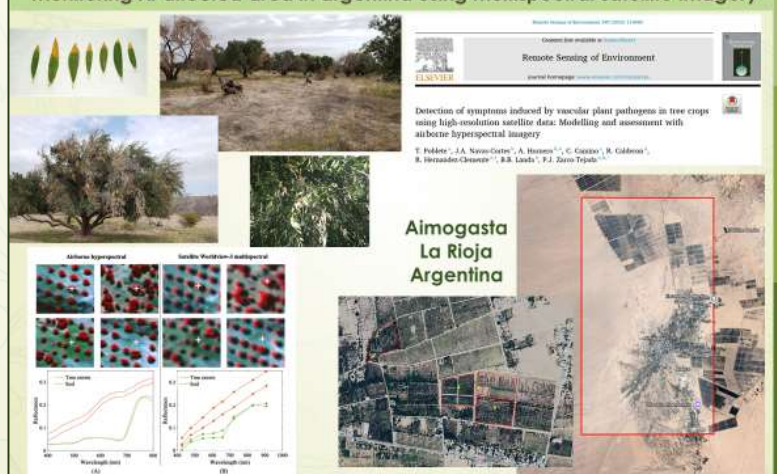
Task 2.6. Use of canine olfactory detection of *Xf* at inspection ports, nursery and field scale



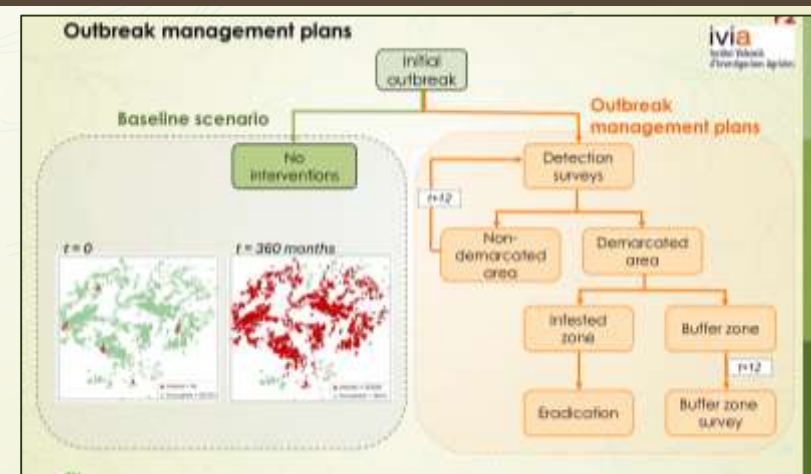
Task 2.5. Global model for *Xf* detection and monitoring using remote sensing



Monitoring Xf affected área in argentina using multispectral satellite imagery

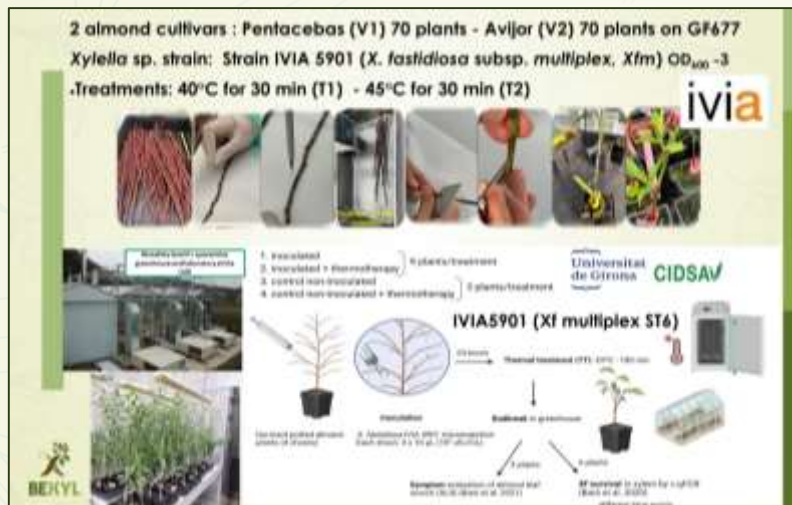
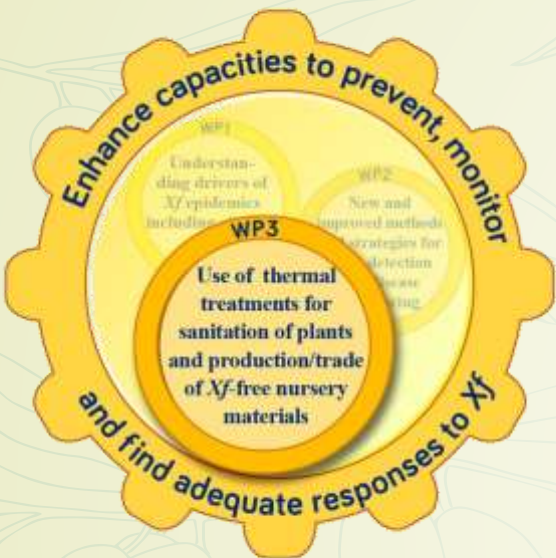


Task 2.7. Development of optimized statistical designs for surveillance of X_f and its vectors



Beyond *Xylella*, integrated strategies for mitigating *Xylella fastidiosa* impact in Europe (BeXyl)

Task 3.1. Efficacy of different TT protocols on the viability of Xf in vitro and in planta



The trees HW treated in 2023 were grown for phenological observation and detection of potential epigenetic modifications

Almond

| | # trees | T °C | t min |
|------------|---------|-------|--------|
| AVJLOR | 5 | 50 °C | 40 min |
| PENTACEBAS | 5 | 45 °C | 40 min |
| VIALFAS | 5 | 45 °C | 30 min |
| ISABELONA | 5 | 45 °C | 30 min |
| | 5 | 40 °C | 30 min |

Olive

| | # trees | T °C | t min |
|-----------|---------|-------|--------|
| KORONEIO | 5 | 50 °C | 30 min |
| ARBOSSANA | 5 | 40 °C | 40 min |
| ARBEQUINA | 5 | 40 °C | 30 min |
| LECCIANA | 5 | 40 °C | 30 min |
| FLORENTIA | 5 | 34 °C | 40 min |

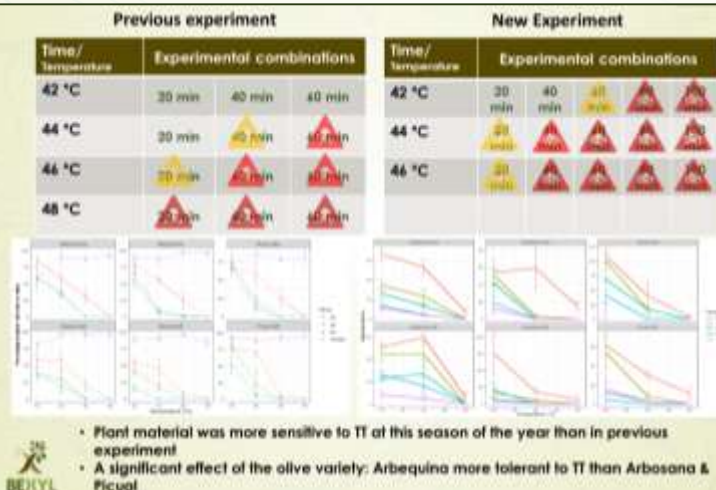


Task 3.2. Evaluation of TTs on the viability of olive propagating planting materials

- Experiments were conducted with commercial and prototype HWT equipment on 7 evergreen/deciduous species: *Olea europaea*, *Prunus dulcis*, *P. avium*, *P. persicae*, *Morus alba*, *Junglans regia*, *Ficus carica*.
- Experiments used different propagating materials: buds for grafting, canes for rooting, whole plants for planting ready for the market.



EPFA protocol for *Vitis vinifera* 50°C for 45' lethal for the majority of spp. tested

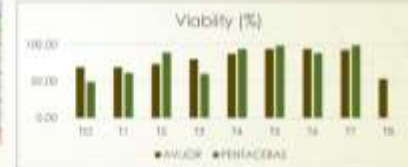


Task 3.3. Large-scale use of sustainable-TT at nursery/quarantine level and drafting of official standards

HWT Almond: Increase times at 45°C and test higher T°

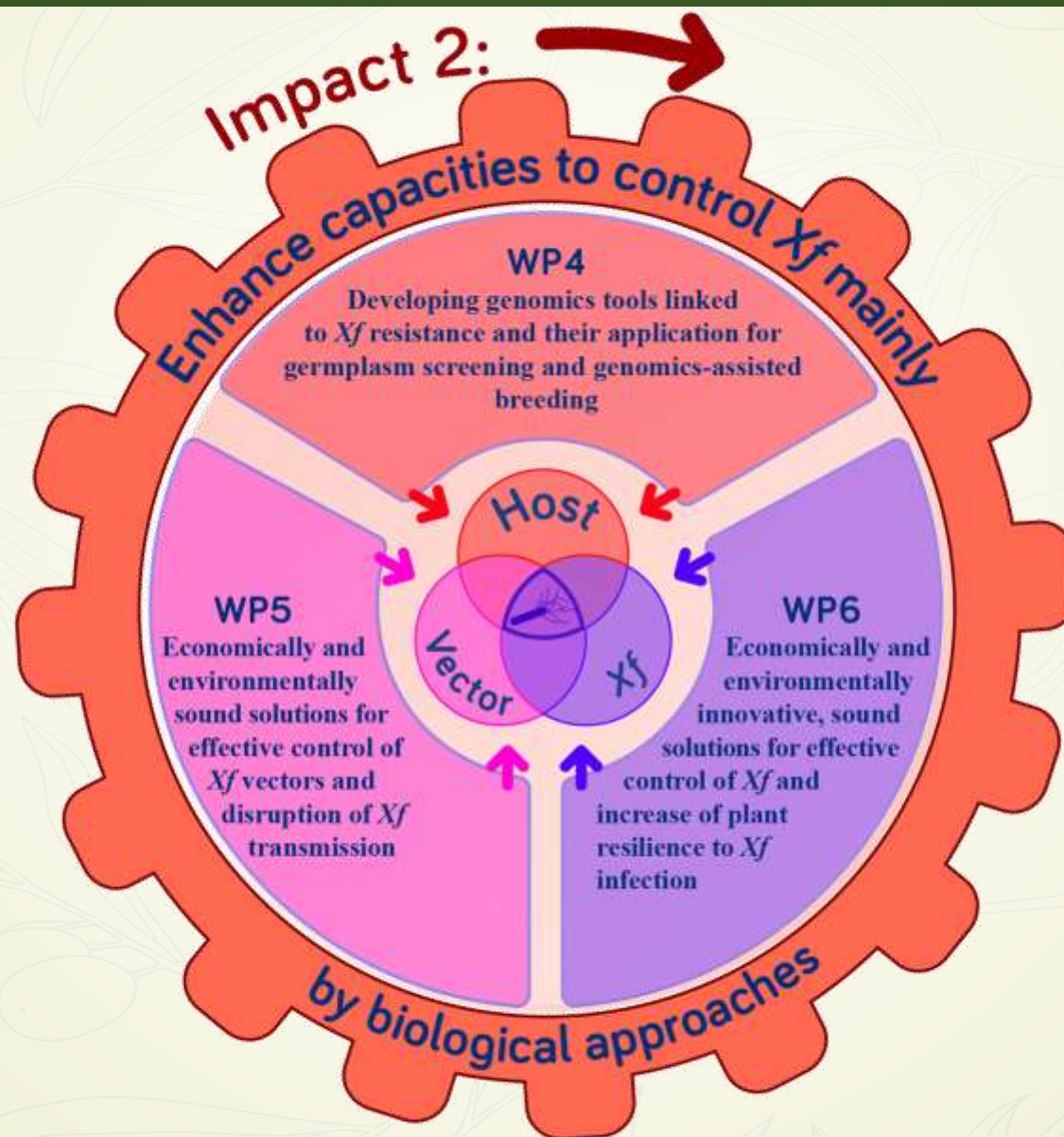
Varieties: Avjlor (Lauranne), Pentacebas
 Date: June 2024

| | # trees | T °C | t min |
|-------------|---------|-------|--------|
| Control | 50 | 20 | 40 min |
| | 10 | 45 °C | 40 min |
| | 10 | 45 °C | 60 min |
| | 10 | 45 °C | 80 min |
| Procedure 1 | 10 | 45 °C | 30 min |
| | 10 | 45 °C | 40 min |
| | 10 | 45 °C | 40 min |
| Procedure 2 | 10 | 45 °C | 40 min |



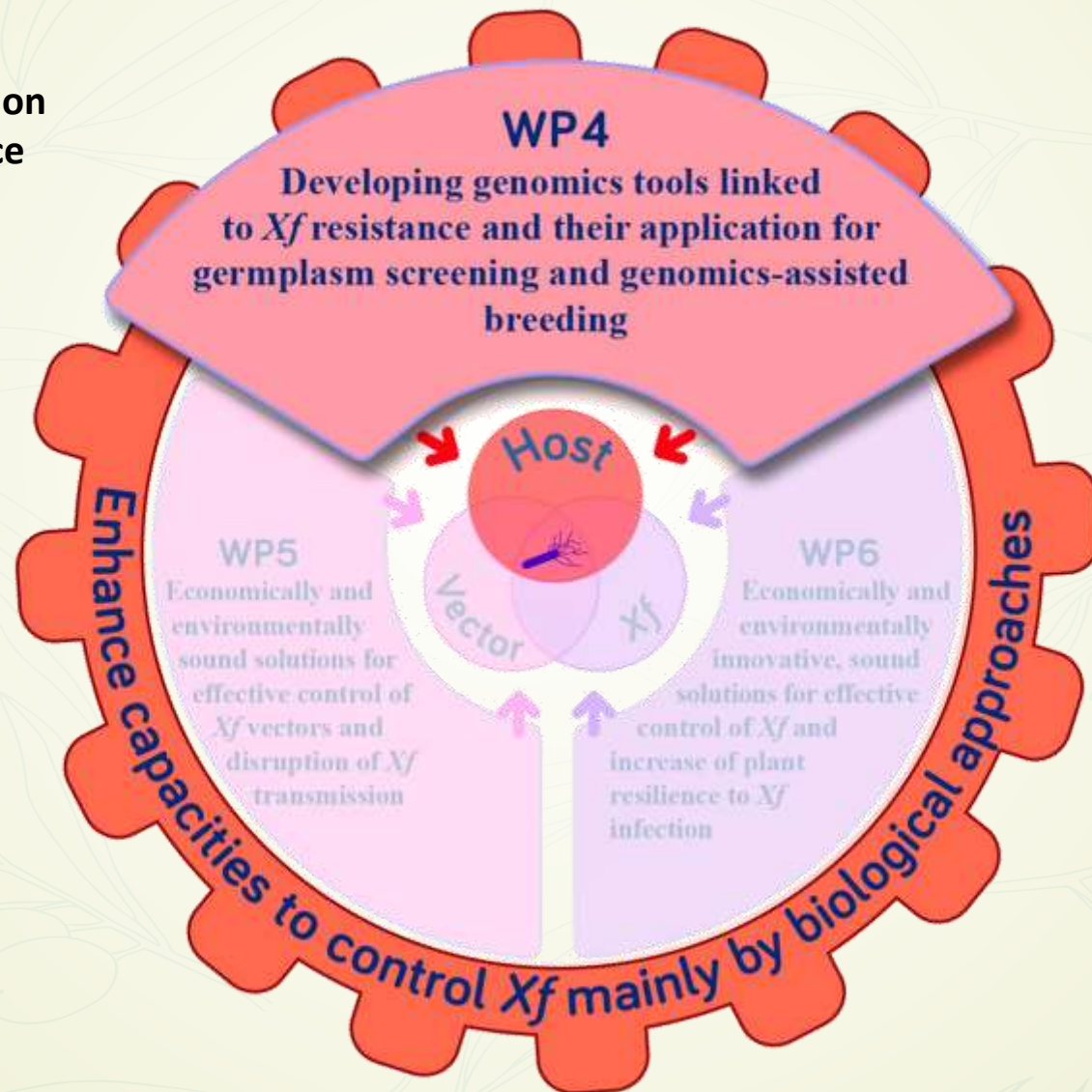
- No significant differences were found between Avjlor and Pentacebas treated with T of 45°C - 48°C
- Procedure 2 is discarded because the viability is not acceptable.
- Both varieties have economically acceptable viability ratios at temperatures of 48°C, improving results at lower T.

Beyond *Xylella*, integrated strategies for mitigating *Xylella fastidiosa* impact in Europe (BeXyl)



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- Large-scale testing of genotypes field/greenhouse
- Molecular plant responses to infection
- Mapping genes and QTL to resistance
- Breeding for new varieties

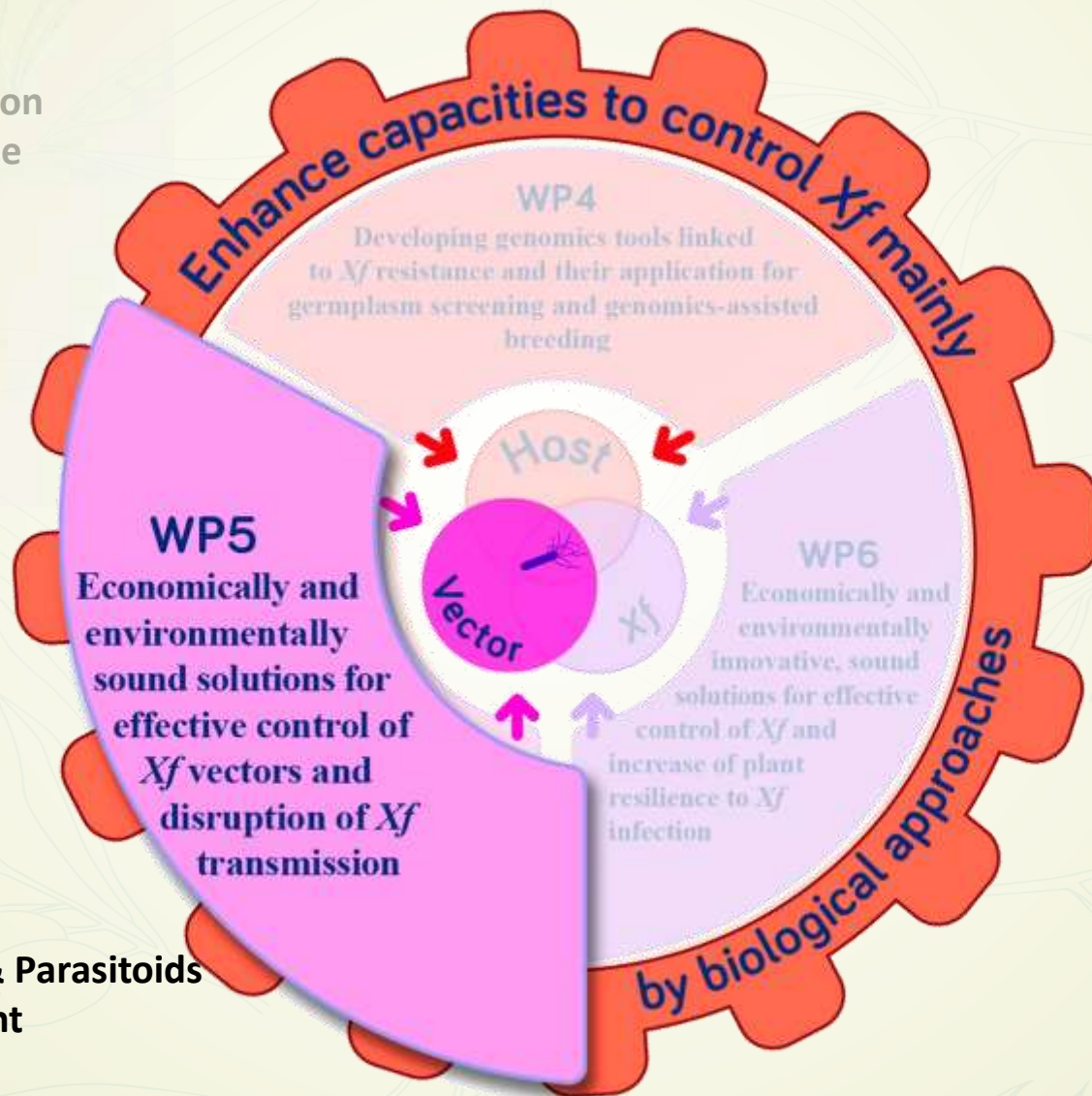


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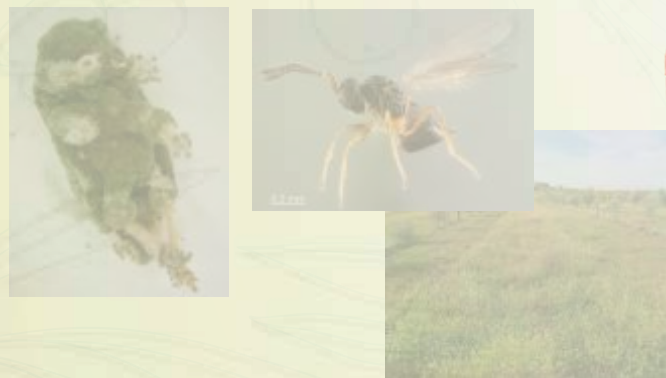


- Entomopathogenic fungi
- Virome of insect vectors & Parasitoids
- Ground cover management
- Tools to interfere vector acquisition/transmission

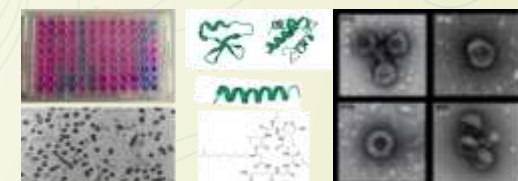
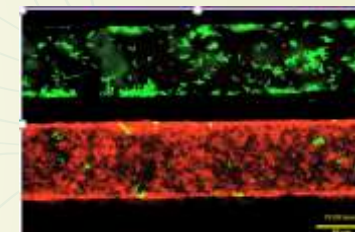
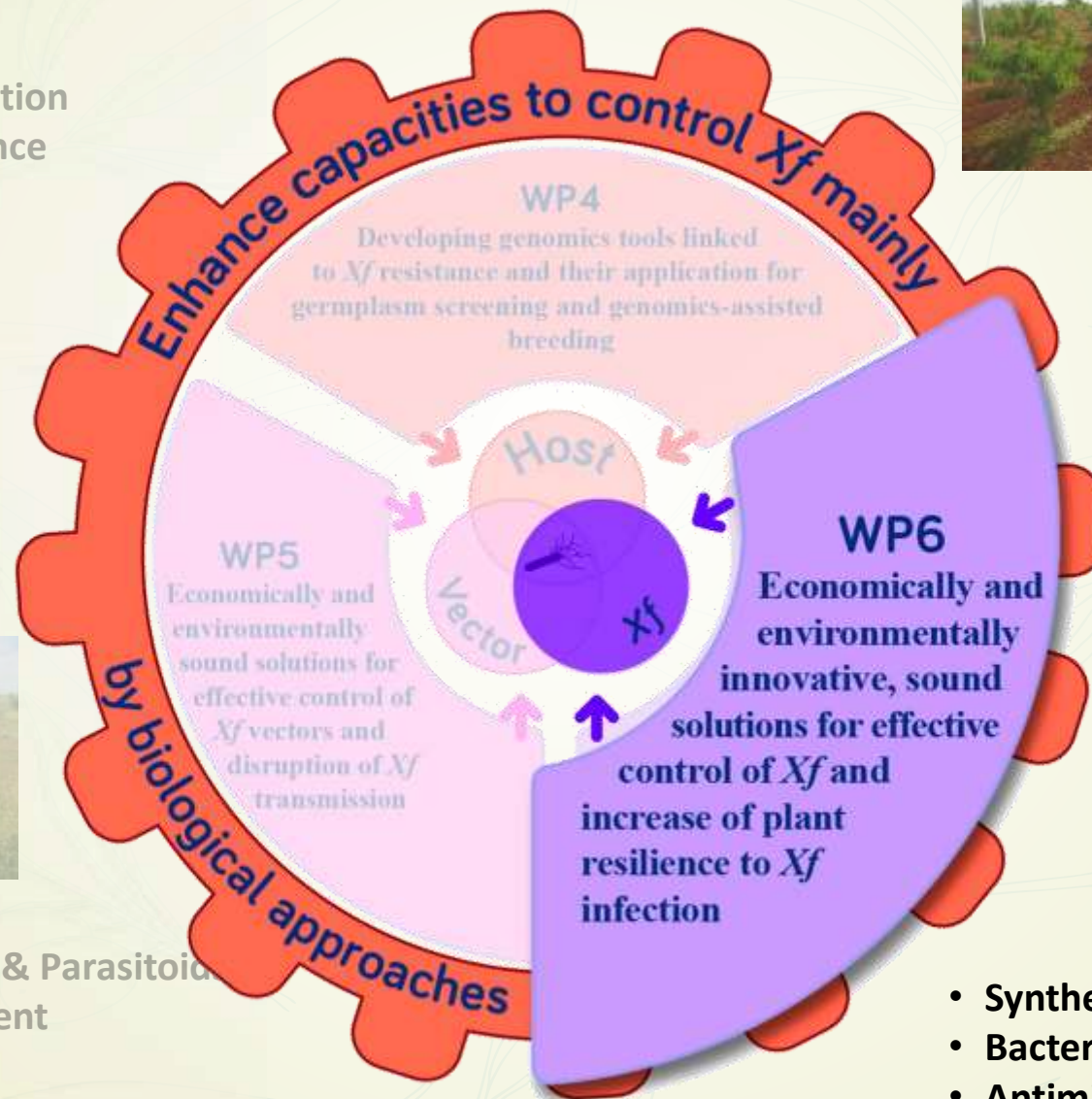


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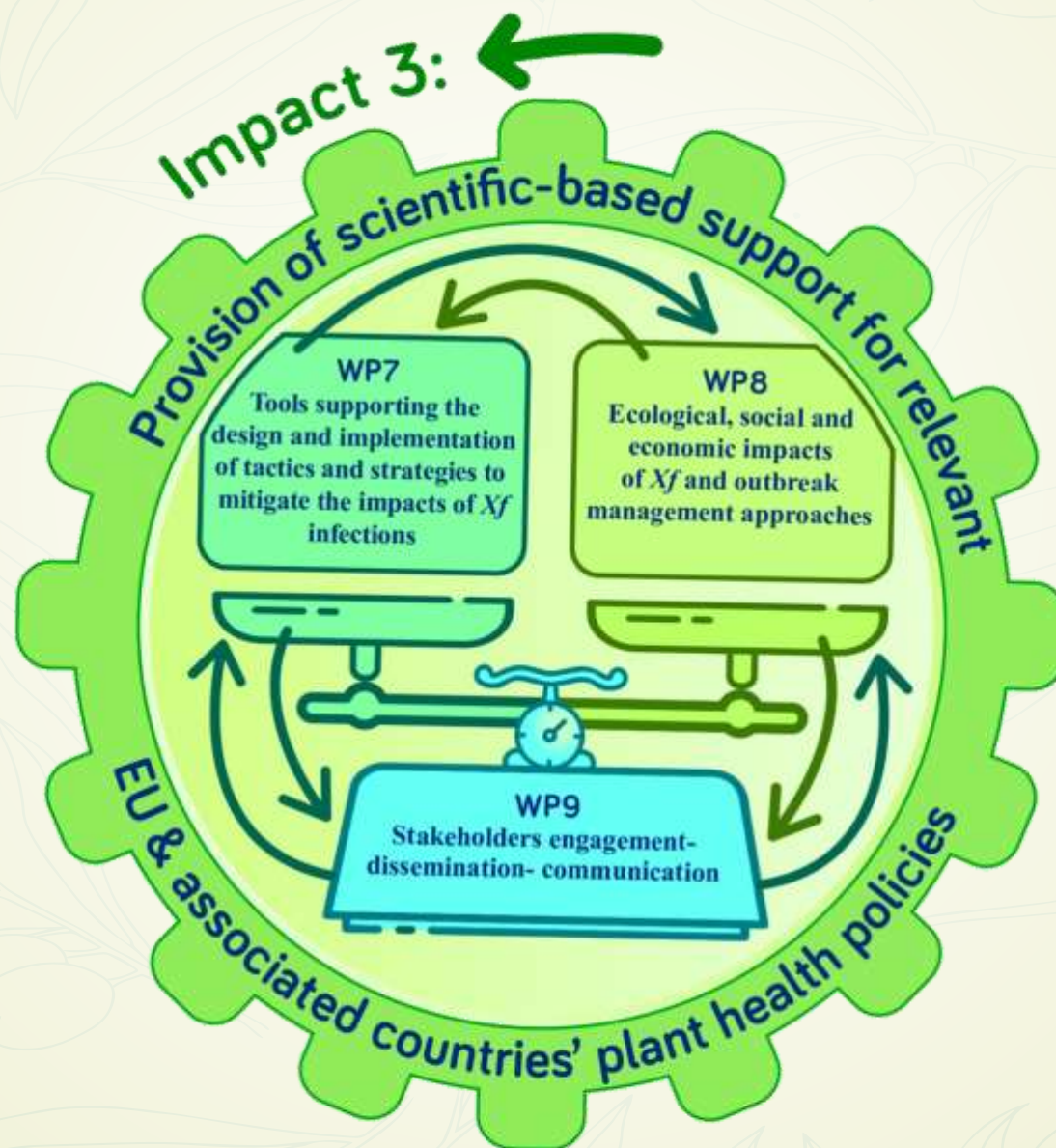


- Entomopathogenic fungi
- Virome of insect vectors & Parasitoids
- Ground cover management
- Tools to interfere vector acquisition/transmission



- Synthetic communities of xylem-bacteria
- Bacteriophages
- Antimicrobials (peptides, plant extracts...)

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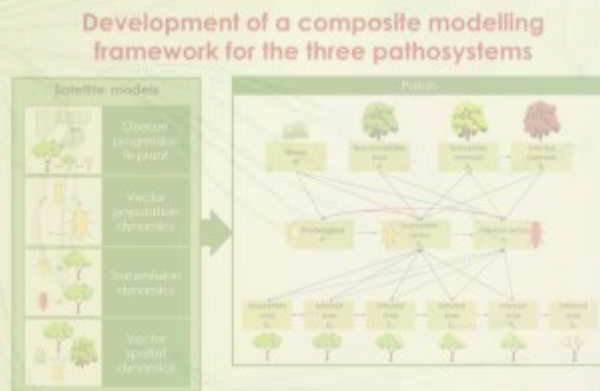


- ### Development of a composite modelling framework for the three pathosystems



Beyond *Xylella*, integrated strategies for mitigating *Xylella fastidiosa* impact in Europe (BeXyl)

- Integrated modeling framework



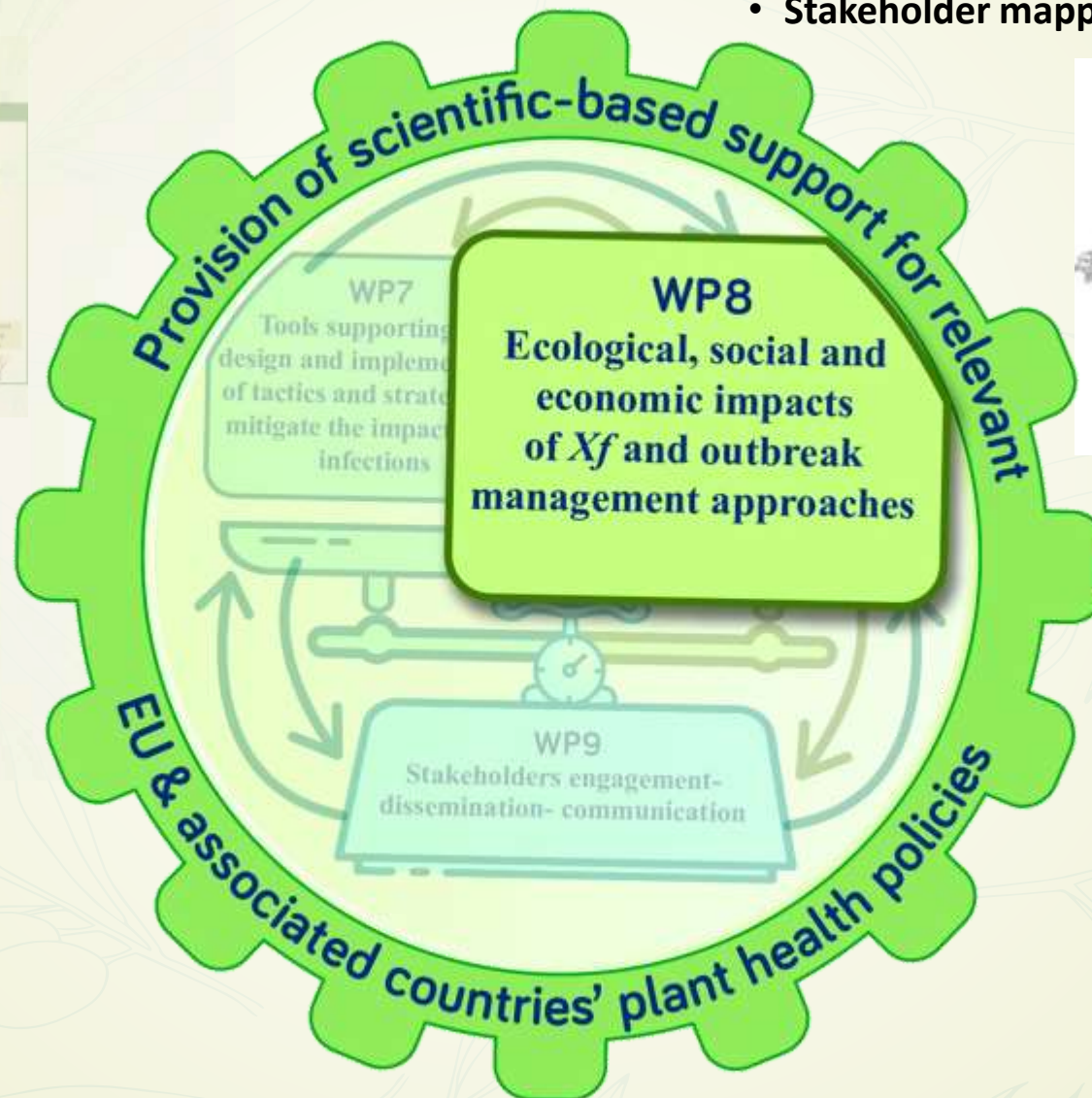
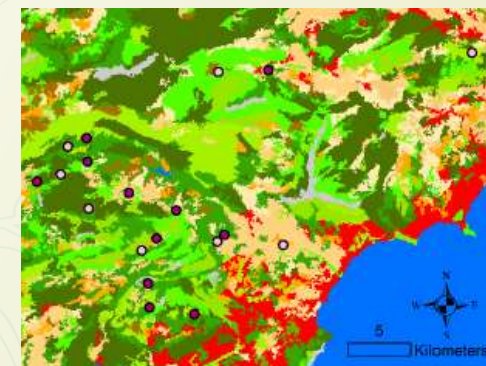
- Best agronomic Practices
Network of plots for monitoring and demonstration of IPM tools



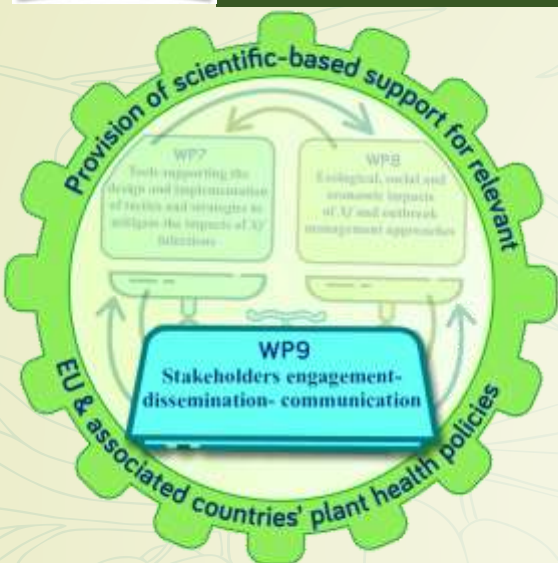
- Stakeholder mapping and socioeconomic analysis



Ecological impacts associated with *Xf* outbreaks and disease management strategies

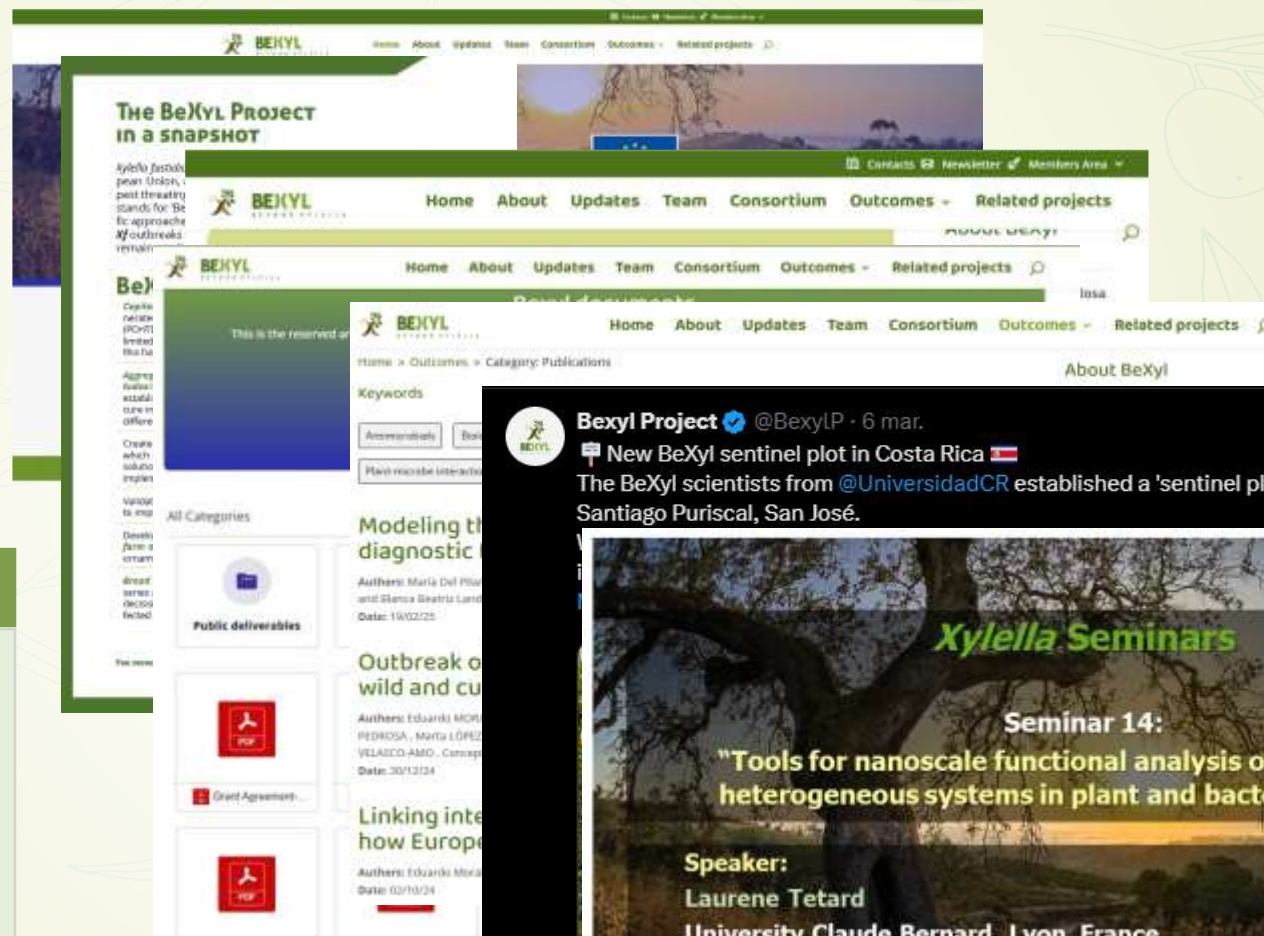


Beyond *Xylella*, integrated strategies for mitigating *Xylella fastidiosa* impact in Europe (BeXyl)



Examples:

- **Website:**
<https://bexylproject.org/>
- Newsletter
- Public Documents
- Publications
 - Videos
 - Practice Abstracts
- **Social Media**
- **Xylella Seminars**
- **EU-CAP-Network**



Beyond *Xylella*, integrated strategies for mitigating *Xylella fastidiosa* impact in Europe (BeXyl)

To summarize:



A worldwide project

31 partners from **14 countries** and a stakeholder's board with more than **40 government agencies, NGOs, nurseries, and farmer's associations**



The Goal

creating a **community** of **scientists, citizens, and end-users**, such as farmers to policymakers, to shorten the distance between research and on-field applications



The methodology

a **multidisciplinary approach** to fill the knowledge gaps on Xf and develop practical solutions to manage the outbreaks

Beyond *Xylella*, integrated strategies for mitigating *Xylella fastidiosa* impact in Europe (BeXyl)



Thanks for your attention !

Xylella

**FROM emergency
TO management**



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Thank you!

<https://www.bexylproject.com>

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