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BEYOND XYLELLA

Practice abstracts Batch 1-RP1

Deliverable 9.4

29 February 2024

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1. INTRODUCTION

The Agricultural European Innovation Partnership (EIP-AGRI), now part of the EU CAP Network, strives to promote competitive and sustainable farming and forestry that achieves more and better outcomes with fewer resources. It contributes to ensuring a steady supply of food, feed, and biomaterials, developing its work in harmony with the essential natural resources on which farming depends.

Practice abstracts refer to the format defined by EIP-AGRI for communicating projects, activities, and results. A **Practice Abstract** serves as a concise summary adhering to a standardized format employed across European initiatives such as H2020 and Horizon Europe.

Defined by the EIP-AGRI, this format facilitates knowledge flows on innovative and practice-oriented projects from the beginning to the end of the project and fosters connections among potential partners in research and innovation projects. It plays a pivotal role in forming a centralized collection of practical knowledge throughout the EU, facilitated by the EIP-AGRI projects database, which aids in spreading the findings from various interactive research and innovation projects.

Moreover, **Practice Abstracts** deliver essential information, guidance, and/or best practices applicable in the daily operations of end-users. Essentially, **Practice Abstracts** are vital for broadcasting the main objectives and outcomes of European projects, crafted collectively by consortium partners and aimed at a diverse and extensive audience including farmers, foresters, advisers, plant health authorities, advisors, researchers, and all other actors across the EU interested in succinct and practical information.

For this reason, all the BeXyl Practice Abstracts are being developed under EIP-AGRI format and sent to the EU CAP Network website for their dissemination. Additionally, due to the shortness of the text to be included in the Practice Abstracts an extended version of them have been uploaded to the BeXyl website for those readers that want to know more about their specific contents.

To ensure a wider dissemination of these **Practice Abstracts**, WP9 worked on the elaboration of attractive visuals allowing a dissemination via different channels. All the **Practice Abstracts** already delivered are available on BeXyl's website in a dedicated tab. They can be shared easily on social networks.

The first two **Practice Abstracts** prepared for BeXyl project have these main objectives:

- **Practice Abstract 1:** It will present the main research investigations and the expected results of the research to be conducted within BeXyl.
- **Practice Abstract 2:** It will present the advanced approaches that BeXyl will develop for Monitoring, Early Identification, and Surveillance of *X. fastidiosa* and its vectors.

Both practise abstracts have been submitted to EIP-AGRI on 29th February 2024, for being published in the EIP-AGRI projects database at the EU CAP Network web page (https://eu-cap-network.ec.europa.eu/index_en).

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2. PRACTICE ABSTRACT N. 1

The formatted Practice Abstract N.1 is available at this link and included in **Annex 1**.

The extended version of Practice Abstract N.1 is available at this link and included in **Annex 2**.

Practice Abstract 1	
Short title in English	Beyond *Xylella*, Integrated Management Strategies for Mitigating *Xylella fastidiosa* impact in Europe - Main project research investigations and expected research outcomes
Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces).	*Xylella fastidiosa* (*Xf*) is a "special observed" pathogen in the European Union, as is one of the most detrimental and priority plant pest threating EU agriculture, landscape and environments. BeXyl stands for 'Beyond *Xylella*' and means integrating different scientific approaches to propose and test practical solutions to manage *Xf* outbreaks in the EU, helping the agricultural/forestry sectors to remain productive and sustainable at long-term. BeXyl is expected to: • **Capitalize results**, experimental materials and protocols generated by the large partnership and recent H2020 projects to effectively counteract the impact of this harmful pathogen. • **Aggregate biological information** acquired under a wide range of latitudes/conditions to i) identify critical environmental drivers favouring *Xf* establishment and spread, considering climate change scenarios, and ii) secure information on the resilience of crops exposed under a wide range of different inoculum/management/climatic conditions. • **Create a multi-stakeholder community**, from end- users to policy makers, deciding on which disease management solutions to converge major efforts, while promoting their full adoption and implementation. • Validate **optimized statistical designs for surveillance** of *Xf* and its vectors to improve EU prevention and preparedness. • **Developing and validating solutions** for improving plant health at nursery, farm and landscape level including a wide range of plant species for conventional and organic sectors. • **Broad dissemination of solutions** from the diagnostic laboratory, to nurseries and farms, including IPM decision support systems and guidelines tailored to infected and noninfected areas. For more technical and detailed information check here the extended version.

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3. PRACTICE ABSTRACT N. 2

The 2nd BeXyl Practice Abstract provides an appraisal of the tools for surveillance, detection, and early monitoring that BeXyl plan to achieve on WP2. Once the main results are available a new Practice Abstract will be prepared to describe them.

The formatted Practice Abstract N.2 is available at this link and included in **Annex 3**.

The extended version of Practice Abstract N.2 is available at this link and included in **Annex 4**. The extended version of this Practice Abstract N.2 will be regularly updated to include all approaches and tools developed in the BeXyl project as progress is achieved.

Practice Abstract 2	
Short title in English	New strategies and improved methods for surveillance, early detection and monitoring of *Xylella fastidiosa* and its vectors
Short summary for practitioners in native language (*can be the language of the coordinator / one of the partners - otherwise in English*) (1000-1500 characters, word count – no spaces).	BeXyl's main action plans are focused on developing advanced approaches for Monitoring, Early Identification, and Surveillance of Xf and its vectors. How will BeXyl make a difference? • Improved Monitoring: We're introducing new ways to keep an eye on the disease, including the use of special light traps to catch insects that spread Xf. • Better plant and vector Testing: We're developing new and fast methods to detect infected plants using advanced cutting-edge molecular diagnostic techniques and bioinformatics. • Better Survey Techniques: We'll create better survey plans using advanced statistics and mathematical models and active search strategies to find the disease sooner and more accurately. • Using Technology Advancements: We'll use the latest advanced imaging from planes and satellites, as well as on-site analysis with proximal sensors, to spot the infection before plants show symptoms. • Dogs to the Rescue: Trained dogs will be used to sniff out the disease in plants that don't look sick yet, which could be really helpful at ports of entry and plant nurseries. • Education and Training: Through workshops and specialized training, we aim to enhance the skills of those on the frontline in diagnosing and managing the disease. • Awareness Campaigns: We aim to raise awareness about how serious this disease is, how to spot it encouraging everyone to be part of the solution.

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• Community Engagement and Cooperation: We'll launch a big communication effort, getting everyone involved from local communities to international partners.

By tackling the problem from all these angles, BeXyl hopes to protect our plants better and ensure the health and safety of our agriculture and natural landscape.

For more technical and detailed information check here the extended version of this Practice Abstract.

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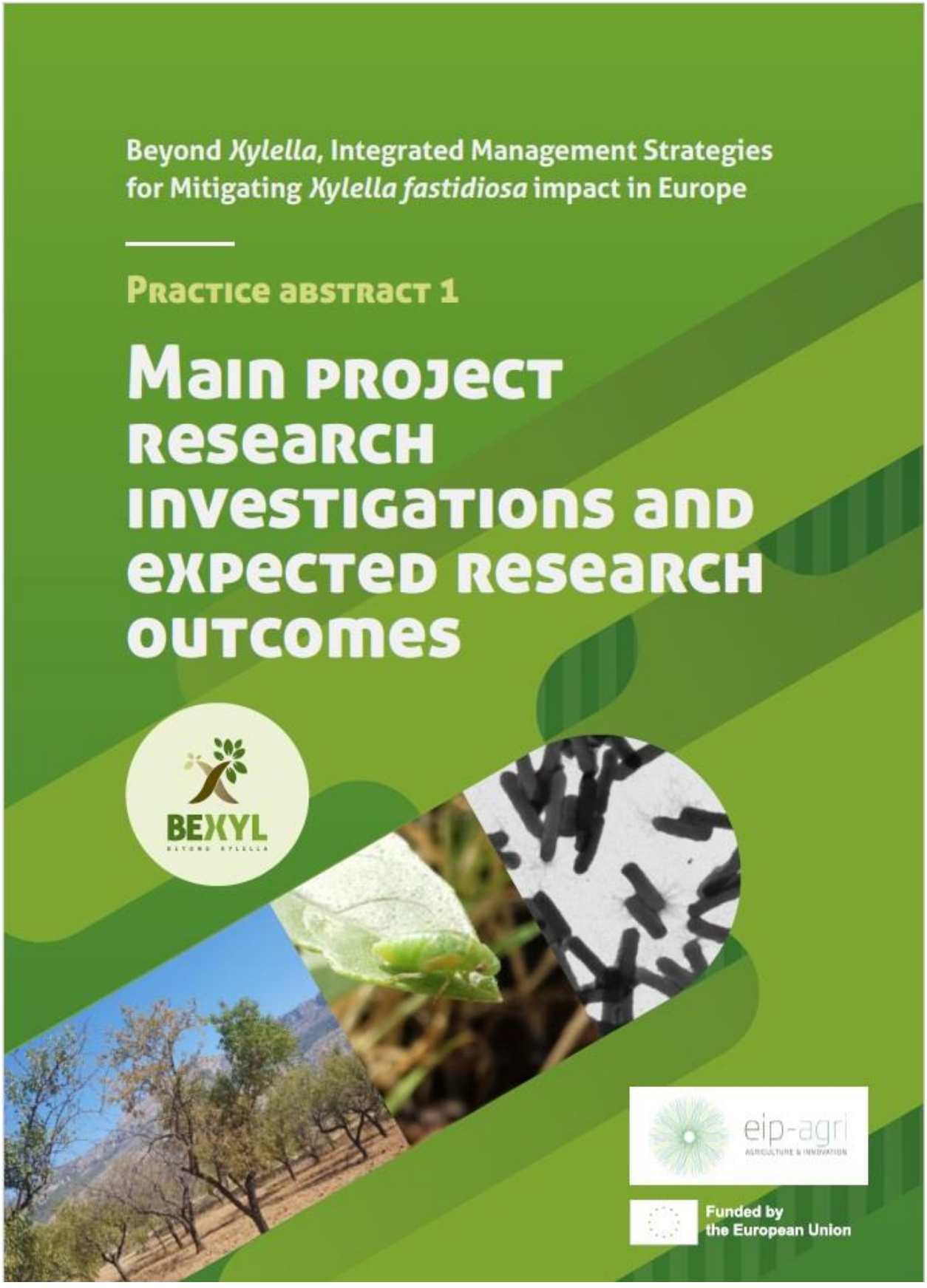
ANNEX 1: PRACTICE ABSTRACT 1 SHORT



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The BeXyl Project in a snapshot

Xylella fastidiosa (***Xf***) is a "special observed" pathogen in the European Union, as is one of the most detrimental and priority plant pest threating EU agriculture, landscape and environments. **BeXyl** stands for 'Beyond *Xylella*' and means integrating different scientific approaches to propose and test practical solutions to manage ***Xf*** outbreaks in the EU, helping the agricultural/forestry sectors to remain productive and sustainable at long-term.

BeXyl is expected to:

Capitalize results, experiences, experimental materials and protocols generated by the large partnership and deriving from recent H2020 projects (POnTE, XF-ACTORS, BIOVEXO), for advancing and extending the currently limited tools and strategies available to effectively counteract the impact of this harmful pathogen.

Aggregate biological information acquired under a wide range of latitudes/conditions to i) identify critical environmental drivers favouring *Xf* establishment and spread, considering climate change scenarios, and ii) secure information on the resilience of crops exposed under a wide range of different inoculum/management/climatic conditions.

Create a ***multi-stakeholder community***, from end- users to policy makers, which is the core of the project, deciding on which disease management solutions to converge major efforts, while promoting their full adoption and implementation.

Validate ***optimized statistical designs for surveillance of Xf and its vectors*** to improve EU prevention and preparedness.

Developing and validating ***solutions*** for improving plant health at ***nursery, farm and landscape level*** including ***a wide range of plant species*** (crops, ornamental and forestry species) for conventional and organic sectors.

Broad dissemination of solutions from the diagnostic laboratory, to nurseries and farms, thanks to different types of research tasks, including IPM decision support systems and guidelines tailored to infected and noninfected areas.

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For more technical and detailed information check here the extended version

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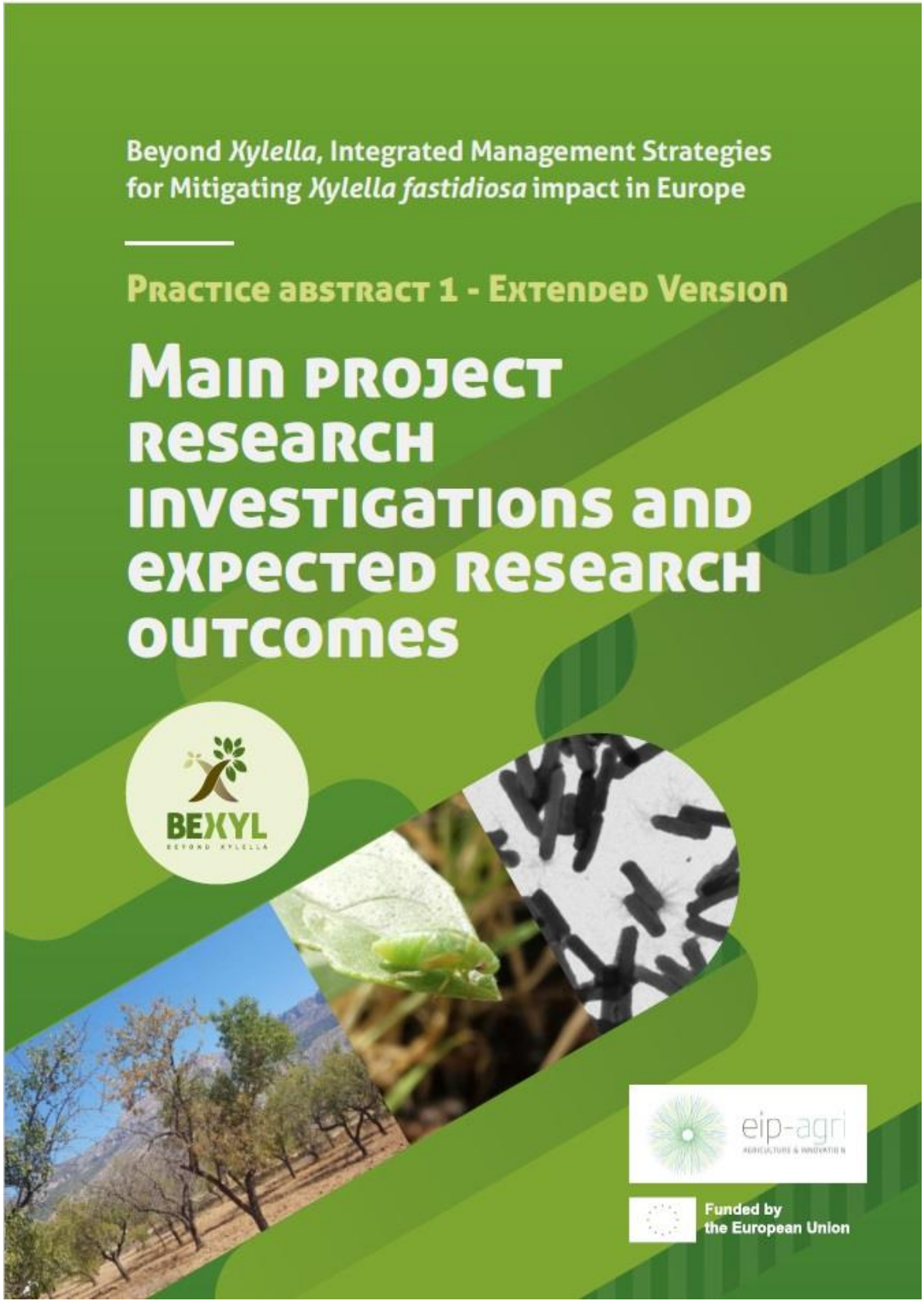
ANNEX 2: PRACTICE ABSTRACT 1 EXTENDED



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The BeXyl Project in a snapshot

Xylella fastidiosa (***Xf***) is a "special observed" pathogen in the European Union, as is one of the most detrimental and priority plant pest threating EU agriculture, landscape and environments. BeXyl is the second international research project in Europe entirely devoted to develop a multidisciplinary research program on ***Xf***. BeXyl stands for 'Beyond *Xylella*' and means integrating different scientific approaches to propose and test practical solutions to manage ***Xf*** outbreaks in the EU.

BeXyl consortium fosters the convergence of top worldwide scientists and the bottom-up demand of stakeholders, providing the best possible opportunity for synergic collaborations to tackle–***Xf***. The project workplan has been designed to address the research needs of farmers, nursery producers, risk managers and policy makers presented and discussed during the European EFSA Conferences 2019-2023 on ***Xf***.

BeXyl is expected to:

Capitalize results, experiences, experimental materials and protocols generated by the large partnership and deriving from recent H2020 projects (POnTE, XF-ACTORS, BIOVEXO), for advancing and extending the currently limited tools and strategies available to effectively counteract the impact of this harmful pathogen.

Aggregate biological information acquired under a wide range of latitudes/conditions to i) identify critical environmental drivers favouring *Xf* establishment and spread, considering climate change scenarios, and ii) secure information on the resilience of crops exposed under a wide range of different inoculum/management/climatic conditions.

Create a ***multi-stakeholder community***, from end- users to policy makers, which is the core of the project, deciding on which disease management solutions to converge major efforts, while promoting their full adoption and implementation.

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Developing and validating ***solutions*** for improving plant health at ***nursery, farm and landscape level*** including ***a wide range of plant species*** (crops, ornamental and forestry species) for conventional and organic sectors.

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WHY BeXyl HAS BEEN FUNDED?

To propose a ***multidisciplinary approach*** to efficiently advance the development of practical solutions to fill the practical gaps and the lack of optimized approaches to manage *Xf*.

To not reinvent the wheel. Capitalize on previous successful research projects, focusing research in providing an overarching interpretation and exploitation of results.

To co-creates science-based solutions with a large number of stakeholders, highly interconnected national and internationally, with high economic and societal impact on the exploitation and adoption of the project results.

Excellent value for money, integrating and building on previous and ongoing worldwide experiences.

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 *X. fastidiosa* outbreaks, helping the agricultural/forestry sectors to remain productive and sustainable at long-term.

To accomplish its global aim **BeXyl** has been built mainly on the foundations of the knowledge generated by the H2020 project XF-ACTORS to strengthen the EU research network tackling ***Xf*** outbreaks, to ensure the best use and exploitation of the research outputs gained so far. **BeXyl** project has set eight **specific objectives** to address the main issues indicated in the call scope (Figure 1) and those research needs specified by farmers and foresters, nursery producers, risk managers and policy makers during EFSA conferences (Figure 2).

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Figure 1. BeXyl Specific objectives build to address the research needs identified by farmers and foresters, nursery producers, risk managers and policy makers during EFSA conferences on *Xf*

Figure 2. Key elements and scope of the topic HORIZON-CL6-2021-FARM2FORK-01-04 addressed by BeXyl

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Xf worldwide

Several variants and strains of ***Xf*** are known worldwide, and more than 650 plant species can be colonized by one or more strains of the bacterium. In several plant species, it can remain latent, but the bacterium is well known as the causal agent of important diseases in grapevine, almond, oleander, orange, peach, citrus, coffee, avocado, olive tree, and oak. The bacterium affects the normal physiological processes of the plants and can lead to their death.

EU Research on Xf

In October 2013, for the first time in the EU and in the Mediterranean Countries, scientists reported the presence of ***Xf*** on olive trees in Puglia, southern Italy. Since then, surveillance has led to the discovery of outbreaks in regions of France, Spain and Portugal. Several species of xylem sap-sucking insects, mainly "spittlebugs", have also been identified as vectors of the bacterium.
Since 2015 the European Union has been financing research to find ways to reduce the impact of ***Xf***. At the time, very little was known about the characteristics of European outbreaks. The POnTE (2015-19) and XF-ACTORS (2016-21) projects enabled the EU scientific community to develop knowledge about the 'behaviour' and interactions of the bacterium with European ecosystems. This process represented the factual-based guidance for economic operators and policymakers to put in place emergency measures to curb the spread of the bacterium in the EU.

BeXyl a step forward

BeXyl aims to secure and exploit the research outcomes achieved by advancing and transferring into practice the most promising prevention and containment strategies. **BeXyl** means "Beyond Xylella". That suggests the time is ripe to move away from emergency mode to more sophisticated management strategies against Xylella fastidiosa current outbreaks and prevent new introductions in Europe.

The project fills gaps in research, dedicating substantial analysis to the **socio-economic and environmental impact of the pathogen under climate change scenarios**. Stakeholders' involvement is another distinctive characteristic. More than 40 research institutions, government agencies, nurseries and farmer's associations, NGOs, and "operational groups" of the EU-funded European Innovation Partnership, participate in the project. The goal is to create a community of scientists, citizens, economic operators, and policymakers to **shorten the distance between research and on-field applications**.

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BeXyl will support studies on both basic research and technological innovation. In the first group, there is work on **the drivers of *Xf* epidemics in the EU**, considering climate change. Scientists will also be modelling the impact and **sustainability of different practical tactics** to contrast the pathogen's spread in different agroecosystems and landscapes. In the second group, we find **improved detection methods for the bacterium and its vectors**, with tools ranging from remote sensing technology to dogs' sense of smell. **BeXyl** will also establish a **global network of "sentinel plots"** acquiring data from a wide range of latitudes and conditions.

Other research lines include **thermal treatment** to secure **safe plant material exchange**. To support specific plant breeding programs, scientists will improve the **understanding of genetic mechanisms leading to resistance to *Xf***. Findings in the studies carried out in former research projects encourage exploring beneficial bacteria (bacteriophages), innovative antimicrobial compounds, and microbial formulations that reduce the spread of ***Xf*** within plants. BeXyl will also outline new solutions for helping farmers to **use integrated pest management to control the bacterium and its vectors**.

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ANNEX 3: PRACTICE ABSTRACT 2 SHORT

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BeXyl's main action plans are focused on developing advanced approaches for **Monitoring, Early Identification, and Surveillance of *Xylella fastidiosa* (*Xf*) and its vectors.**

How will BeXyl make a difference?

Improved Monitoring: We're introducing new ways to keep an eye on the disease, including the use of special light traps to catch insects that spread Xf.

Better plant and vector Testing: We're developing new and fast methods to detect infected plants using advanced cutting-edge molecular diagnostic techniques and bioinformatics.

Better Survey Techniques: We'll create better survey plans using advanced statistics and mathematical models and active search strategies to find the disease sooner and more accurately.

Using Technology Advancements: We'll use the latest advanced imaging from planes and satellites, as well as on-site analysis with proximal sensors, to spot the infection before plants show symptoms.

Dogs to the Rescue: Trained dogs will be used to sniff out the disease in plants that don't look sick yet, which could be really helpful at ports of entry and plant nurseries.

Education and Training: Through workshops and specialized training, we aim to enhance the skills of those on the frontline in diagnosing and managing the disease.

Awareness Campaigns: We aim to raise awareness about how serious this disease is, how to spot it encouraging everyone to be part of the solution.

Community Engagement and Cooperation: We'll launch a big communication effort, getting everyone involved from local communities to international partners.

By tackling the problem from all these angles, BeXyl hopes to protect our plants better and ensure the health and safety of our agriculture and natural landscape.

For more technical and detailed information check here the extended version

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ANNEX 4: PRACTICE ABSTRACT 2 EXTENDED

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BeXyl project expected impacts:

BeXyl is expected to enhance capacities to prevent, monitor, and find adequate responses to the quarantine plant pathogen *Xylella fastidiosa,* the first EU priority pests. Furthermore, BeXyl is expected to provide support to relevant EU and Associated Countries' plant health policies

How these impacts will be achieved?

Annual surveillance programs for *Xylella fastidiosa* (***Xf***) are mandatory (Regulation EU 2019/1702 and Regulation EU 2020/1201). However, the large extension of some outbreaks show that early detection is still a major challenge to be accomplished. **BeXyl** aims to strengthen preventive strategies and methods for surveillance, early detection and monitoring of ***Xf*** and its vectors including a diverse set of tools:

New *In field* trapping method for spittlebugs based on black light traps will be evaluated for monitoring vector populations and infectivity.

New methods for ***In field* tests** or methods to quickly and accurately identify/quantify ***Xf*** infected plants and vectors supported by **high-throughput molecular techniques** and powerful bioinformatics tools to enable the discrimination of *Xf* genetic diversity.

Develop **optimized statistical survey designs** for ***Xf*** and its vectors, combining passive and active surveillance using scenario trees and Bayesian approaches.

Airborne and satellite hyperspectral and thermal images from remote sensing and **In-situ plant phenotyping** to discriminate between asymptomatic ***Xf*** infections and abiotic-induced spectral signatures.

Canine olfactory detection of asymptomatic phases of ***Xf*** infection with potential applications for phytosanitary inspections at ports, nurseries and field scale.

Workshops, interlaboratory tests, guidelines and training programs for plant and insect sampling and ***Xf*** diagnosis to improve reliability, sensitivity and enhance ***Xf*** detection during official monitoring and surveys, which will complement EFSA survey guidelines.

Raise awareness for a better understanding of the scientific basis of official control programs and the threat of new ***Xf*** outbreaks in the EU, enhancing more effective implementation of surveillance and IPM strategies.

A strong communication program based on **stakeholder's engagement,** improved information campaigns, **simulation exercises** and **citizen science** involving a diverse range of stakeholders and an international cooperation network with countries affected by ***Xf.***

By tackling the problem from all these angles, BeXyl hopes to protect our plants better and ensure the health and safety of our agriculture and natural landscape.

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Impacts achieved:

Evaluation of surveillance strategies for *Xylella fastidiosa* in the EU

Martina Cendoya and Antonio Vicent. *Institut Valencià d'Investigacions Agràries (IVIA), Spain*

Surveillance for *Xylella fastidiosa* (*Xf*) is mandatory in the EU, both to substantiate pest freedom in non-affected areas as well as to delimit the size and extent of current outbreaks (Regulation EU 2020/1201). Surveillance strategies for *Xf* are defined by the EFSA guidelines, but their performance for outbreak management in terms of effectiveness and efficiency has been quantified only to a limited extent.

As a case study, the disease dynamics of almond leaf scorch, caused by *Xf*, in the affected area of Alicante, Spain, were approximated using an individual-based spatial epidemiological model. The emergence of this outbreak was dated based on phylogenetic studies, and official surveys were used to delimit the current extent of the disease. Different survey strategies and disease control measures laid down in Regulation EU 2020/1201 were compared to determine their effectiveness and efficiency for outbreak management in relation to a baseline scenario without interventions. One-step and two-step survey approaches defined by the EFSA guidelines were compared with different confidence levels, buffer zone sizes and eradication radii, including the minimum distances established by Regulation EU 2020/1201. The effect of disease control interventions was also considered by decreasing the transmission rate in the buffer zone.

All outbreak management plans reduced the number of infected trees (effectiveness) but large differences were observed in the number of susceptible trees left (efficiency). The two-step survey approach and high confidence level increased the efficiency, while also reducing the transmission rate. Only the outbreak management plans with the two-step survey approach removed infected trees completely (**Fig. 1**), but they required much greater survey efforts. Although control measures reduced disease spread, surveillance demonstrated to be the key factor in the effectiveness and efficiency of the outbreak management plans.

To facilitate the use by risk managers and plant health authorities, an open-access R shiny app has been developed to simulate disease spread under different epidemiological settings.

Likewise, the performance and resulting survey efforts of different surveillance strategies and control measures can be simulated using the open-source R code provided below.

Cendoya M, Navarro-Quiles A, López-Quílez A, Vicent A, Conesa D. 2024. An individual-based spatial epidemiological model for the spread of plant diseases. Journal of Agricultural, Biological and Environmental Statistics (accepted)

Code and data:
https://zenodo.org/records/7128855

https://spatial-ibm.shinyapps.io/spread_results_app/

Cendoya M, Lázaro E, Navarro-Quiles A, López-Quílez A, Conesa D, Vicent A. 2024. Performance of outbreak management plans for emerging plant diseases: the case of almond leaf scorch caused by *Xylella fastidiosa* in mainland Spain. Phytopathology (accepted)

Code and data:
https://zenodo.org/records/10251507

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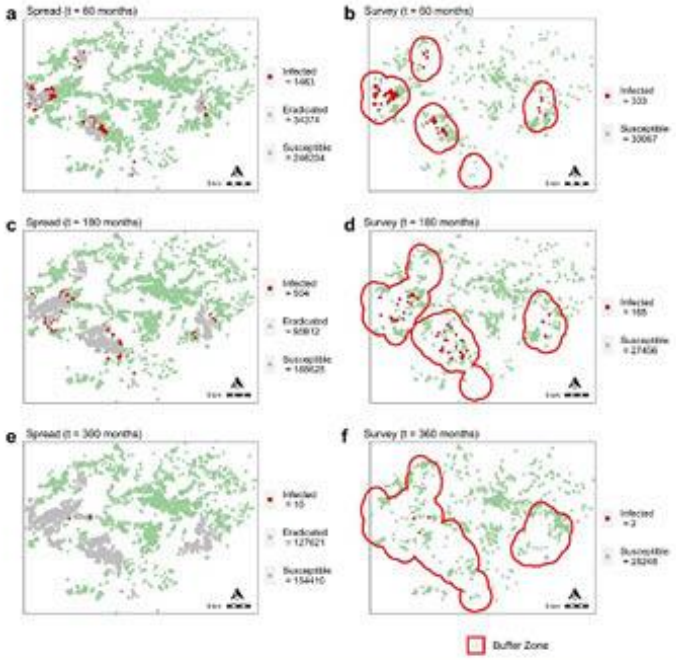

Figure 1. Georeferenced distribution and number of susceptible, infected, and eradicated trees (left), and surveillance and buffer zone delimitation (right), for an outbreak management plan with two-step survey approach.