Beyond *Xylella*, Integrated Management Strategies for Mitigating *Xylella fastidiosa* impact in Europe

Practice abstract 2 - Extended Version

New strategies and improved methods for surveillance, early detection and monitoring of *Xylella fastidiosa* and its vectors

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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

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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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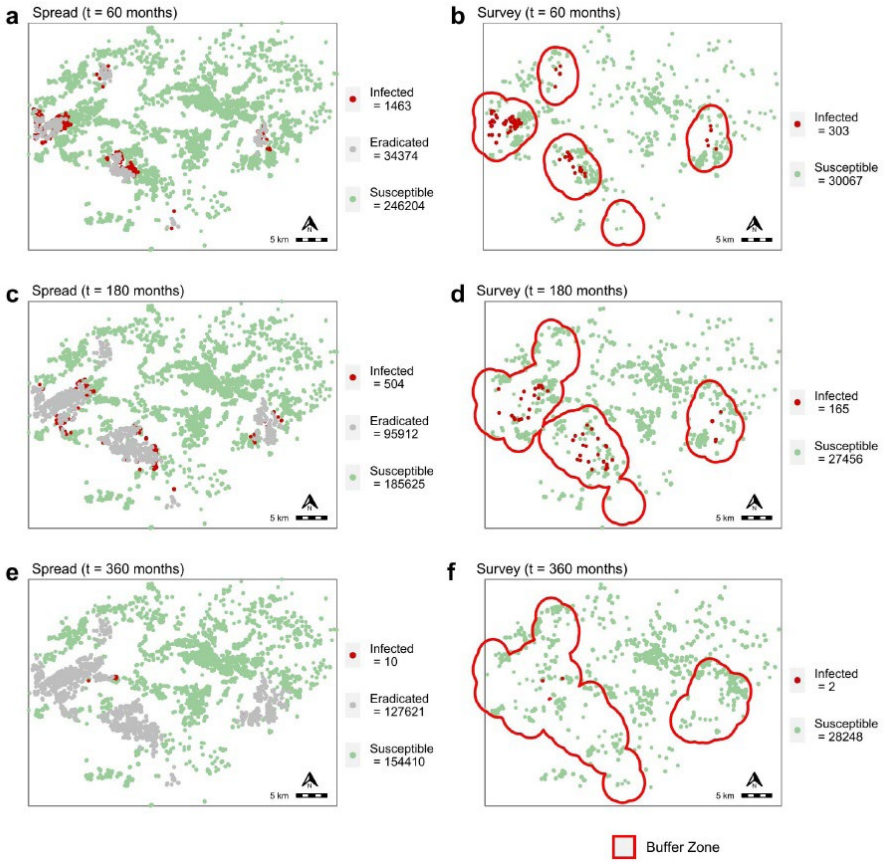

Figure 1. Georeferenced distribution and number of susceptible, infected, and eradicated trees (left), and surveillance and buffer zone delimitation (right), for an outbreak management plan with two-step survey approach.

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