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

Practice abstract 20

A multi-scale approach for early detection and monitoring of *Xylella fastidiosa*

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Early detection of ***Xylella fastidiosa*** **(*Xf*)** is essential for timely eradication, containment and surveillance. ***Xf*-**infected plants may remain asymptomatic for long periods, and symptoms are often non-specific, delaying reliable detection. **BeXyl** addressed this limitation by evaluating non-destructive proximal and remote-sensing approaches to detect spectral changes associated with physiological alterations induced by ***Xf*** infection before visible symptoms appear.

How did BeXyl make a difference?

BeXyl developed a multi-scale detection framework combining proximal sensing at leaf level, high-throughput phenotyping at plant level, and remote sensing at canopy and landscape level using airplane, UAV and satellite platforms.

The approach was tested in key Mediterranean crops, including olive, almond and grapevine, under controlled and field conditions in Spain, Italy, Argentina and the United States. Molecular diagnostics confirmed infection status and provided ground-truth for model development.

Main outcomes

BeXyl identified spectrally-derived **physiological traits** associated with early ***Xf*** infection, including changes in pigment content, chlorophyll fluorescence, stomatal conductance, and canopy temperature.

Field campaigns generated large datasets across pathosystems supporting early **detection models** and contributing to an **adaptive modelling framework** aimed at improving transferability across acquisition times, sites and crops.

Impact: BeXyl advanced early *Xf* surveillance by moving beyond visual symptom assessment towards scalable, sensor-based detection. The results provide a basis for operational monitoring tools to guide targeted sampling, improve detection and delimiting surveys and support faster plant-health decisions. Further validation under different epidemiological and environmental conditions is needed before full operational deployment, but the work represents a major step towards pre-symptomatic *Xf* detection at field and regional scales.

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