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Harnessing the Power of Digital Technologies to Protect Plants & the Environment

D5.5: Practice Abstracts – batch 1

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Executive Summary

This deliverable, ***D5.5: Practice Abstracts—batch 1,*** *compiled under Work Package 5 of the STELLA project, presents the first set of 25 Practice Abstracts (PAs). These abstracts summarise key technical, methodological, and strategic aspects of STELLA's activities up to Month 16, reflecting the project's progress in developing a Pest Surveillance System (PSS) and piloting it in six real-life Use Case Pilots (UCPs) across five countries.*

The STELLA project addresses the growing need for efficient, real-time, and digitalised pest and disease surveillance solutions in agriculture and forestry. The presented PAs summarise various aspects of the STELLA project, including the Use Case Pilots (UCPs) baseline and plan. They aim to provide the foundation for implementing the STELLA UCP roadmap. Specifically, the abstracts cover various topics, including digital data collection protocols, smart pest detection systems, and integrated pest response mechanisms. They also highlight the application of these systems across diverse crops, pests and geographies—such as addressing Grapevine Leafroll Disease (GLD) and Bois Noir (BN) in vineyards in Alsace, monitoring Ceratocystis platani in Greek plane forests, managing Potato Leafroll Virus in Lithuania; surveillance of Ralstonia Solanacearum in Italian tomato production, addressing the threat of Bull's Eye Rot in New Zealand apples, and Verticillium dahliae and Pseudomonas savastanoi pv. savastanoi in olive orchards in Greece.

The main conclusion of this deliverable is that the presented PAs effectively and concisely explain the STELLA project and its diverse activities to a wide range of stakeholders. By outlining the progress of UCP preparation and planning, including a description of each UCP and its specificities related to risks, pest monitoring methods, data collection, and potential challenges, the deliverable provides valuable context for the project's objectives and potential impact.

The primary purpose of this deliverable is to summarise the project's initial outcomes in an accessible format for all stakeholders. The abstracts serve as concise, stakeholder-oriented knowledge products that support STELLA's dissemination and exploitation objectives. It aims to inform practitioners, policymakers, researchers, and other stakeholders about the project's goals, work, and key findings. Ultimately, this deliverable serves as a reference document to facilitate understanding of the STELLA project, attract attention to its initiatives, and encourage the uptake of digital solutions in plant health. The Practice Abstracts are uploaded to the EU CAP NETWORK project database and will be disseminated via the project's communication channels to maximise visibility and uptake.

Table of Contents

List of Figures

List of Tables

Glossary of terms and abbreviations used

List of Abbreviations and Acronyms	
AI	Artificial Intelligence
AOC	Appellation d'Origine Contrôlée
BN	Bois Noir
CAP	Common Agricultural Policy
ELISA	Enzyme-Linked Immunosorbent Assay
EPPO	European and Mediterranean Plant Protection Organization
EU	European Union
GLD	Grapevine Leafroll Disease
HORIZON	Horizon Europe (EU Research and Innovation Framework Programme)
IoT	Internet of things
PA	Practice abstract
PCR	Polymerase Chain Reaction
PLRV	Potato Leafroll Virus
PSS	Pest Surveillance System
QPs	Quarantine Pests
RNQPs	Regulated Non-Quarantine Pests
RPAS	Remotely Piloted Aerial Systems
UCP	Use Case Pilot
WP	Work Package

1 Introduction

Crop losses caused by pests and diseases threaten food security, biodiversity, and rural livelihoods. Regulated non-quarantine pests (RNQPs) and Quarantine Pests (QPs) reduce yields and incur economic losses and environmental damage. QPs are strictly regulated due to their potential to cause severe financial or environmental damage if introduced. RNQPs, though widespread, can still impact crop yield and quality. It is, therefore, crucial to minimise the presence of RNQPs and prevent the outbreaks of quarantine pests in new areas. Surveillance and containment measures and increased public awareness could help towards that goal while providing substantial cost reductions and lowering environmental and human health risks in Europe. However, the lack of effective monitoring and surveillance systems for both QPs and RNQPs remains a significant challenge.

The STELLA project ("Harnessing the Power of Digital Technologies to Protect Plants & the Environment"), funded under Horizon Europe (Project No. 101134750), aims to design and implement an innovative digital Pest Surveillance System (PSS). It seeks to advance pest monitoring and surveillance solutions, pioneer novel methodologies, and validate efficacy in real-world agricultural systems to protect plants and the environment. The system comprises three interconnected subsystems:

- An early warning system harnessing novel pest forecasting models and Internet of Things (IoT) sensors.
- A pest detection system leveraging remotely piloted aerial systems (RPAS), remote and proximal sensing, citizen science, and traps.
- A pest response system enabling data-driven decision-making for containment and mitigation measures.

The project validates its methodologies in six Use Case Pilots (UCPs) across five countries, focusing on eight key pests of economic and ecological significance. STELLA also pursues capacity building, stakeholder engagement, and policy development to support sustainable, digital pest management practices in line with EU objectives to reduce pesticide dependency and enhance resilience in agriculture.

This deliverable (D5.5) presents the first batch of 25 Practice Abstracts, offering targeted, user-friendly summaries of STELLA's ongoing work. A second batch (D5.6) of 35 Pas will be delivered in Month 46. The Practice Abstracts have been prepared based on project deliverables and partner contributions, aligned with the EIP-AGRI standard format to facilitate broad dissemination.

1.1 Identification of STELLA PAs

The partners identified the PAs in alignment with the project progress until M16 and the development of the project deliverables that can provide the necessary information. The project results that were identified are summarised below, along with the respective deliverables that were used as a source:

Table 1. Practice Abstracts – batch 1

A/A	Practice Abstract Title	Relevant Deliverable	Contributors
1	PA #1 STELLA Project: Empowering Practitioners with Digital Data Collection for Plant Health	STELLA_D2.1: Data Collection Protocols	ACTA, EDENCORE, Pessl Instruments, AUA-PL, IFV, BOKU, LAL, UCSC
2	PA #2 Alsace's Terroir and Digital Innovation: The STELLA Project's Use Case for Vineyard Surveillance	STELLA_D4.1: UCP baseline description and plan	BOKU, LAL, AUA-PL, IFV, AFL, AUA-SF, UCSC
3	PA #3 Pest Challenges in French Vineyards: Grapevine Leafroll Disease and Bois Noir – Detection, Impact, and Management Strategies	STELLA_D4.1: UCP baseline description and plan	BOKU, LAL, AUA-PL, IFV, AFL, AUA-SF, UCSC
4	PA #4 Conventional Vineyard Pest Monitoring and Detection Methods in France	STELLA_D4.1: UCP baseline description and plan	BOKU, LAL, AUA-PL, IFV, AFL, AUA-SF, UCSC
5	PA #5 Enhancing Viticulture Pest Monitoring through Digital Technologies in Alsace	STELLA_D4.1: UCP baseline description and plan	BOKU, LAL, AUA-PL, IFV, AFL, AUA-SF, UCSC
6	PA #6 Site Description and Regional Challenges: Ceratocystis platani in Evia, Greece	STELLA_D4.1: UCP baseline description and plan	BOKU, LAL, AUA-PL, IFV, AFL, AUA-SF, UCSC
7	2.6 PA #6 Site Description and Regional Challenges: Ceratocystis platani in Evia, Greece	STELLA_D4.1: UCP baseline description and plan	BOKU, LAL, AUA-PL, IFV, AFL, AUA-SF, UCSC
8	PA #8 Conventional Pest Monitoring and Detection Methods for Ceratocystis platani in Greece	STELLA_D4.1: UCP baseline description and plan	BOKU, LAL, AUA-PL, IFV, AFL, AUA-SF, UCSC
9	PA #9 Enhancing Ceratocystis platani monitoring in Greece with STELLA	STELLA_D4.1: UCP baseline description and plan	BOKU, LAL, AUA-PL, IFV,

			AFL, AUA-SF, UCSC
10	PA #10 Site Description and Regional Challenges for Enhanced Pest Monitoring in Lithuanian Potato Farming in Vilkaviškis	STELLA_D4.1: UCP baseline description and plan	BOKU, LAL, AUA-PL, IFV, AFL, AUA-SF, UCSC
11	PA #11 Pest Challenges in Lithuanian Potato Farming: Addressing Potato Leafroll Virus through the STELLA Project in the Vilkaviškis Region	STELLA_D4.1: UCP baseline description and plan	BOKU, LAL, AUA-PL, IFV, AFL, AUA-SF, UCSC
12	PA #12 Conventional Pest Monitoring and Detection Methods in Lithuanian Potato Farming: Baseline Assessment for the STELLA Project in Vilkaviškis	STELLA_D4.1: UCP baseline description and plan	BOKU, LAL, AUA-PL, IFV, AFL, AUA-SF, UCSC
13	PA #13 Potential Improvements to Pest Monitoring and Detection in Lithuanian Potato Farming with the STELLA Project	STELLA_D4.1: UCP baseline description and plan	BOKU, LAL, AUA-PL, IFV, AFL, AUA-SF, UCSC
14	PA #14 Site description & regional challenges – Ralstonia solanacearum case study in Emilia-Romagna region (Italy)	STELLA_D4.1: UCP baseline description and plan	BOKU, LAL, AUA-PL, IFV, AFL, AUA-SF, UCSC
15	PA #15 Pest challenges in processing tomato production in the Emilia-Romagna region (Italy)	STELLA_D4.1: UCP baseline description and plan	BOKU, LAL, AUA-PL, IFV, AFL, AUA-SF, UCSC
16	PA #16 Conventional pest monitoring and detecting the quarantine pest Ralstonia solanacearum in Emilia-Romagna region (Italy)	STELLA_D4.1: UCP baseline description and plan	BOKU, LAL, AUA-PL, IFV, AFL, AUA-SF, UCSC
17	PA #17 Updated phytosanitary measures to control Ralstonia solanacearum from the STELLA project	STELLA_D4.1: UCP baseline description and plan	BOKU, LAL, AUA-PL, IFV, AFL, AUA-SF, UCSC
18	PA #18 STELLA PSS for Improved Bull's Eye Rot Management in New Zealand Apples: Addressing Regional Challenges in Hawke's Bay	STELLA_D4.1: UCP baseline description and plan	BOKU, LAL, AUA-PL, IFV, AFL, AUA-SF, UCSC
19	PA #19 Addressing the Threat of Bull's Eye Rot in New Zealand Apples: Pest Challenges in Hawke's Bay	STELLA_D4.1: UCP baseline description and plan	BOKU, LAL, AUA-PL, IFV, AFL, AUA-SF, UCSC
20	PA #20 Limitations of Conventional Pest Monitoring for Latent Apple Diseases in New Zealand: The Case of Bull's Eye Rot	STELLA_D4.1: UCP baseline description and plan	BOKU, LAL, AUA-PL, IFV, AFL, AUA-SF, UCSC
21	PA #21 Enhancing Pest and Disease Monitoring in New Zealand Apples through the STELLA Project's Digital Technologies	STELLA_D4.1: UCP baseline description and plan	BOKU, LAL, AUA-PL, IFV, AFL, AUA-SF, UCSC

22	PA #22 Site description & Regional Challenges: Olive groves in Greece	STELLA_D4.1: UCP baseline description and plan	BOKU, LAL, AUA-PL, IFV, AFL, AUA-SF, UCSC
23	PA #23 Challenges of Verticillium dahliae and Pseudomonas savastanoi pv. savastanoi in olive trees	STELLA_D4.1: UCP baseline description and plan	BOKU, LAL, AUA-PL, IFV, AFL, AUA-SF, UCSC
24	PA #24_Conventional pest monitoring and detection methods of Verticillium dahliae and Pseudomonas savastanoi pv. savastanoi in Olive Trees	STELLA_D4.1: UCP baseline description and plan	BOKU, LAL, AUA-PL, IFV, AFL, AUA-SF, UCSC
25	PA #25 Enhancing Pest and Disease Monitoring in Olive Trees Using STELLA	STELLA_D4.1: UCP baseline description and plan	BOKU, LAL, AUA-PL, IFV, AFL, AUA-SF, UCSC

The PAs are uploaded to the EU CAP NETWORK project database and are available on the STELLA website.

1.2 Deliverable Overview and Report Structure

The document is outlined in three chapters and structured to present STELLA's Practice Abstracts, which will be used as components for the efficient and effective implementation of dissemination and communication of the project. This document is comprised of the following three chapters:

Chapter 1 provides a summary of the project scope and the document's overall structure;

Chapter 2 presents the Practice Abstracts;

Chapter 3 provides the conclusions.

2 Practice Abstracts

2.1 PA #1 STELLA Project: Empowering Practitioners with Digital Data Collection for Plant Health

A significant challenge for farmers and foresters is the timely and accurate detection of pests and diseases and understanding their development. The STELLA project addresses this by offering opportunities to utilise modern digital tools for more precise, rapid, and objective monitoring, potentially leading to time and cost savings and improved yields.

The STELLA project has established standardised data collection protocols and guidelines for various digital technologies. These include protocols for:

- Remote sensing: Utilising satellite and drone imagery to provide a broad overview of vegetation health across all crop types and architectures. For example, the protocol details are used in Copernicus, Sentinel-2, and commercial satellites.

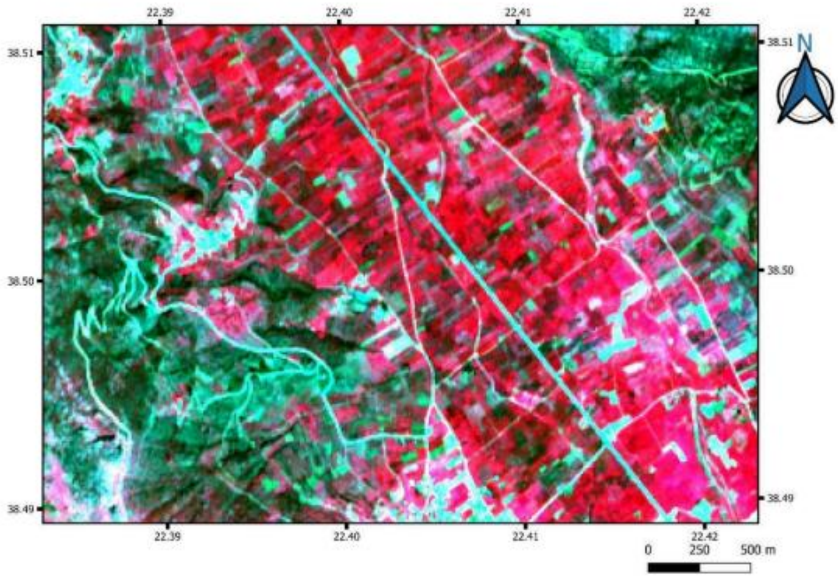

Figure 1. An example of False-Colour Composite Sentinel-2 Image of olive tree plantations in Greece (Source: acquired using GEE)

- Proximal sensing: Employing close-range sensors like the EDEN Viewer for detailed plant monitoring in crops with 3D or 4D architecture, such as orchards and vineyards.

Figure 2. The rear view of the EDEN viewer with the names of the buttons, LEDs, and terminals (Source: EDEN)

- IoT tools: Integrating weather stations and insect traps for continuous environmental and pest data acquisition across various crop types and geographical regions.

Figure 3. Example of an electronic insect trap installed in the field

- Crowdsourcing (citizen science): Using a smartphone application for collecting field observations and images from arable crops, orchards/vineyards, and forestry/wild forests, with guidelines tailored for different crop types and geographical variability.

These protocols aim to ensure accuracy, consistency, objectivity, and efficiency in data collection. They facilitate the integration of information across all sources within STELLA to develop improved pest-monitoring systems.

Practitioners can utilise these protocols developed by the STELLA project to begin integrating digital monitoring practices. It becomes possible to:

- Gather more comprehensive data regarding plant health and potential threats using standardised data collection and sharing methods.
- Potentially benefit from future pest and disease prediction tools developed using this standardised data collected within the STELLA project.
- Enable earlier detection of issues, allowing for timely interventions that can reduce damage and potentially lower the need for extensive treatments, leading to cost savings. For instance, proximal sensing with the EDEN Viewer aims to identify early disease symptoms in vineyards and orchards.
- Participation in crowdsourcing activities through the smartphone app allows for contribution to a broader understanding of plant health challenges across different regions, with protocols tailored for different user expertise levels.

While integrating new technologies, as outlined by the STELLA project, may require an initial investment of time and learning, the potential benefits include enhanced productivity through healthier plants, reduced operational costs, and more effective resource management. The crowdsourcing element also allows practitioners to actively contribute their field expertise to research efforts within the STELLA project. The STELLA WP2 datasets, protocols and guidelines will be made available to the scientific community, potentially expanding the scope and applicability of these technologies.

Additional dissemination and exploitation material(s): STELLA Project Website

URL(s): https://stella-pss.eu

2.2 PA #2 Alsace's Terroir and Digital Innovation: The STELLA Project's Use Case for Vineyard Surveillance

The STELLA project aims to enhance vineyard health monitoring in Alsace by integrating digital technologies. The Institut Français de la Vigne et du Vin (IFV) in Colmar leads this initiative, aiming to improve disease and pest surveillance using remote sensing, AI-driven analytics, and real-time monitoring tools.

Alsace is a well-known viticultural region in northeastern France. It is located along the foothills of the Vosges Mountains. This location offers a unique setting for testing and implementing digital pest and disease surveillance technologies because of its distinct characteristics. The Alsace vineyard spans approximately 15,500 hectares of cultivated land. It benefits from a semi-continental climate with cold winters, warm summers, and moderate rainfall. This climate, combined with a diverse range of soil types, creates an ideal environment for viticulture. The vineyards are mainly planted on steep slopes with excellent sun exposure, crucial for grape ripening and producing high-quality wines.

Figure 4. Alsace's vineyard, France (Source: CIVA)

Viticulture is a cornerstone of Alsace's cultural and economic identity. The region's vineyards produce world-renowned wines. Alsace's white wines are known for their purity, freshness, and strong expression of terroir. The area is home to four noble grape varieties—Riesling, Gewurztraminer, Pinot Gris, and Muscat—as well as Pinot Blanc, Sylvaner, and Pinot Noir. Pinot Noir is the only red variety permitted under the "Appellation d' Origine Contrôlée" (AOC) Alsace system.

The wines of Alsace are classified under three AOCs:

- **AOC Alsace** is the most common designation, covering a wide range of still wines.
- **AOC Alsace Grand Cru** is reserved for wines from 51 precisely defined terroirs, emphasising unique microclimatic and geological characteristics.
- **AOC Crémant d'Alsace** is a highly regarded sparkling wine produced using the traditional method.

A distinctive feature of Alsace wines is their traditional bottle shape, the Flûte d'Alsace, which reflects centuries-old winemaking traditions. Many vineyards in the region embrace sustainable, organic, or biodynamic viticultural practices, further reinforcing Alsace's reputation for high-quality, environmentally conscious wine production.

Figure 5. The Alsacian wine bottle: "Flûte d'Alsace", (Source: CIVA)

Beyond wine production, Alsace's vineyards are deeply rooted in the region's cultural, economic, and environmental landscape. Alsace is a renowned wine tourism destination. Its picturesque villages, medieval castles, and vibrant local gastronomy attract visitors. The Alsace Wine Route offers an immersive experience where wine lovers can explore historic wineries, taste exceptional wines, and engage with passionate winemakers.

In the framework of the STELLA project, we selected a diverse network of eight vineyard plots covering 3.6 hectares. The pilot sites are strategically distributed across Alsace's vineyard to represent various environmental conditions, soil compositions, microclimates, and vineyard management practices, including conventional, organic, and biodynamic approaches. The pilot sites allow researchers to assess the effectiveness of the STELLA Pest Surveillance System (PSS) in monitoring and managing major grapevine diseases like Grapevine Leafroll Disease and Bois Noir.

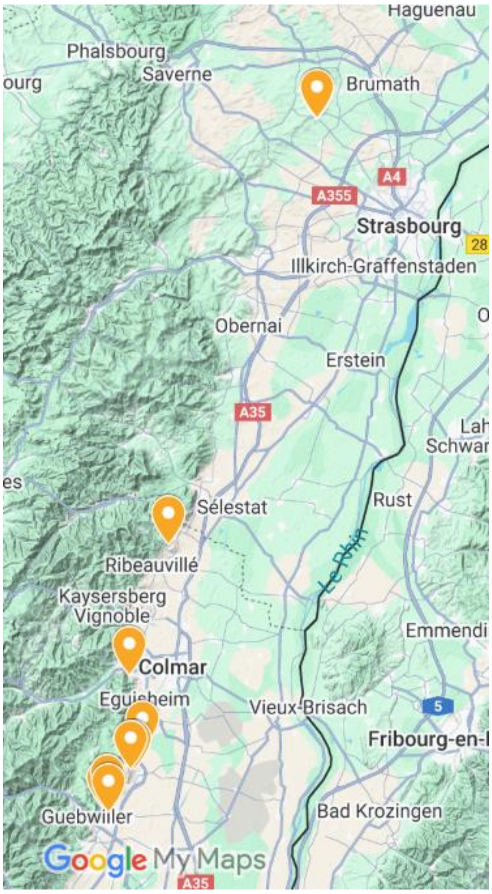

Figure 6. Map of the plots of the French UCP (Source: Google Maps)

The plots of the French Use Case Pilot also feature a variety of grape selections, including Auxerrois, Chardonnay, Sylvaner, and Pinot Noir, and represent both sparkling and still wine production styles. INRAE of Colmar (the French National Institute of Research in Agriculture and Environment), a local agricultural high school, and cooperative winegrowers own and manage these plots and ensure a comprehensive evaluation across different operational scales and approaches.

The STELLA project aims to develop and validate digital tools to address the increasing disease pressure and contribute to a more sustainable and resilient future for the region's vital wine industry.

Additional dissemination and exploitation material(s): STELLA Project Website

URL(s): https://stella-pss.eu/

Geographical Location

The research and innovation activities for the French UCP (UCP1) are taking place in the Alsace region in northeastern France.

2.3 PA #3 Pest Challenges in French Vineyards: Grapevine Leafroll Disease and Bois Noir – Detection, Impact, and Management Strategies

The STELLA project is focused on utilising digital technologies to enhance pest monitoring and decision-making in vineyards in Alsace, northeastern France. Specifically, it addresses Grapevine Leafroll Disease (GLD) and Bois Noir (BN).

GLD is caused by Grapevine Leafroll-associated Viruses (GLRaVs). These viruses disrupt the transport of sugars in the vine, leading to characteristic symptoms such as leaf discolouration and nerves remaining green—red in red grape varieties and yellow in white ones—as well as leaf rolling. GLD is mainly transmitted by mealybugs and soft-scale insects, with an increasing prevalence linked to climate change, pest management practices, and the global exchange of plant material.

The disease's causal agents include GLRaVs ranging from 1 to 8, but GLRaV-1, 2, and 3 are particularly impactful. An important aspect is that GLRaV-2 can also cause graft incompatibility. The main transmission routes are through vector insects and infected plant material, highlighting the necessity for certified virus-free planting material. The symptoms of GLD can vary significantly depending on the grape variety and the specific virus strain, often leading to delayed ripening, reduced vine vigour, and lower yields.

Several methods are employed for disease detection: biological indexing involves grafting onto susceptible indicator varieties, ELISA (Enzyme-Linked Immunosorbent Assay) detects viral antigens, and PCR (Polymerase Chain Reaction) offers a highly sensitive molecular method. The impact of GLD on vineyards is economically devastating; it can result in yield losses, reduced vine lifespan, and higher production costs, which collectively diminish grape and wine quality.

Figure 7. GLD leaf symptoms on Pinot Noir (Source: IFV)

In contrast, Bois Noir (BN) is caused by *Candidatus Phytoplasma solani*, a type of phytoplasma belonging to the Stolbur group. This pest disrupts nutrient and water transport within the plant's phloem and is classified as a Regulated Non-Quarantine Pest (RNQP). BN has a wide host range that includes wild plants such as nettles and bindweed, which serve as reservoirs for the phytoplasma. BN transmission primarily occurs through the insect vector *Hyalesthes obsoletus*, a planthopper, with its spread influenced by vector populations, climate factors, and the presence of reservoir plants.

Figure 8. Parthenolecanium corni, one of the vectors of GLD (Source: IFV)

Figure 9. Symptoms of Bois Noir on Gamay - Gaillac, South-West (France), (Source: IFV)

Figure 10. Vector of Bois noir, Hyalesthes obsoletus (France), (Source: IFV)

Symptoms of Bois Noir can also vary, including foliage discolouration, delayed lignification, and bunch abortion. These signs are identical to those of Flavescence Dorée. Detection methods for BN include field observation of symptoms, which can be unreliable, and molecular detection techniques, such as PCR, which provide more accurate confirmation.

The overall impact of BN entails reduced yield and grape quality, shortened vine longevity, and significant economic losses. Indirectly, BN complicates disease management by masking the detection of Flavescence Dorée, a regulated quarantine organism. This increases survey costs as extensive efforts are required to differentiate between diseases and accurately assess the extent of BN infection. Management strategies for both GLD and BN emphasise a comprehensive and integrated approach. For GLD, this encompasses using certified, virus-free planting material, advancing knowledge and detection techniques, and controlling vector populations. In the case of BN, vector control and managing surrounding reservoir plants are crucial.

The STELLA project aims to provide innovative solutions incorporating digital technologies and decision-support tools, facilitating more precise vineyard management. This includes early disease detection and optimised intervention strategies, marking a significant step towards a more sustainable and resilient viticulture.

Additional dissemination and exploitation material(s): STELLA Project Website

URL(s): https://stella-pss.eu

Geographical Location:

The research and innovation activities for the French UCP (UCP1) are taking place in the Alsace region in northeastern France.

2.4 PA #4 Conventional Vineyard Pest Monitoring and Detection Methods in France

French vineyards, particularly in Alsace, face significant threats from Grapevine Leafroll Disease (GLD) and Bois Noir (BN), impacting grape yield and quality. Current methods for detecting and monitoring these diseases are often complex, time-consuming, and can lead to errors. The goal is to improve how these diseases are managed to protect the harvests.

Current Methods & Challenges:

- **Visual Field Inspections:** This is the primary method where you look for symptoms like leaf discolouration and rolling for GLD and yellowing leaves and shrivelled berries for BN. However, these symptoms are sometimes not specific to the disease. They can differ depending on the grape variety, time of year, and environmental conditions, making it easy to misdiagnose or miss infections, especially with white grapes. These surveys can also be costly and time-consuming; for example, a visual survey in Alsace costs around €11.52 per hectare. There are also regional surveys conducted annually by FREDON in Alsace for Yellowing diseases (BN and Flavescence Dorée), which cost a significant amount (€150,000 – €200,000 per year).
- **Trapping and Population Monitoring:** For GLD, the focus is on mealybugs and soft-scale insects that spread the disease. For BN, leafhoppers are the main culprits, and yellow sticky traps are used to see how many are present. Knowing when these insects are active helps time treatments.
- **Laboratory-based Diagnostics:** If you suspect GLD or BN, lab tests like ELISA and PCR can confirm the presence of the viruses and bacteria causing these diseases. Testing early in the season is essential to decide what actions to take. The only way to confirm BN is through expensive lab tests (PCR, costing around €25 per sample).

Potential Improvements with STELLA:

The STELLA project aims to improve pest and disease monitoring by using modern digital tools like onboard cameras, drones, satellites, connected traps, weather stations, and artificial intelligence. The idea is to move from reacting to disease outbreaks to predicting them, allowing for more targeted and effective management. This could lead to:

- More accurate and faster detection of pests and diseases across larger areas.
- Automated monitoring of the insects that spread these diseases, saving you time and effort.

- Better decisions on when and where to act, potentially reducing the treatments needed and improving your yields.

Practical Implications & Potential Benefits:

While the STELLA project is ongoing (2024-2027), the goal is to provide tools that will ultimately be:

- More cost-effective than intensive manual scouting and widespread treatments.
- More efficient, allowing you to focus your time and resources where needed.
- Better for the environment by enabling more precise and targeted interventions, reducing the overall use of pesticides.
- Improved yields and quality by catching and managing problems earlier.

The project aims to create a holistic digital system that provides early warnings and supports informed decision-making using modern technology. Stay tuned for developments from the STELLA project, as it could offer valuable new tools to help you manage vineyard pests and diseases more effectively.

Additional dissemination and exploitation material(s): STELLA Project Website

URL(s): https://stella-pss.eu

Geographical Location

The research and innovation activities for the French UCP (UCP1) are taking place in the Alsace region in northeastern France.

2.5 PA #5 Enhancing Viticulture Pest Monitoring through Digital Technologies in Alsace

The health of vineyards in regions such as Alsace, a well-known viticultural area in northeastern France, faces increasing threats, notably from the prevalence of Grapevine Leafroll Disease (GLD) and Bois Noir (BN). These diseases considerably impact the quantity and quality of grape yields, thereby underscoring the necessity for enhanced monitoring and management approaches. In response to these challenges, the French Use Case Pilot (UCP 1) within the STELLA project is integrating advanced digital technologies. These include onboard cameras, drones, satellites, connected traps, weather stations, and soil sensors, all aimed at improving the detection of pests and supporting more informed decision-making processes.

Effective pest monitoring is paramount for the sustainable management of vineyards. However, several challenges exist in current practices, particularly concerning the early detection of pests and diseases, tracking their spread, and using data to drive management decisions. Digital tools offer a significant opportunity to enhance the accuracy and efficiency of pest surveillance. The STELLA project intends to contribute to this improvement by introducing innovative solutions for pest surveillance.

Traditional methods of pest monitoring in viticulture face several limitations. Visual assessments, often relied upon by growers, are inherently subjective, demand significant labour input, and are susceptible to errors. While more precise, laboratory testing methods, such as PCR and ELISA, are associated with high costs and are time-consuming, making them less scalable for widespread routine monitoring. Furthermore, the surveillance of disease vectors, such as mealybugs and leafhoppers, presents difficulties in tracking their populations and dynamics. Another significant challenge is data fragmentation related to pest occurrences and the lack of standardised and centralised record-keeping systems.

The STELLA project aims to overcome these limitations and enhance pest monitoring by applying several key digital technologies and methodologies.

Remote Sensing and Artificial Intelligence (AI)-Powered Image Analysis: One of STELLA's core innovations involves using remote sensing technologies, specifically drones and satellite imagery, to detect vineyard symptoms that may indicate pest infestation or disease. These aerial and space-based platforms can cover large areas efficiently, providing a broad overview of vineyard health that might be challenging to obtain through ground-based visual inspections alone. However, the data these imaging systems capture requires sophisticated analysis to be truly informative. This is where AI-based image processing plays a crucial role. By training algorithms on known patterns of disease symptoms, such as those caused by GLD and Bois Noir, the system can automatically analyse the imagery and differentiate between these and other potential causes of plant stress. This technology has the potential to enable earlier detection of problems, even before they become readily apparent to the human eye.

Real-Time Data Integration and Smart Monitoring Systems: STELLA also integrates multiple data sources in real-time to understand pest and disease dynamics. This includes connecting field data with information from weather stations and climatic models. By analysing how weather conditions correlate with pest lifecycles and disease development, it becomes possible to develop predictive models for pest outbreaks. Furthermore, the project explores using Internet of Things (IoT) sensors for the real-time monitoring of vector populations. These sensors, such as connected traps, can continuously monitor the presence and abundance of key pests, providing timely alerts and valuable data on their population dynamics. This real-time data integration facilitates a more proactive and responsive approach to pest management.

Automated Decision-Support Tools: The wealth of data generated and analysed within the STELLA framework is channelled into automated decision-support tools designed to assist growers and other stakeholders. One key aspect is the development of early warning systems. By combining predictive models with real-time monitoring data, these systems can alert growers to potential pest outbreaks or disease risks, allowing timely intervention. Risk assessment models are also being developed, integrating historical and real-time data to provide a more nuanced understanding of the factors contributing to pest and disease pressure. Furthermore, STELLA aims to establish the STELLA PSS platform, which utilises advanced technologies such as smart sensors, drones, satellite images, and AI models to detect and track diseases in real-time. The Stella PSS will facilitate collaborative data sharing among growers, researchers, and policymakers. This can lead to a more coordinated and effective regional approach to pest management.

Implementing STELLA's enhanced pest monitoring system is expected to yield significant benefits for growers and other stakeholders in the viticulture sector.

Earlier and More Accurate Detection: Remote sensing and AI-powered analysis can detect pests and diseases earlier and more accurately, potentially significantly reducing the spread of these problems within vineyards. Early detection allows for targeted interventions before infestations or infections become widespread, which can lead to substantial reductions in treatment costs. By identifying affected areas more precisely, growers can focus their efforts and resources where they are most needed.

Better-Targeted Control Strategies: The detailed and timely information provided by STELLA's system enables the implementation of better-targeted control strategies. This includes optimising pesticide use and ensuring that treatments are applied only when and where necessary, thereby reducing the overall environmental impact and costs associated with chemical applications. Furthermore, the insights gained can support adopting integrated pest management (IPM) practices, which emphasise a more holistic and sustainable approach to pest and disease control.

Cost Savings and Efficiency Improvements: STELLA can generate significant cost savings and efficiency improvements for vineyard operators by providing early warnings and facilitating more precise interventions. Remote monitoring provides a continuous overview of vineyard health, reducing the need for frequent and potentially unnecessary field inspections. Similarly, the more targeted use of laboratory tests, guided by the system's alerts and analysis, can lower diagnostic costs. Overall, these efficiencies contribute to a more economically sustainable vineyard operation.

Improved Vineyard Resilience: In the face of increasing climate variability and evolving pest pressures, the tools and knowledge provided by STELLA are expected to improve vineyard resilience. By enabling proactive and informed management decisions, growers can better protect their crops and ensure their vineyards' long-term health and productivity.

Additional dissemination and exploitation material(s): STELLA Project Website

URL(s): https://stella-pss.eu

Geographical Location

The research and innovation activities for the French UCP (UCP1) are taking place in the Alsace region in northeastern France.

2.6 PA #6 Site Description and Regional Challenges: *Ceratocystis platani* in Evia, Greece

Evia, Greece's second-largest island and the third-largest in the eastern Mediterranean, is known for its unique natural landscapes and rich cultural heritage. Among its natural treasures are naturally occurring forests of plane trees (*Platanus orientalis*), which are now under severe threat from an invasive deadly fungus called *Ceratocystis platani*. First detected in Greece in 2003, this fungus causes canker stain disease, spreading rapidly and devastating plane trees across the country.

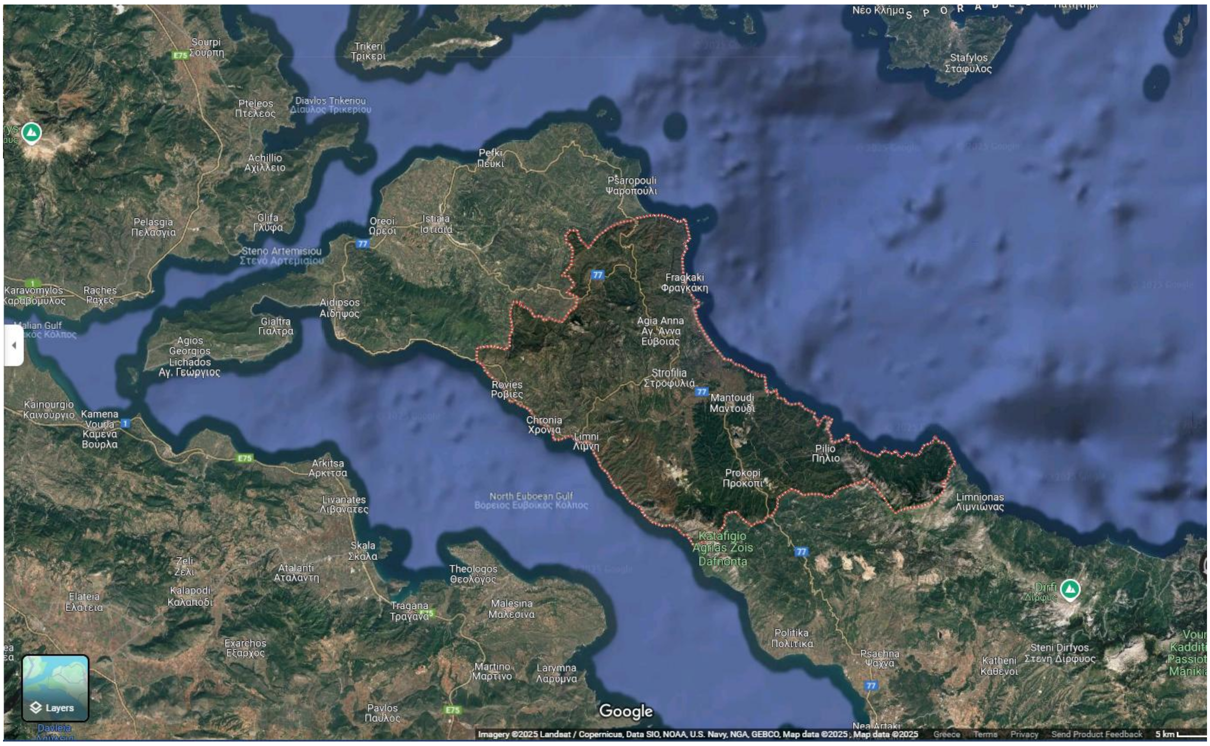

Figure 11. Mantoudi-Limni-Agia Anna, North Evia, Greece (Source: Google Maps)

This disease has caused an ecological disaster in Evia island since 2017, killing hundreds of centuries-old plane trees, particularly along riverbanks. In recent years, the selected case study area, the Municipality of Mantoudi-Limni-Agia Anna in North Evia, has been repeatedly struck by severe natural disasters. Extreme weather events such as cyclone Zorbas in 2018, a massive wildfire in 2021, and storms Daniel and Elias in 2023 have intensified environmental degradation and further worsened the pathogen's spread.

According to local authorities of the municipality of Mantoudi-Limni-Agia Anna, more than 80% of the plane trees in the area are now infected. So far, more than 3,000 infected trees have been cut down, with another 1,200 trees expected to be removed soon. Among the losses were trees of exceptional aesthetic and cultural significance, some over 500 years old and declared as "Monuments of Nature." In some areas, the disease has spread so much that eradication is no longer feasible where the disease has reached epidemic proportions.

Figure 12. Infected plane trees along the Kireas River in the Mantoudi-Limni-Agia Anna region (Source: AUA)

The STELLA EU Horizon project aims to control the spread of *C. platani* through continuous monitoring, timely interventions, and preventive measures. The first monitoring sites were established in the Kireas plane forest near Mantoudi and Prokopi, close to the Kireas River, a natural pathway for the disease. These locations were also chosen for their proximity to populated and touristic areas, increasing visibility and public awareness. A key aspect of the project is engaging local communities in monitoring efforts, raising awareness, and encouraging protective measures to safeguard the island's iconic plane forests.

A crucial tool in this project is the STELLA PSS platform, which utilises advanced technologies such as smart sensors, drones, satellite images, and AI models to detect and track diseases in real-time. This modern approach replaces outdated, labour-intensive methods with an efficient and automated system, making disease control more cost-effective. By combining cutting-edge technology with community involvement, STELLA seeks to mitigate the impact of *C. platani*, preserve Evia's natural and cultural heritage, and serve as a model for sustainable disease management in other regions facing similar challenges. The success of this initiative relies on collaboration between local authorities, research institutions, policymakers, and citizens, all working together to protect Evia's invaluable plane forests.

Additional dissemination and exploitation material(s): STELLA Project Website

URL(s): https://stella-pss.eu

Geographical Location

The research and innovation activities for this Greek UCP (UCP2) are taking place in the Municipality of Mantoudi-Limni-Agia Anna area in North Evia.

2.7 PA #7 Pest challenges: *Ceratocystis platani*

Ceratocystis platani, a highly destructive fungal pathogen, is the primary cause of canker stain disease in plane trees (*Platanus* spp.). This invasive fungus leads to severe tree decline and mortality within 3 to 7 years. First identified in Greece in 2003, the disease has rapidly spread across several regions, including Messenia, Arkadia, Ilia, Epirus, and Thessaly, resulting in significant economic and environmental damage. Outbreaks have been particularly severe in urban and riparian areas, where plane trees are essential for ecosystem stability. Since these trees are often located in remote forests and private gardens, monitoring them is difficult, allowing the disease to spread further. Their loss poses serious threats to biodiversity, tourism, and local economies, particularly in areas of historical and recreational significance.

The disease spreads rapidly through infected plants, wood, soil, and unclean tools, as well as through wind, water, animals, insects and even root connections. The fungus infects plane trees through wounds in the bark, rapidly growing and blocking the tree's ability to transport water and nutrients. Initial symptoms include leaf yellowing and wilting, stunted growth, branch dieback, and full canopy desiccation. Once infected, trees cannot recover and typically die within months to a few years, depending on their size and vigour. In *Platanus orientalis*, the dominant plane tree species in Greece, cankers are often hidden beneath thick, rough bark, delaying symptom recognition and allowing the disease to advance unnoticed.

Figure 13. Plane trees showing advanced dieback after infection by Ceratocystis platani (Source: AUA)

Managing *C. platani* is challenging due to its aggressive nature and lack of effective chemical treatments. Prevention remains the only effective control strategy. Strict biosecurity measures—such as disinfecting pruning tools, using disease-free planting material, and carefully handling infected trees—are essential to limit further spread. However, enforcement of these measures is inconsistent, and the extensive distribution of plane trees in urban and riparian environments makes containment efforts labour-intensive and costly.

To enhance disease management, the STELLA Horizon EU Project is exploring innovative approaches, including remote sensing technology for early symptom detection, IoT devices for environmental monitoring, and predictive models to assess outbreak risks. Collaboration among local authorities, scientists, and the public is crucial for improving surveillance and controlling the spread of *C. platani*. Increasing public awareness and community involvement can strengthen monitoring efforts, enhance early detection, and reduce management costs. By integrating advanced technology, research, and coordinated action, Greece can work toward safeguarding its plane tree populations and preserving their ecological, cultural, and economic significance.

Additional dissemination and exploitation material(s): STELLA Project Website

URL(s): https://stella-pss.eu/

Geographical Location:

The research and innovation activities for the Greek UCP (UCP2) are taking place in the Municipality of Mantoudi-Limni-Agia Anna area in North Evia.

2.8 PA #8 Conventional Pest Monitoring and Detection Methods for *Ceratocystis platani* in Greece

Ceratocystis platani is a regulated fungal pathogen responsible for canker stain disease in plane trees. This disease has caused severe outbreaks in Greece, particularly in the region's natural populations of *Platanus orientalis*, the predominant plane tree species. To protect plane tree populations, Greek authorities conduct nationwide surveys every year. These surveys collect samples from natural forests and urban landscapes and produce import or trade plane trees. Collected samples are sent to official laboratories, where they undergo analysis to confirm the pathogen's presence using visual assessments and molecular techniques. These diagnostic methods follow the European and Mediterranean Plant Protection Organization (EPPO) standards to ensure accurate identification and control. The disease can be visually detected between May and September when canopy symptoms become apparent, while canker stains on tree trunks can be observed throughout the year. However, in *P. orientalis*, the thick and rough bark can conceal cankers, delaying symptom identification and allowing the infection to progress undetected.

Although the conventional monitoring system in place plays a vital role in managing *C. platani*, it also faces several challenges. Visual inspections and field sampling demand specialised expertise, significant labour, and substantial time investment, making them particularly difficult in large areas or dense forests. Laboratory analysis of samples, while practical, is often costly and time-consuming, which can delay the identification of pest outbreaks and response efforts. Additionally, many plane trees grow in remote, hard-to-reach areas, making it difficult for inspectors to access them quickly and efficiently. The main challenge for the surveillance of *C. platani* is the early detection of new disease foci. By the time the pathogen is identified - whether in the field or the laboratory- it may have already spread to nearby and distant trees through root connections, water movement, contaminated soil, wood, and cutting tools or machinery. These challenges show the need for faster, more affordable ways to detect pests and respond quickly. Better tools and methods can help make the process easier, lower costs, and speed up detection to protect plant health and stop pests from spreading.

Additional dissemination and exploitation material(s): STELLA Project Website

URL(s): https://stella-pss.eu

Geographical Location

The research and innovation activities for the Greek UCP (UCP2) are taking place in the Municipality of Mantoudi-Limni-Agia Anna area in North Evia.

2.9 PA #9 Enhancing *Ceratocystis platani* monitoring in Greece with STELLA

The canker stain disease, caused by the fungus *Ceratocystis platani*, poses a significant threat to plane trees in Greece. With the pathogen already widespread and reaching epidemic levels in some areas, eradication is no longer an option. Instead, efforts must focus on tracking its spread to prevent further outbreaks in new regions. Traditional monitoring methods, such as visual inspections and laboratory testing, are effective but time-consuming and expensive, and they often detect the disease too late. Early detection is crucial to prevent the pathogen's spread, which can easily move between trees through roots, contaminated water, soil, and cutting tools.

The STELLA platform offers a modern approach to disease monitoring by integrating digital tools like IoT sensors and remote sensing technologies. By replacing manual inspections with automated data collection, STELLA enhances efficiency and accuracy while reducing costs. To overcome accessibility challenges, drones and satellite imagery provide comprehensive spatial monitoring, ensuring that even remote forested areas are included in surveillance efforts.

Figure 14. UAV monitoring of pathogen-infected Platanus trees along the Kireas River (Source: AUA)

These tools can track disease spread more efficiently than traditional methods, making it easier to map affected areas and take quick action. This reduces the need for labour-intensive inspections and speeds up response efforts. The system also predicts outbreaks by monitoring environmental conditions and the presence of the fungus, quickly alerting authorities so they can act and prevent the disease from spreading in time. Another advantage of STELLA is its ability to involve local communities. Through mobile apps and citizen science initiatives, foresters and the general public can contribute to disease tracking by reporting potential infections and expanding the monitoring network. The platform also provides training material to help professionals utilise advanced monitoring technologies, equipping them with essential skills for effective disease management. By combining innovative technology with collaborative efforts, STELLA can significantly improve the detection and control of *C. platani* in Greece. This approach minimises pest identification and response delays, helping slow the fungus spread and protect Greece's valuable plane tree populations.

Figure 15. Weather sensor installation in the UCP at Mantoudi-Limni-Agia Anna (Source: AUA)

Additional dissemination and exploitation material(s): STELLA Project Website

URL(s): https://stella-pss.eu

Geographical Location

The research and innovation activities for this Greek UCP (UCP2) are taking place in the Municipality of Mantoudi-Limni-Agia Anna area in North Evia.

2.10 PA #10 Site Description and Regional Challenges for Enhanced Pest Monitoring in Lithuanian Potato Farming in Vilkaviškis

The Lithuanian Use Case Pilot (UCP3) is situated in the **Vilkaviškis region in the southwest of Lithuania**. This region has **four distinct seasons** with an average annual temperature of **+7.9°C**. The yearly precipitation reaches approximately **598 mm**, with the highest amount typically occurring in July. The annual average air humidity is around 80%. The prevailing soil group in Vilkaviškis is categorised as **Group I soils**, which have very good economic value. Potato farming holds significant importance in the Vilkaviškis region, playing a key role in the **local community and economy**, with approximately **500 hectares** dedicated to potato cultivation annually.

Figure 16. The Vilkaviškis region in the southwest of Lithuania (Source: Google Maps)

Despite these favourable conditions, **potato farmers in the Vilkaviškis region face significant challenges in pest management**, with the **Potato Leafroll Virus (PLRV)** being a primary concern. PLRV can cause **necrosis of the phloem tissue in potato plants**, leading to potential yield losses.

Effective control measures for PLRV depend on timely intervention, including managing environmental factors and selecting appropriate crop varieties. Therefore, **early detection and preventive strategies are crucial** to mitigate the spread and impact of this virus.

The **STELLA project** aims to address these regional challenges in the Vilkaviškis region by developing and implementing its **Pest Surveillance System (PSS)**. The PSS intends to integrate an **early warning system**, a **pest detection system** potentially utilising technologies such as satellite imaging and pest traps, and a **pest response system**. By introducing digital tools for enhanced monitoring and early detection of pests like PLRV, the STELLA project seeks to provide potato farmers in the Vilkaviškis region with the means to make more proactive and effective pest management decisions, ultimately aiming to **reduce yield losses and improve the sustainability of potato production** in the area. User requirements analysis indicated potential benefits of the PSS in **reducing yield losses** and improving pest control.

The **selection of the Vilkaviškis region** was based on several key criteria. These included considering climate changes and monitoring **pest migration from central Europe**. Furthermore, the **willingness of local farmers to collaborate closely** was a very important factor in the selection process. The diverse conditions presented by selecting fields of **varying sizes and layouts** and **diverse soil conditions** were also considered beneficial for testing the STELLA PSS under different scenarios. Including fields with varying levels of crop health and proximity to water sources were additional factors in the selection. Ensuring **field accessibility for regular monitoring** was also a key consideration.

Additional dissemination and exploitation material(s): STELLA Project Website

URL(s): https://stella-pss.eu

Geographical Location:

The research and innovation activities for the Lithuanian UCP (UCP3) are taking place in the Vilkaviškis district, located in southwestern Lithuania.

2.11 PA #11 Pest Challenges in Lithuanian Potato Farming: Addressing Potato Leafroll Virus through the STELLA Project in the Vilkaviškis Region

Potato farming in the Vilkaviškis region of Lithuania is significantly challenged by pests, most notably the **Potato Leafroll Virus (PLRV).** PLRV can cause up to 50% yield loss in potato crops by reducing the quality and quantity of the harvest. Aphids transmit the virus, and controlling its spread heavily depends on understanding their life cycles.

Figure 17. Aphids of the Potato Leafroll Virus (PLRV), (Source: AFL)

Effective control measures include pest monitoring, early detection, and prevention in the right place and time, as well as breeding and managing environmental conditions. Current conventional agri-technical solutions in the region have limitations in effectively controlling specific pests and diseases like PLRV. Early detection and preventive measures are crucial for preventing the spread of PLRV. Farmers in the region are seeking improved methods for pest monitoring and early detection to mitigate these losses.

Figure 18. Necrosis of the phloem tissue of potato after infection by PLRV (Source: AFL)

The STELLA project's Lithuanian Use Case Pilot (UCP3), located in the Vilkaviškis district in the southwestern part of Lithuania, explicitly targets the challenge of PLRV. The STELLA PSS implemented in this UCP includes satellite imagery and connected/smart insect traps. These technologies aim to provide a more advanced and potentially earlier detection of pests and diseases than existing methods. The project also intends to develop a holistic digital system to aid in the early warning and detection of regulated pests like PLRV alongside a response strategy using modern sensing technology and Artificial Intelligence.

Farmers in the Vilkaviškis region hope the STELLA PSS will reduce yield losses, improve pest control, enhance potato quality, optimise pesticide use, and prevent plant diseases. The platform's expected features include compatibility with existing tools, ease of use, and adaptability to specific needs.

Additional dissemination and exploitation material(s): STELLA Project Website

URL(s): https://stella-pss.eu

Geographical Location

The research and innovation activities for the Lithuanian UCP (UCP3) are taking place in the Vilkaviškis district, located in southwestern Lithuania.

2.12 PA #12 Conventional Pest Monitoring and Detection Methods in Lithuanian Potato Farming: Baseline Assessment for the STELLA Project in Vilkaviškis

Potato farming in the Vilkaviškis region of Lithuania employs conventional agri-technical solutions for pest control. However, the specific methods used for monitoring and detecting pests, such as the Potato Leafroll Virus (PLRV), have limitations. Understanding these current practices is crucial for evaluating the potential improvements offered by the STELLA project. The objective is to describe the existing approaches to pest management and identify areas where innovation is needed.

Current pest control in the Vilkaviškis region relies on general agri-technical principles:

- Crop rotation
- Consideration of different field sizes and soil types
- Awareness of proximity to water sources
- Seedbed preparation
- Liming
- Irrigation
- Variety selection
- Consideration of environmental conditions
- Determining planting time

Beyond these general practices, few alternative chemical control methods exist for specific pests. Manual collection of the first larvae in small areas is practised for the Colorado beetle, and for larger areas, special machines mechanically shake off beetles. However, insecticides are the primary method for controlling aphids, which transmit PLRV, especially on seed crops. The survey conducted within the STELLA project indicates that, for the most part, respondents had not participated in pest monitoring activities (75%), and none had encountered the application of digital tools in the fields.

The current conventional methods in the Vilkaviškis region for pest monitoring appear to be limited, particularly for early detection and specific pest identification beyond well-established pests like the Colorado beetle. The heavy reliance on general agricultural practices and reactive measures like insecticide application for aphids highlights a need for more proactive and targeted approaches. The lack of experience with digital tools suggests that introducing the STELLA PSS will require user-friendly interfaces and adequate training to ensure adoption. The anticipated improvements with STELLA, such as using pest traps and satellite imaging, aim to enhance the identification of pests, enable early warning, and provide a basis for more targeted interventions, potentially reducing reliance on broad-spectrum treatments.

Additional dissemination and exploitation material(s): STELLA Project Website

URL(s): https://stella-pss.eu

Geographical Location:

The research and innovation activities for the Lithuanian UCP (UCP3) are taking place in the Vilkaviškis district, located in southwestern Lithuania.

2.13 PA #13 Potential Improvements to Pest Monitoring and Detection in Lithuanian Potato Farming with the STELLA Project

Current conventional pest monitoring and detection methods in the Vilkaviškis region of Lithuania rely on general agri-technical principles and primarily reactive measures, such as insecticide application for aphid control, the vector of Potato Leafroll Virus (PLRV). There is a lack of widespread involvement in pest monitoring initiatives and limited experience with digital tools among farmers. The objective is to introduce and evaluate the potential of the STELLA Pest Surveillance System (PSS) to offer more effective and timely pest monitoring and detection methods, specifically for PLRV and other relevant pests in potato farming.

The STELLA project's Lithuanian Use Case Pilot (UCP3) aims to significantly improve pest monitoring and detection by implementing a holistic digital system.

Figure 19. Smart trap, (Source: AFL)

This system includes:

- The use of connected/smart insect traps for improved pest identification and early detection.
- The application of satellite imagery to provide a broader overview of crop health and potentially identify areas at risk.

- The development of an early warning system harnessing novel pest forecasting models and Internet of Things (IoT) sensors.
- A pest detection system leveraging the technologies above to enable earlier and potentially more accurate identification of regulated pests like PLRV.
- A vision for a pest response system that will furnish geolocated hotspots for initiating containment and counteractive measures. The intention is to move beyond the limited alternative means of controlling specific pests and diseases currently available.

The implementation of the STELLA PSS is anticipated to offer several key benefits for potato farmers in the Vilkaviškis region:

- **Improved identification of pests:** Utilising traps and satellite imagery will allow for more specific and potentially earlier identification of threats.
- **Reduction of affected areas:** Timely detection should lead to quicker intervention and limit the spread of pests and diseases like PLRV.
- **Reduced crop damage:** Early warning and detection can enable preventative or early-stage control measures, minimising the impact on yield and quality.
- **Improved yield:** Effective pest and disease management can positively impact farmers' harvests.
- **Development of a holistic digital system:** This system will aid in the early warning and detection of regulated pests through modern sensing technology and Artificial Intelligence, offering a more integrated approach to pest management.

Farmers in the region have expressed hope that the PSS will reduce yield losses, improve pest control, enhance potato quality, optimise pesticide use, and prevent plant diseases. The success of these improvements will depend on the platform's user-friendliness, compatibility with existing tools, and adaptability to their specific needs.

Additional dissemination and exploitation material(s): STELLA Project Website

URL(s): https://stella-pss.eu

Geographical Location:

The research and innovation activities for the Lithuanian UCP (UCP3) are taking place in the Vilkaviškis district, located in southwestern Lithuania.

2.14 PA #14 Site description & regional challenges – *Ralstonia solanacearum* case study in Emilia-Romagna region (Italy)

Italy is the third largest producer of processing tomatoes worldwide after the USA and China and the first exporter of tomato products. In Northern Italy, the Emilia-Romagna region plays a significant role in tomato production, accounting for 68.8% of the cultivated area dedicated to tomato production. This crop significantly contributes to the region's agricultural economy (in 2022, the value of the processing tomato supply chain was equal to 44.6 billion euros), providing jobs in farming and related sectors, such as food processing. On average, the number of tomato producers in Northern Italy is 2,000, organised in 13 producer organisations (POs).

The areas surrounding Parma and Piacenza are particularly suitable for processing tomato cultivation in the Emilia-Romagna region due to their humid sub-tropical climate. The "OI Pomodoro da Industria nel Nord Italia", the central inter-branch organisation in this area, serves as a governance body for the tomato supply chain, facilitating decision-making among producers and processors. In 2024, the hectares intended for tomato production in Italy were about 75 thousand, and the total output was about 5 tons, yielding 69.5 t/ha.

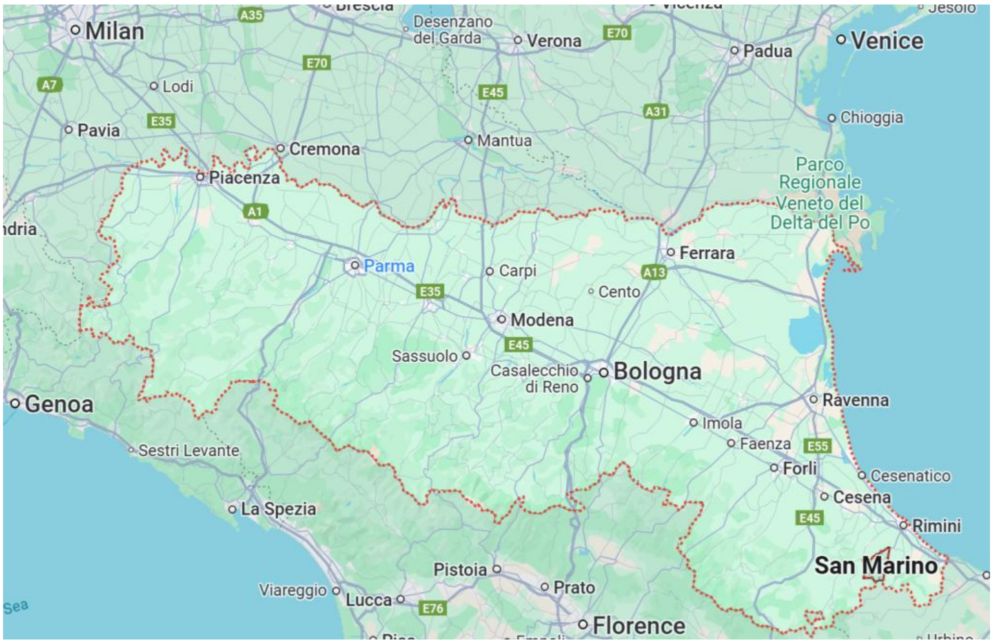

Figure 20. The Emilia-Romagna Region, Italy (Source: Google Maps)

Although the climate and soil are generally less suitable for tomato production in Northern Italy than in Southern Italy, which has historically been more involved in fresh tomato production, this region has maintained a competitive edge in processing tomato production.

Several important pathogens threaten to process tomato crops, with their impact worsened by climate change. For instance, in 2024, excessive rainfall and persistent precipitation delayed the transplantation period and led to an earlier end of harvesting. Additionally, higher summer temperatures hindered vegetative development, resulting in lower yields (58.6 t/ha) than the previous five years (75.5 t/ha). At least, these weather conditions enabled moderate damage from the red spider mite, another significant threat to tomato production in the Emilia-Romagna region. For instance, in 2018, the red spider mite contributed to a drop in field tomato production of around 13% compared to the turnover signed by the POs and tomato producers. However, highly wet years lead to severe downy mildew and Alternaria damages. Alternaria is especially damaging for developing mycotoxins, whose concentrations are monitored as they may lead to allergies.

Given that global processing tomato production is concentrated in a few key regions, the effects of climate change are significant. Projections suggest that cooler areas like China and California may gain a competitive advantage in the coming decades.

In this context, the STELLA project focuses on the tomato quarantine bacterium *Ralstonia solanacearum*, whose prevalence may be affected by climate change. Phytosanitary inspectors rigorously conduct inspections, with specific procedures activated upon formally detecting the bacterium (DPG/2025/124). Figure xx shows a quick and simple diagnostic method for *Ralstonia* species: placing a freshly cut stem in a glass of water. If present, the bacteria will ooze from the stem as a white, milky stream.

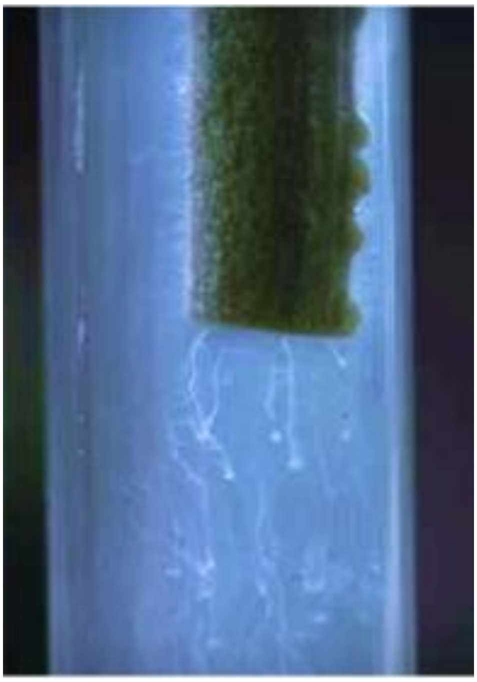

Figure 21. Quick and straightforward diagnostic method for Ralstonia species (Source: UCSC)

Over the project's four-year duration, the plots under examination will involve the areas where the pest has been or may have been identified. The goal is to develop an early-warning monitoring tool specific for *R. solanacearum*, which will be integrated into the STELLA Pest Surveillance System (PSS) digital platform.

Additional dissemination and exploitation material(s): STELLA Project Website

URL(s): https://stella-pss.eu

Geographical Location:

The research and innovation activities for the Italian UCP (UCP4) are taking place in the northern part of Italy, in the Emilia-Romagna Region, in the Provinces of Piacenza and Parma.

2.15 PA #15 Pest challenges in processing tomato production in the Emilia-Romagna region (Italy)

Despite the climate change challenge, several pests and diseases compromise processing tomato production. Farmers cultivating tomatoes need to adapt to an increase in the potential for pest outbreaks, which is also favoured by the climate change scenario.

In the North of Italy, key diseases include early blight, late blight, bacterial spot, and bacterial speck. At the same time, pests such as red spider mites, tomato fruitworms, aphids, and thrips require continuous monitoring during the growing season.

In recent years, bacterial wilt caused by *Ralstonia solanacearum* has emerged in the Emilia-Romagna region, leading to severe plant wilting. With no effective pesticides or alternative defences available, the only control measure is the destruction of infected crops. The bacterium spreads through infected plant material, soil, and contaminated irrigation water, persisting in the soil for several years.

Since 2017*, R. solanacearum* infections have become more frequent and cover larger areas in Emilia Romagna. Immediate steps were taken and formalised in June 2018, with the Executive Resolution DPG/2018/9896. Consequently, technical bodies were set up to manage the emergency, such as the Crisis Unit, comprising the Plant Health Inspectors and the regional Plant Health Laboratory technicians. The provinces in the Emilia-Romagna region where *R. solanacearum* was identified are Ferrara, Bologna, and Parma (Figure 22). In 2024, *R. solanacearum* was not found in the previously circumscribed areas, but monitoring is ongoing to verify the potential eradication.

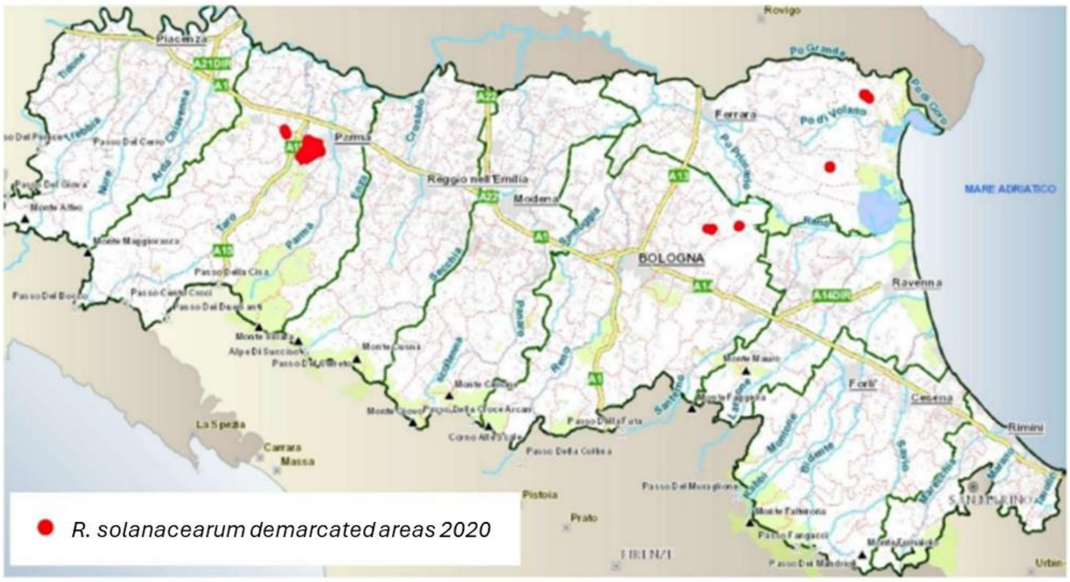

Figure 22: R. Solanacearum demarcated areas 2020, (Source: UCSC)

The STELLA project addresses *the challenge of R. solanacearum* by developing simple bioclimatic indices to assess the risk of disease spread in real-time. This early warning system empowers farmers and decision-makers to implement timely, targeted interventions.

The goal is to provide users of the STELLA Pest Surveillance System (PSS) with a predictive tool for assessing bacterial wilt risk, thereby improving the early detection of disease onset.

By adopting this index, users can:

- Monitor environmental conditions and detect high-risk periods earlier;
- Alerting the phytosanitary authorities promptly;
- Implement targeted control measures (such as quarantine and crop destruction) before outbreaks escalate.

In summary, the STELLA project offers a digital tool to mitigate pest and disease impacts in processing tomato production, improving early warning detection in the agricultural future under the climate change scenario.

Additional dissemination and exploitation material(s): STELLA Project Website

URL(s): https://stella-pss.eu

Geographical Location:

The research and innovation activities for the Italian UCP (UCP4) are taking place in the northern part of Italy, in the Emilia-Romagna Region, in the Provinces of Piacenza and Parma.

2.16 PA #16 Conventional pest monitoring and detecting the quarantine pest *Ralstonia solanacearum* in the Emilia-Romagna region (Italy)

This Italian Use Case Pilot focuses on the quarantine pathogen *Ralstonia solanacearum*, which affects tomato (*Solanum lycopersicum*) crops in Italy. The Parma and Piacenza provinces have a large concentration of tomato growers and processing industries, making this area the third-largest global producer of tomatoes after China and California.

Currently, inspections and samplings are conducted by teams of scouters of the phytosanitary service, selected by order of the Regional Administration, and through the support of technicians from POs (Producers Organisations). Surveys are conducted between the flowering and the harvesting stages (BBCH 60-89); if apparent symptoms of *Ralstonia solanacearum* are found during the inspections (Figure 23), the Plant Protection Organisation (PPO) officers are immediately informed, and they are in charge for initiating laboratory testing (conducted in double) to confirm the presence of the pathogen. Specific actions - such as destroying all infected material - are carried out, and in the particular field, no bacterial host can be approved for cultivation for at least five years.

Figure 23. Early symptoms of Ralstonia solanacearum infection on tomato plants show (left) - Drooping of lower leaves followed soon after by wilting of entire plants and (right) damping-off in early stages (Source: UCSC)

The STELLA project recognises the critical importance of effective monitoring and surveillance systems for quarantine and regulated non-quarantine pests. Its goal is to address plant disease detection and mitigation challenges effectively. This objective will be addressed by addressing existing surveillance infrastructure gaps, enhancing monitoring capabilities, and investing in prevention measures through remote sensing and proximal sensing technologies, IoT devices, and citizen science.

In the Italian UCP, all tomato-growing fields are potentially under investigation as they are all subjected to the outbreak of *R. solanacearum*; as a result, the proximal sensing technology cannot be applied. On the contrary, remote sensing technologies, IoT devices, and citizen science will be essential instruments to elaborate an effective tool in the successful early detection of *R. solanacearum* outbreaks. Citizen engagement will be facilitated through a digital application for reporting pathogen data. All gathered information will support the final digital platform, the STELLA Pest Surveillance System (PSS), enabling a comprehensive, digitised approach to outbreak management.

Additional dissemination and exploitation material(s): STELLA Project Website

URL(s): https://stella-pss.eu

Geographical Location:

The research and innovation activities for the Italian UCP (UCP4) are taking place in the northern part of Italy, in the Emilia-Romagna Region, in the Provinces of Piacenza and Parma.

2.17 PA #17 Updated phytosanitary measures to control *Ralstonia solanacearum* from the STELLA project

The STELLA project objective is to advance current pest monitoring and surveillance solutions by supporting emerging digital technologies and proposing disruptive methodologies and tools.

The first step involves the development of novel plant pest monitoring strategies, encompassing and fusing the latest trends and developments in AI, IoT, and remote and proximal sensing. Then, the performance of plant pest monitoring and recommendation solutions will be tested and validated through real-life use case pilots (UCPs) in commercial farming systems and areas that are difficult to reach. There will be 6 UCPs tested across five countries and operating on eight critical diseases. The final goal will be to enhance pest monitoring, early warning systems and territorial surveillance, possibly removing the phytosanitary risks.

The Italian UCP focuses on *Ralstonia solanacearum*, a quarantine pathogen that affects tomato (Solanum lycopersicum) and poses a particular threat to the processing-tomato supply chain. According to the objective of the STELLA project, pest monitoring and detection will be improved thanks to advanced tools of different categories:

- **Remote Sensing technologies** will be employed to obtain detailed images of the sampling fields and surroundings once the assessment of *R. solanacearum* is confirmed or via past outbreak reports. Satellite imagery will be used to capture large-scale data on vegetation health, plant stress indicators, and symptom distribution, tracing backwards from the sampling date (only for positive cases), with at least one image per week;
- **IoT devices** will be implemented according to the protocol. Weather stations and sensors, installed in the area for continuous monitoring and real-time data transmission, will ensure an interesting source of data to analyse the disease epidemiology after the symptoms have been confirmed;
- **Crowdsourcing activities** following the citizen science protocol will report observations and upload photos of symptomatic plants via the developed Data Collection App.

All gathered data will be helpful for the final version of the digital platform STELLA Pest Surveillance System (PSS) and the elaboration of bioclimatic indices to improve and facilitate the early warning and detection of *R. solanacearum* in areas where the pest was already reported or to predict new regions where the pathogen could spread.

Additional dissemination and exploitation material(s): STELLA Project Website

URL(s): https://stella-pss.eu

Geographical Location:

The research and innovation activities for the Italian UCP (UCP4) are taking place in the northern part of Italy, in the Emilia-Romagna Region, in the Provinces of Piacenza and Parma.

2.18 PA #18 STELLA PSS for Improved Bull's Eye Rot Management in New Zealand Apples: Addressing Regional Challenges in Hawke's Bay

The New Zealand apple industry faces significant losses due to Bull's eye rot disease, caused by the fungus *Neofabraea alba*. This latent disease expresses symptoms in cool stores, often months after infection in the orchard, leading to potential rejection in export markets. Current methods cannot predict latent infections and spatially explicit risk. The STELLA project addresses the challenge of early detection and risk assessment of *N. alba* infection in Hawke's Bay, where warm and humid conditions favour disease development.

The research and innovation activities for the New Zealand UCP (UCP5) are taking place in the Hawke's Bay region of New Zealand. Specific trial orchards are located within this region, and the UCP collaborates with commercial apple orchards, including those associated with the Smart & Sustainable (S&S) project, T&G Global, and Mr. Apple. The Hawke's Bay region is the largest apple-growing area in New Zealand. It is characterised by a climate with high sunshine hours, moderate temperatures, well-timed rainfall, and low wind, making it particularly favourable for apple cultivation. The soils are predominantly fertile, free-draining silty loams.

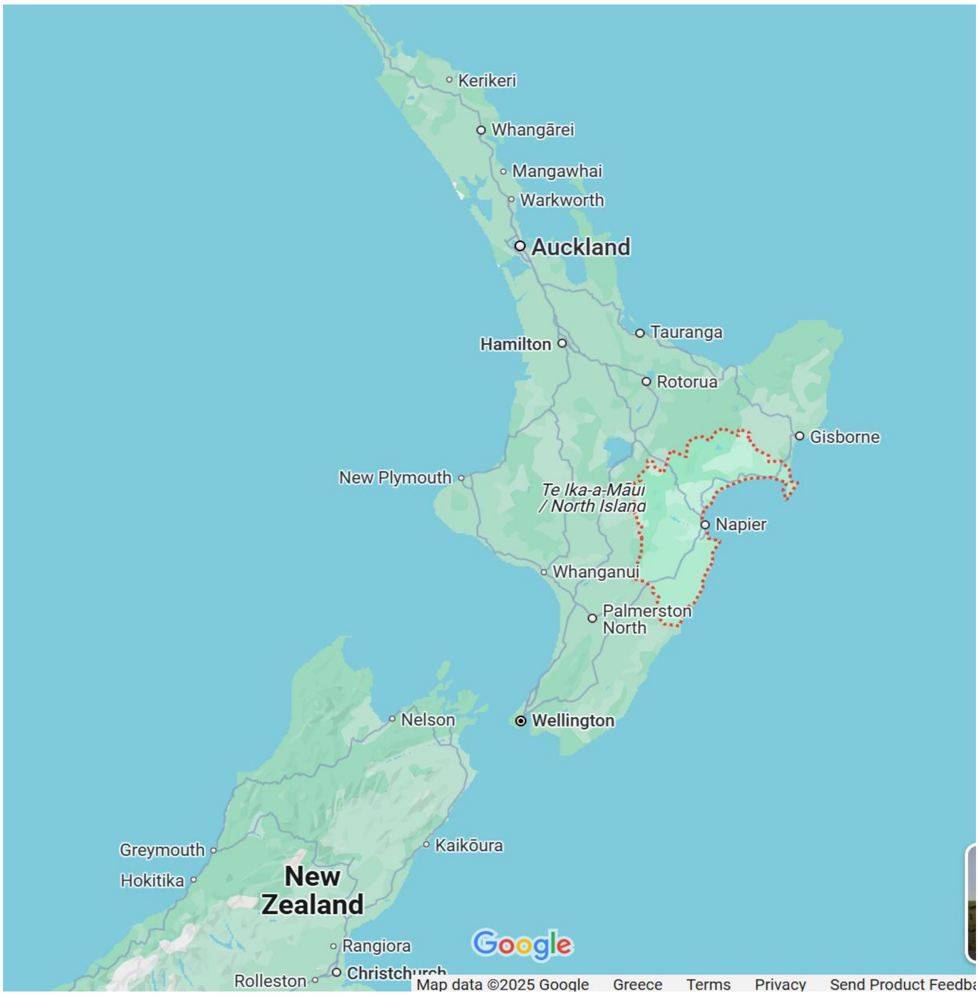

Figure 24: The Hawke's Bay region of New Zealand (Source: Google Maps)

Facilitating elements for implementing the STELLA PSS in Hawke's Bay include the well-established infrastructure for fruit production (pack houses, cool stores, export logistics) and a strong regional awareness of the fruit industry. The presence of research organisations like Plant and Food Research (PFR) and industry bodies like New Zealand Apples & Pears Inc (NZAPI), with ongoing research and development efforts (e.g., the Smart & Sustainable project), also provide a supportive environment. Collaboration and agreements have been developed between STELLA and these local initiatives.

Regional challenges that the STELLA PSS aims to address include the difficulty in managing orchard hygiene effectively in vast commercial and intensive growing systems. Weather extremes, such as Cyclone Gabrielle in 2023, have also significantly impacted the region's apple crop, highlighting the need for resilient pest and disease management strategies. A key message to end-users is that the STELLA PSS aims to complement existing practices by providing spatially explicit risk assessments for Bull's eye rot, enabling more proactive and targeted management approaches. Future actions will involve workshops to test the platform and gather feedback from New Zealand apple growers.

Additional dissemination and exploitation material(s): STELLA Project Website

URL(s): https://stella-pss.eu

Geographical Location:

The research and innovation activities for the New Zealand UCP (UCP5) are taking place in the Hawke's Bay region of New Zealand.

2.19 PA #19 Addressing the Threat of Bull's Eye Rot in New Zealand Apples: Pest Challenges in Hawke's Bay

The New Zealand apple industry, particularly in the Hawke's Bay region, faces a significant challenge from Bull's eye rot disease caused by the fungal pathogen *Neofabraea alba*. This disease poses a considerable challenge because fruit infections on the tree are latent and cannot be detected until symptoms appear in cool storage, often leading to substantial postharvest losses, sometimes ranging from 60% to 80% depending on growing conditions, variety, and pre-harvest fungicide treatment. This can jeopardise fruit exports and result in rejection in importing markets. Current understanding of the factors influencing apple tree and fruit susceptibility to *N. alba* infections remains poor.

The symptoms of Bull's Eye Rot include:

- **Lesions**: Small, circular, and sunken spots on the fruit, which expand over time. These lesions typically have a "bull's eye" appearance with concentric rings.
- **Colour**: The lesions' centre may become tan or brown, surrounded by a darker margin.
- **Texture**: Decayed tissue is dark brown inside with a dense consistency and a clear margin between decayed and healthy tissue. Usually, decayed tissue does not readily separate from the healthy tissue.

Figure 25. Bull's eye rot from a side wound infection (Source: TJ Mullinex, Good Fruit Grower)

Figure 26. Bull's eye rot lesion on the side of a Fuji apple (Source: TJ Mullinex, Good Fruit Grower)

By focusing on the pest challenges posed by *Neofabraea alba*, the STELLA project aims to provide New Zealand apple growers in Hawke's Bay with tools for improved prediction and management of Bull's eye rot risks before symptoms manifest in storage. A better understanding of when and where infection risks are highest could lead to more targeted orchard hygiene practices and potentially more effective and timely interventions. The development of risk maps could inform growers about blocks or orchards with a higher likelihood of latent infections, allowing for prioritisation of management strategies and potentially reducing significant postharvest fruit losses.

A significant regional challenge is the difficulty in implementing effective orchard hygiene (removing fallen fruit and pruning debris) across vast commercial growing systems to eliminate potential sources of *N. alba*. The latent nature of the infection and the lack of methods to predict which blocks or orchards may have higher latent infections further complicate management. Extreme weather events, such as Cyclone Gabrielle in 2023, which caused significant rainfall, winds, and flooding, have also severely impacted the region's apple crop and could influence disease pressure. The STELLA project aims to address these challenges by providing insights into infection risks, potentially leading to more efficient resource allocation for disease management and improved resilience to environmental impacts. A key message to end-users is that the project is working to provide tools that complement current practices by offering a better understanding of the specific pest challenges associated with Bull's eye rot in the Hawke's Bay environment.

Additional dissemination and exploitation material(s): STELLA Project Website

URL(s): https://stella-pss.eu

Geographical Location:

The research and innovation activities for the New Zealand UCP (UCP5) are taking place in the Hawke's Bay region of New Zealand.

2.20 PA #20 Limitations of Conventional Pest Monitoring for Latent Apple Diseases in New Zealand: The Case of Bull's Eye Rot

In New Zealand's apple industry, particularly within the critical growing region of Hawke's Bay, conventional pest monitoring and detection methods face significant limitations when dealing with diseases exhibiting latent infections, such as Bull's eye rot (*Neofabraea alba*). Current approaches often involve reactive measures, relying on periodic scouting and manual inspection. However, for Bull's eye rot, fruit infections occur in the orchard but remain undetectable until symptoms manifest in cool storage, sometimes months later. This delay hinders timely intervention and can lead to substantial postharvest losses. Orchardists cannot predict which block, orchard, or region may have higher latent infections in a season. Existing lab-based detection methods and disease population models are under development but are often not spatially explicit and require significant input and calibration.

New Zealand apple growers in Hawke's Bay rely on general orchard hygiene practices and pre-harvest fungicide treatments to manage potential Bull's eye rot risks. However, the factors influencing fruit susceptibility remain poorly understood, making targeted interventions challenging. The reliance on postharvest detection of Bull's eye rot in cool stores is a major drawback of conventional methods, as significant losses may have already occurred when the disease is identified. The vast commercial and intensive growing systems in Hawke's Bay also present a challenge for implementing thorough orchard hygiene across all areas.

The STELLA project aims to complement existing efforts by providing spatially explicit risk assessments that could help growers overcome the limitations of current broad-scale management approaches and better target their resources to mitigate the specific challenges posed by the latent nature of *Neofabraea alba* infection. Developing more sensitive and early detection methods is also a key objective, addressing the inability to identify infected fruit in the orchard.

The STELLA project anticipates that its Pest Surveillance System could offer improved early warning and risk assessment, potentially enabling more targeted orchard hygiene practices and informing decisions on the timing and application of management strategies. Generating risk maps could help growers identify areas with a higher likelihood of latent infections, allowing for prioritisation of postharvest monitoring and management. While the project is ongoing, the expected benefit is a move towards more proactive and spatially informed disease management, contrasting with the current reactive and non-specific approaches.

Additional dissemination and exploitation material(s): STELLA Project Website

URL(s): https://stella-pss.eu

Geographical Location:

The research and innovation activities for the New Zealand UCP (UCP5) are taking place in the Hawke's Bay region of New Zealand.

2.21 PA #21 Enhancing Pest and Disease Monitoring in New Zealand Apples through the STELLA Project's Digital Technologies

The New Zealand apple industry, predominantly in the Hawke's Bay region, faces significant challenges in effectively monitoring and managing pests and diseases, particularly those with latent infections like Bull's eye rot (caused by *Neofabraea alba*). Current conventional monitoring methods, which often rely on visual inspection and reactive measures, are limited in detecting these issues early. For Bull's eye rot, infections occur in the orchard but remain undetectable until postharvest, leading to substantial losses. There is a need for improved, proactive monitoring systems that can provide earlier insights into pest and disease risks.

The STELLA project's New Zealand Use Case Pilot (UCP5) is actively developing and testing a Pest Surveillance System (PSS) to enhance pest and disease monitoring capabilities significantly. This system integrates modern digital technologies, including UAV/RPAS, satellites, EDEN Viewer, spore samplers, and weather stations. The goal is to create models and digital solutions to assess 'risk hot spots' and generate 'risk maps' for key pests and diseases, including *N. alba*. Furthermore, there is a focus on developing and advancing splash-spore sampler technology to enable earlier and more precise detection of airborne inoculum in orchards. This comprehensive approach aims to provide a more detailed and timely understanding of pest and disease dynamics than traditional methods.

New Zealand apple growers in Hawke's Bay will benefit from enhanced early detection and prediction of pest and disease risks, including latent infections like Bull's eye rot, by using STELLA PSS. The system's ability to integrate data from various sources and generate spatially explicit risk assessments could enable more targeted and efficient orchard management practices. This may include optimising the timing and application of interventions, improving orchard hygiene strategies, and potentially reducing significant postharvest fruit losses. Developing advanced detection methods, such as enhanced spore samplers, could provide earlier warnings, allowing for proactive measures to mitigate potential outbreaks. Ultimately, the STELLA project aims to equip growers with data-driven insights for more effective and sustainable pest and disease management, moving beyond the limitations of conventional, often reactive approaches.

The project's close collaboration with industry organisations like New Zealand Apples & Pears Inc. (NZAPI) ensures that the developed solutions are relevant and aligned with the needs of apple growers in the region.

Additional dissemination and exploitation material(s): STELLA Project Website

URL(s): https://stella-pss.eu

Geographical Location

The research and innovation activities for the New Zealand UCP (UCP5) are taking place in the Hawke's Bay region of New Zealand.

2.22 PA #22 Site description & Regional Challenges: Olive groves in Greece

Olive production plays a crucial role in Greece’s economy and culture. The country is one of the largest global olives and olive oil producers. However, the industry faces growing challenges due to emerging pests and diseases.

STELLA Horizon EU Project aims to address significant challenges olive producers face by collecting data from the Attica and Atalanti regions. In Attica alone, over 9,500 farmers depend on olive farming, but widespread monoculture practices make trees more vulnerable to diseases like Verticillium wilt and Olive knot disease. The Mediterranean climate - hot, dry summers and mild, wet winters - further increases the risk by creating ideal conditions for disease spread. Tackling these problems is essential to ensuring sustainable and profitable olive production.

The project is based on two study sites: a pilot orchard at the Agricultural University of Athens (AUA) and three experimental plots in Atalanti. The AUA site allows researchers to study disease progression under controlled conditions, while the Atalanti plots provide real-world insights into disease impact and management in commercial orchards. These sites include olive trees of different varieties—such as Kalamon, Koroneiki, and Amfissis—and olive trees of varying ages, allowing researchers to examine how local climate and growing conditions influence disease development.

Figure 27. Aerial view of the olive grove designated for the use case pilot in the Atalanti region (Source: AUA)

Traditional disease detection methods - like pathogen isolation and microscopic examination - are slow, labour-intensive, and sometimes inaccurate. STELLA integrates advanced technologies such as IoT and remote and proximal sensing to overcome these limitations. These tools provide real-time data on environmental conditions, pathogen activity, and early disease symptoms, helping detect infections before they become severe.

By focusing on early detection and improved disease management, the project builds a comprehensive database that enables farmers to apply targeted interventions, reducing pesticide use, minimising crop losses, and improving overall productivity. In turn, these efforts contribute to the long-term sustainability of olive farming in Greece.

Additional dissemination and exploitation material(s): STELLA Project Website

URL(s): https://stella-pss.eu

Geographical Location:

The research and innovation activities for this Greek UCP (UCP6) are in a pilot orchard at the Agricultural University of Athens (AUA) and three experimental plots in Atalanti.

2.23 PA #23 Challenges of *Verticillium dahliae* and *Pseudomonas savastanoi pv. savastanoi* in olive trees

Olive trees are essential to Greece's agriculture, economy, and cultural identity, yet they are increasingly threatened by two significant pathogens: *Verticillium dahliae* and *Pseudomonas savastanoi* pv. *savastanoi. Verticillium dahliae* is a soil-borne fungus that causes Verticillium wilt, a severe disease that disrupts water and nutrient transport, leading to wilting, branch dieback, and eventual tree death. Meanwhile, *Pseudomonas savastanoi* pv. *savastanoi* is a bacterial pathogen responsible for olive knot disease, which produces tumour-like swellings on stems, branches, and occasionally leaves and fruits. Both diseases are widespread in the Greek territory and profoundly impact olive production in the country, reducing yields and compromising the quality and quantity of olive oil.

One of the biggest challenges Verticillium dahliae poses is its ability to persist in the soil for many years, making it exceptionally difficult to control. The fungus spreads through contaminated soil, irrigation water, and infected plant material, affecting olive trees and many other crops cultivated nationwide. Since there are no effective chemical treatments to cure infected trees, farmers rely on preventive strategies such as planting resistant olive varieties, improving soil drainage, and practising crop rotation to lower infection risks. Despite these efforts, the fungus threatens olive groves, posing significant economic losses to growers.

Figure 28: Wilting on one side of the olive tree infected by Verticillium dahlia (Source: AUA)

Figure 29. Advanced Verticillium dahliae symptoms in olive trees: leaf curling, necrosis and defoliation (Source: AUA)

Similarly, olive knot disease is caused by *Pseudomonas savastanoi* pv. *savastanoi* is equally challenging to control due to its rapid spread through rain, wind, insects, and contaminated pruning tools. Greece's Mediterranean climate, characterised by high humidity and mild winters, further promotes bacterial growth and proliferation. Once knots develop on tree branches, the bacteria remain inside the plant, making complete eradication nearly impossible. The infection weakens olive trees, reduces fruit production, and increases their susceptibility to secondary diseases. While copper-based treatments and careful pruning can slow down the spread of disease, they do not provide a permanent cure. Preventive measures such as tool disinfection and disease-free planting material are essential to limiting infections.

Figure 30. The formation of hard galls on olive twigs and branches indicates severe infection by Pseudomonas savastanoi pv. Savastanoi, (Source: AUA)

To improve disease management in Greece, the STELLA Horizon EU Project is investigating advanced solutions, including remote sensing technology for early symptom detection, IoT-based environmental monitoring, and predictive models for assessing disease outbreaks. Effective collaboration between researchers, farmers, and policymakers is essential to strengthening disease surveillance and control efforts. Raising public awareness and involving local communities can enhance early detection and reduce management costs. By integrating modern technology, scientific research, and coordinated action, Greece can protect its olive trees and ensure its olive industry's long-term sustainability.

Additional dissemination and exploitation material(s): STELLA Project Website

URL(s): https://stella-pss.eu

Geographical Location:

The research and innovation activities for this Greek UCP (UCP6) are in a pilot orchard at the Agricultural University of Athens (AUA) and three experimental plots in Atalanti.

2.24 PA #24_Conventional pest monitoring and detection methods of *Verticillium dahliae* and *Pseudomonas savastanoi pv. savastanoi* in Olive Trees

Monitoring and identifying *Verticillium dahliae* and *Pseudomonas savastanoi* pv. *savastanoi* in olive trees is essential for effective disease control. Traditional detection methods include field surveys, visual symptom assessment, and laboratory tests. Despite the widespread presence of these pathogens in Greece, systematic monitoring remains limited. *V. dahliae*, a soil-borne fungus responsible for *Verticillium* wilt, is primarily identified through symptoms such as wilting, yellowing leaves, and vascular discolouration. Soil testing and trapping plants help estimate infection levels. Similarly, *P. savastanoi*, which causes olive knot disease, is recognised by characteristic galls on branches. The bacterium enters through wounds caused by environmental factors such as frost, hail, wind, and farming. Since warm and rainy conditions promote infection, studying climate influences could aid disease management, but no official data is available. Laboratory methods, including bacterial culture on selective media, biochemical tests, and molecular diagnostics like PCR, are used to confirm its presence.

Despite their widespread use, these conventional detection techniques have limitations. Visual assessments may be unreliable due to symptom variability and similarity to other diseases. Culture-based techniques, though effective, are time-consuming and require specialised expertise. Environmental factors, such as soil composition and climate conditions, further complicate accurate pathogen identification. Additionally, the severity of Verticillium wilt is influenced by several factors, including the virulence of the fungus, the olive variety, plant age, and environmental conditions. Latent infections often remain undetected until significant damage has already occurred, making early disease management less effective.

Both pathogens pose serious risks to olive cultivation, yet their detection and control remain challenging. Conventional methods can be slow and inconsistent, whereas molecular techniques, though more precise, require specialised equipment and expertise. The lack of structured monitoring programs in Greece further complicates disease management. Combining traditional and modern diagnostic approaches and improved monitoring efforts is essential for early detection and effectively controlling these pathogens in olive groves.

Additional dissemination and exploitation material(s): STELLA Project Website

URL(s): https://stella-pss.eu

Geographical Location:

The research and innovation activities for the Greek UCP (UCP6) are taking place in a pilot orchard at the Agricultural University of Athens (AUA) and three experimental plots in Atalanti.

2.25 PA #25 Enhancing Pest and Disease Monitoring in Olive Trees Using STELLA

The STELLA platform introduces a cutting-edge approach to monitoring *Verticillium dahliae* and *Pseudomonas savastanoi* pv*. savastanoi* in olive orchards through advanced digital technologies. By integrating an Early Warning System, a Pest Detection System, and a Pest Response System, STELLA enhances early detection, surveillance, and intervention strategies. The platform uses IoT sensors to monitor weather and soil conditions, helping predict when disease outbreaks might happen. One of the key benefits of STELLA is its ability to correlate environmental factors with disease progression. Monitoring weather conditions, environmental factors like frost and hail, and agricultural activities such as pruning could help identify potential entry points for pathogens.

Figure 31: Olive disease monitoring utilising the EDEN Viewer camera in the Atalanti region (Source: AUA)

STELLA uses proximal and remote sensing technologies like drones and satellite imagery to enhance spatial monitoring. This allows for more accurate differentiation of diseases with similar symptoms at the field level. Even latent infections not visible through traditional inspections can be detected early. These tools can map pathogen distribution across olive orchards and assess overall crop health with greater accuracy, offering farmers real-time insights into disease hotspots. With this data, farmers can allocate resources more effectively and apply targeted treatments, reducing their reliance on time-consuming traditional methods and minimising the economic impact of disease.

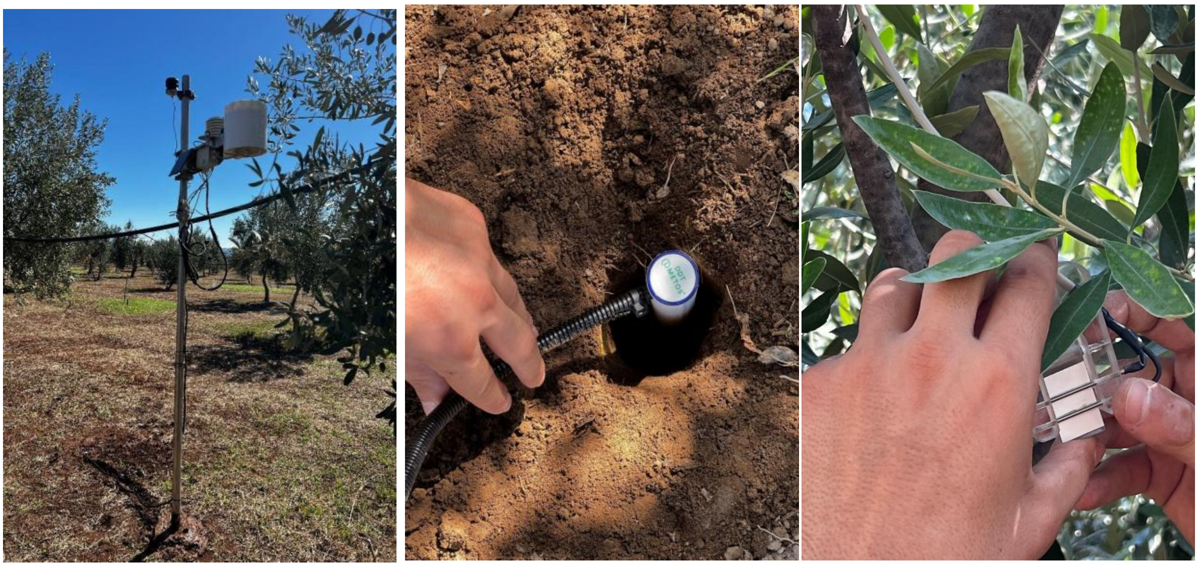

Figure 32. Installation of IoT devices in Olive use case pilot sites for data collection (Source: AUA)

STELLA fosters community engagement by actively involving local farmers, agronomists, and citizens through citizen science initiatives. These initiatives encourage community members to contribute by collecting data, reporting disease symptoms, and participating in monitoring activities, enhancing disease surveillance's reliability and coverage. In addition, the platform offers capacity-building programs to train farmers and agronomists on using new technologies, like IoT sensors, drones, and other remote sensing tools. These programs equip them with the skills to interpret data and take timely actions based on real-time information, improving disease management and overall productivity. By combining innovative digital tools with collaborative efforts, STELLA significantly improves the monitoring and management of *V. dahliae* and *P. savastanoi*, supporting sustainable olive production and plant health protection.

Additional dissemination and exploitation material(s): STELLA Project Website

URL(s): https://stella-pss.eu

Geographical Location:

The research and innovation activities for the Greek UCP (UCP6) are taking place in a pilot orchard at the Agricultural University of Athens (AUA) and three experimental plots in Atalanti.

3 Conclusions

This deliverable, **D5.5: Practice Abstracts – batch 1**, provides a comprehensive and accessible overview of the STELLA project's core objectives and early progress through 25 Practice Abstracts. These PAs describe pest and disease challenges in specific crops and regions, conventional monitoring methods, and how STELLA's digital tools (e.g., IoT sensors, drones, satellite imagery, AI) and the Pest Surveillance System (PSS) aim to improve early detection and modernise pest and disease management in agriculture and forestry.

The Practice Abstracts showcase the progress of the STELLA project across six real-life Use Case Pilots (UCPs) in various European countries and New Zealand. The STELLA UCPs address critical plant health challenges, including:

- Vineyard pest and disease management in Alsace, France, focusing on Grapevine Leafroll Disease (GLD) and Bois Noir (BN). The project explores remote sensing, AI-driven analytics, and real-time monitoring tools to enhance detection and decision-making.
- Monitoring of *Ceratocystis platani* in Greek plane forests, particularly in Evia. STELLA aims to control the spread through continuous monitoring using smart sensors, drones, satellite images, AI models, and by engaging local communities.
- Management of Potato Leafroll Virus (PLRV) in Lithuanian potato farming in the Vilkaviškis region. The project introduces satellite imagery and connected/smart insect traps for earlier pest and disease detection.
- Surveillance of *Ralstonia solanacearum* in Italian tomato production in the Emilia-Romagna region. STELLA is developing an early-warning monitoring tool and bioclimatic indices integrated into the PSS, utilising remote sensing, IoT devices, and citizen science.
- Addressing the threat of Bull's Eye Rot in New Zealand Apples in Hawke's Bay. The project focuses on early detection and risk assessment using innovative technologies, satellites, EDEN Viewer, spore samplers and weather stations.
- Enhanced pest and disease monitoring in Greek olive groves, targeting *Verticillium dahliae* and *Pseudomonas savastanoi* pv. *savastanoi.* STELLA employs IoT and remote and proximal sensing to provide real-time data and improve early detection and targeted interventions.

The presented Practice Abstracts demonstrate the STELLA project's commitment to empowering practitioners with digital tools and standardised data collection protocols to detect pests and diseases more accurately and faster, improve decision-making for targeted interventions, potentially reduce pesticide use, and enhance agricultural systems' resilience.

These Practice Abstracts are uploaded to the EU CAP NETWORK project database, ensuring wider dissemination and potential uptake of the project's findings. A second deliverable (D5.6) containing 35 abstracts is planned for month 46, further expanding the project's progress and outcomes.

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