D4.11 Practice Abstracts – First Batch

ipmorama.eu

Author(s)/Organisation(s)	**Valérie Cadot, Jens Grønbech Hansen, Geert Kessel, Jack Vossen**
Contributor(s)	
Reviewers	
Delivery Date (DoA)	**28.02.2026**
Actual Delivery Date	**25.02.2026**
Dissemination Level	**Public**
Abstract:	

Document Revision History

Date	Version	Author/Contributor/ Reviewer	Summary of main changes
20.02.2026	1.0	Sara Dunny Fox	First submission

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement GA No. 101135348.

Participant Number	Participant organisation name	Short name	Country
1.	TEAGASC - AGRICULTURE AND FOOD DEVELOPMENT AUTHORITY	TEAGASC	Ireland
2.	AARHUS UNIVERSITET	AU	Denmark
3.	WAGENINGEN UNIVERSITY	WU	Netherlands
4.	STICHTING WAGENINGEN RESEARCH	WR	Netherlands
5.	UDRUZENJE ZA PREDUZETNISTVO I INOVACIJE FOODSCALE HUB	FSH	Serbia
6.	INSTITUT NATIONAL DE RECHERCHE POUR L'AGRICULTURE, L'ALIMENTATION ET L'ENVIRONNEMENT	INRAE	France
7.	AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS	CSIC	Spain
8.	CONSIGLIO PER LA RICERCA IN AGRICOLTURA E L'ANALISI DELL'ECONOMIA AGRARIA	CREA	Italy
9.	SAKA PFLANZENZUCHT GMBH & CO. KG	SaKa	Germany
10.	INNOVATION DES PRODUCTEURS DE PLANTS DE POMME DE TERRE	inov3PT	France
11.	S.I.S. SOCIETA ITALIANA SEMENTI S.P.A.	SIS	Italy
12.	BAYERISCHE LANDESANSTALT FUR LANDWIRTSCHAFT	LfL	Germany,
13.	AgriFood Lithuania DIH	AFL	Lithuania
14.	GROUPE D'ETUDE ET DE CONTROLE DES VARIETES ET DES SEMENCES	GIP GEVES	France
15.	FORSCHUNGSINSTITUT FUR BIOLOGISCHEN LANDBAU STIFTUNG	FIBL	Switzerland
16.	EIDGENOESSISCHES DEPARTEMENT FUER WIRTSCHAFT, BILDUNG UND FORSCHUNG	WBF	Switzerland
17.	THE JAMES HUTTON INSTITUTE	JHI	United Kingdom

Disclaimer

Funded by the European Union. Associated country partners funded by SERI & UKRI. However, the views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Title: Integrating breeding for IPM into the deployment landscape for wheat, potatoes and grain legumes
Type of action: HORIZON Research and Innovation Actions
Topic: HORIZON-CL6-2023-BIODIV-01-14
Start date of project: 1 September 2024 ● Duration: 48 months

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement GA No. 101135348.

Table of Contents

List of Abbreviations and Acronyms	
DSS	Decision Support System
ICM	Integrated Crop Management
IPM	Integrated Pest Management
VCUS	Value for Cultivation, Use and Sustainability

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement GA No. 101135348.

Executive Summary

This deliverable presents the first batch of EU CAP Network practice abstracts developed under the IPMorama project. The abstracts focus on key plant health challenges affecting European agriculture and highlight practical Integrated Pest Management (IPM) solutions, digital tools, and surveillance strategies designed to strengthen resilience and sustainability.

The selected abstracts cover the following topics:

- **Wheat Rust Early Warning Survey App** – A digital surveillance and alert system supporting early detection and rapid response to wheat rust outbreaks.
- **Wheat Rust Disease Surveillance in the Value for Cultivation, Use and Sustainability (VCUS) Network** – Integration of disease monitoring into varietal performance testing frameworks to enhance resistance-based decision-making.
- ***Phytophthora* Conundrum** – Addressing emerging challenges in managing potato late blight across cropping systems.
- **IPM Control Strategies for Late Blight** – Practical, science-based approaches combining resistant varieties, forecasting, cultural measures and targeted treatments.
- **Blight and Decision Support Systems** – Use of predictive modelling and digital advisory tools to optimise control timing and reduce unnecessary pesticide applications.

Collectively, these abstracts demonstrate how IPMorama contributes to the objectives of the EU CAP Network by promoting knowledge exchange, improving pest surveillance, enhancing digital innovation, and supporting sustainable crop protection. The deliverable illustrates how research outputs are translated into accessible, practice-oriented knowledge for farmers, advisors, breeders and policymakers. Final outputs were disseminated via the project website and the EU CAP Network, supporting Horizon Europe objectives for communication, dissemination, and exploitation of project results.

Introduction

The transition toward more sustainable and resilient agricultural systems in Europe requires effective knowledge exchange, innovation uptake, and the practical implementation of Integrated Pest Management (IPM). Within this context, the EU CAP Network promotes the dissemination of best practices and innovation through practice abstracts that translate research results into accessible, field-oriented information.

This deliverable presents the first batch of EU CAP Network practice abstracts prepared within the IPMorama project. IPMorama aims to enhance pest and disease monitoring, strengthen early warning systems and support the practical application of IPM strategies across Europe. A core objective of the project is to bridge the gap between research, digital innovation and on-farm decision-making.

The abstracts included in this batch focus on major crop health challenges—particularly wheat rusts and late blight—and explore innovative surveillance tools, resistance evaluation frameworks, and decision support systems. By linking disease monitoring, varietal testing (including VCUS frameworks), and digital forecasting tools, the project contributes to more targeted interventions, reduced pesticide dependency, and improved crop resilience.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement GA No. 101135348.

This document outlines how these practice abstracts align with EU CAP Network objectives and demonstrates IPMORAMA's role in supporting sustainable plant health management across European cropping systems.

Methodology

Compliance with EIP-AGRI Format

The abstracts were developed in full alignment with the EIP-AGRI common format, ensuring compliance with EU CAP Network and Horizon Europe dissemination requirements. The structured headings—**Problem Statement**, **Solution**, and **Benefits and Practical Recommendations**—facilitated clear communication of findings, actionable recommendations, and practical relevance to the target audience.

Template Development and Harmonisation

A harmonised template, developed by one project partner, was used to ensure consistency across all abstracts. The template reflected EIP-AGRI formal requirements, standardised terminology, and integrated guidance notes for contributors, while also accommodating project-specific communication objectives.

Content Development and Internal Validation

Researchers within the project contributed content based on ongoing activities and project results. Stakeholder engagement was encouraged to validate practical relevance, provide guidance, and stimulate interaction with the IPMorama project. Internal review ensured alignment with Integrated Pest Management principles, coherence of messaging, and compliance with EU CAP Network submission criteria.

Target Audience Orientation

Each abstract was designed to clearly identify and address its target audience, including farmers, advisors, breeders, and crop protection specialists. The methodology ensured that outputs were actionable, accessible, and practice-oriented, while promoting adoption of project tools and participation in surveillance networks.

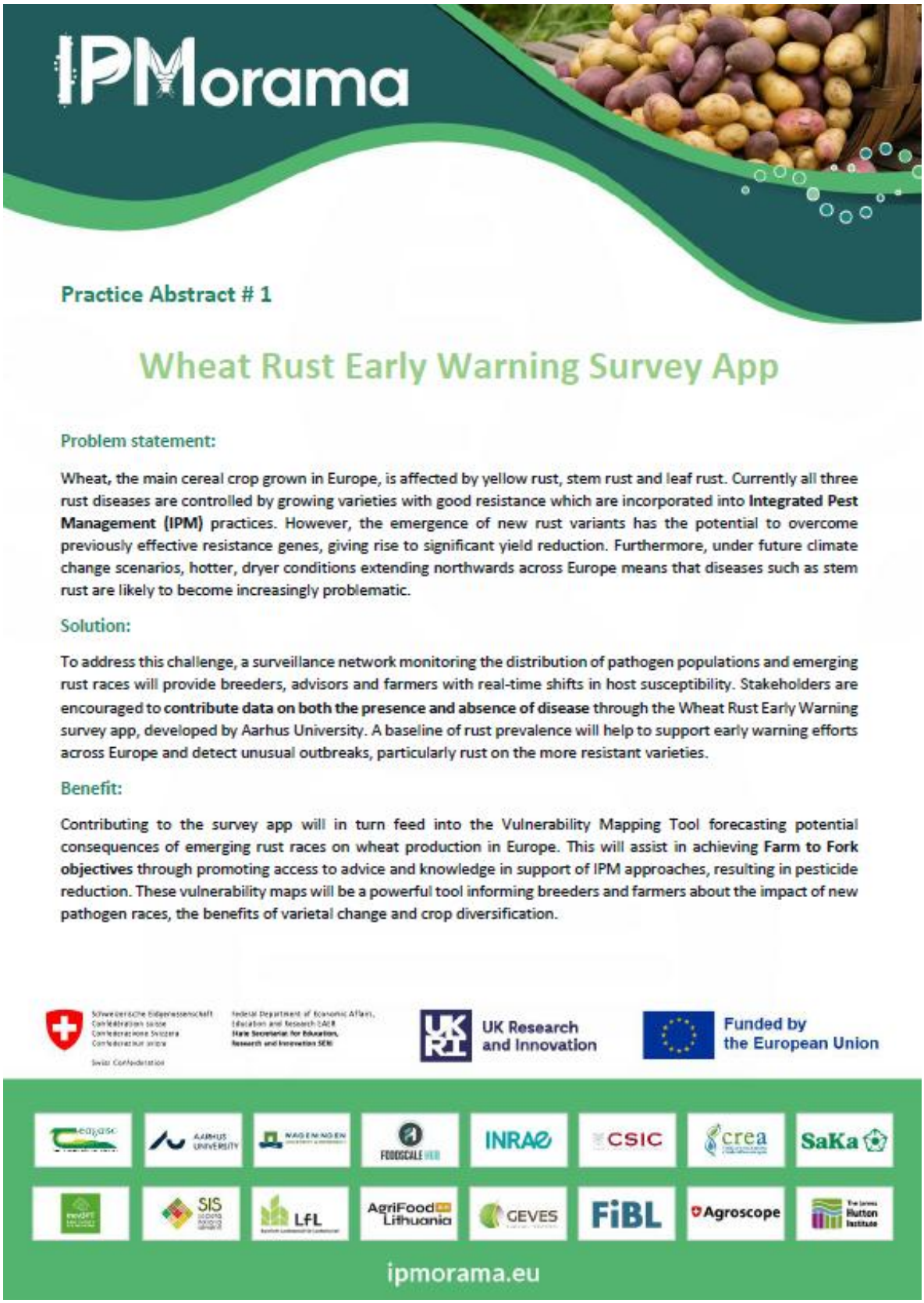
Dissemination

Finalised abstracts were published on the project website and submitted to the EU CAP Network platform. This dual dissemination strategy maximised visibility ensured open access to knowledge and supported Horizon Europe objectives for communication, dissemination and exploitation of project results.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement GA No. 101135348.

The Practice Abstracts

1. Wheat Rust Early Warning Survey App



This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement GA No. 101135348.

Practical recommendations:

Using your **smart phone or tablet** in the field, take part in this season's early warning campaign until June 2025. Photos of symptoms and plots may be uploaded; reporting both **presence and absence** of disease which will ensure comprehensive monitoring.

Upload your observations through this form:

Wheat Rust Survey App

The data will then be displayed visually on the dashboard:

Wheat Rust Dashboard

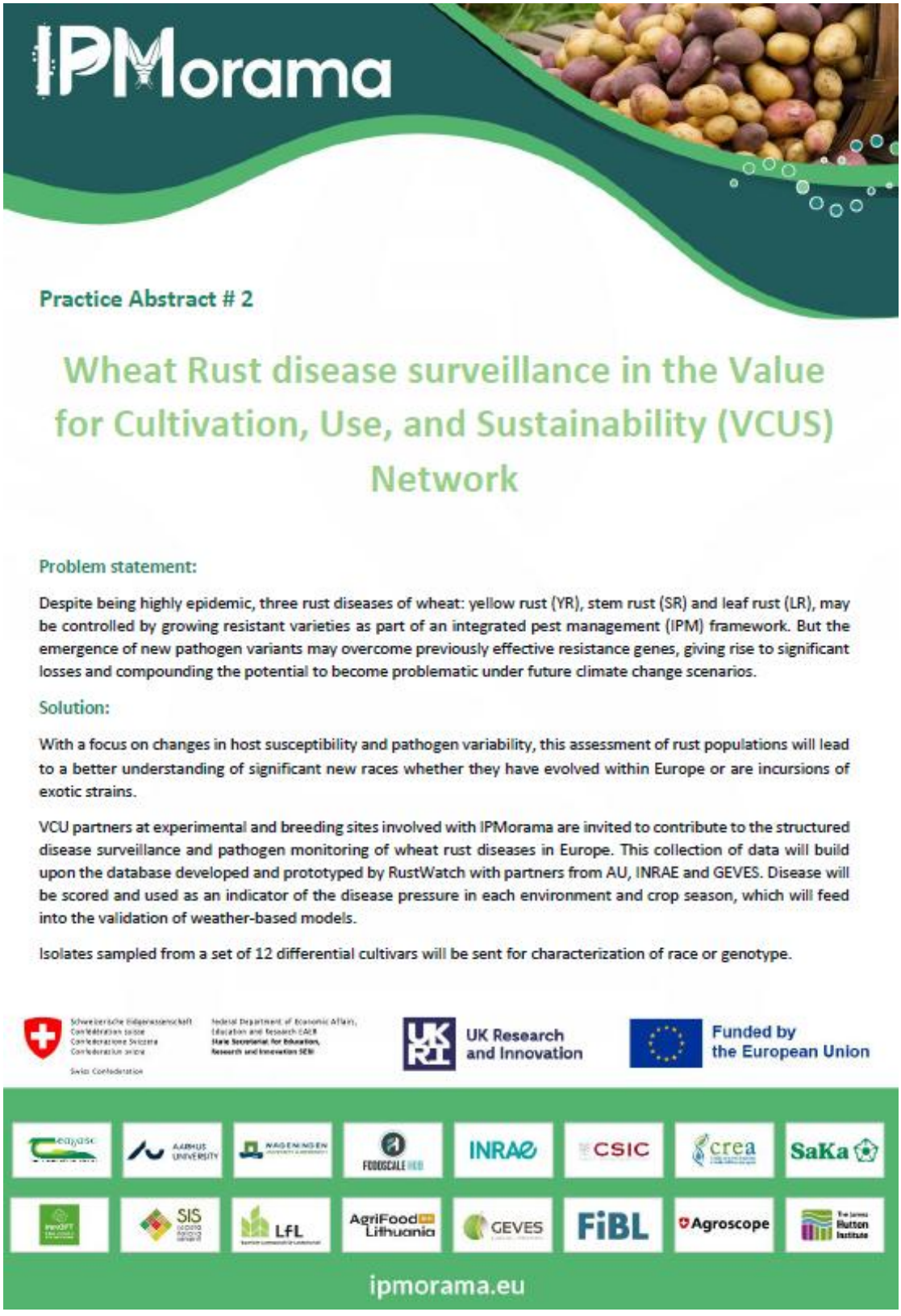
Data contribution will aid in the development of a vulnerability mapping tool to assist the prediction of emerging rust races on wheat across Europe.

UK Research and Innovation

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement GA No. 101135348.

2. Wheat Rust disease surveillance in the VCUS Network



This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement GA No. 101135348.

Benefits:

The goal is to sample new and emerging genotypes in a structured way and return timely results to facilitate IPM decision making during the same growing season. Access to information on races/genotypes and the distribution patterns of rust pressure will result in the early alert of significant shifts in host susceptibility across the pedoclimatic zones of the EU. Better streamlined IPM systems will promote more robust decision making, helping to reduce the negative impacts of disease in European cropping systems.

Practical recommendations for VCU partners: Connect. Score. Sample.

1. **Connect with Wheat Rust Toolbox**

   Login to the Toolbox and get access to your trial webform for reporting

2. **Enter visual score**

   Rate the severity of infected differential cultivars 2-3 times during the season.

3. **Send sample to lab**

   Select samples showing symptoms of any of the three rusts, from previously resistant commercial cultivars showing unusual rust susceptibility, or any cultivars with stem rust. Send the samples of YR and SR to the Global Rust reference center in Denmark, and samples of LR to INRAE in France

For more information: maps and charts with results on disease surveillance and pathogen monitoring from VCU trial sites

Disease severity map

UK Research and Innovation

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement GA No. 101135348.

3. Phytophthora Conundrum

Practice Abstract # 3

Phytophthora Conundrum

Problem statement:

Late blight is a destructive disease of potato foliage and tubers, causing severe yield and quality losses. Conventional control relies heavily on fungicides, while organic systems have no effective tools beyond sanitation and more resistant varieties. *Phytophthora infestans* is rapidly evolving, very quickly developing fungicide resistance and overcoming host resistance genes, creating increasingly capable and aggressive variants.

Societal and policy pressures demand a 50% reduction in pesticide use by 2030, coupled with the withdrawal of active ingredients from available products, highlighting the urgent need for sustainable, effective management strategies that, at the same time, reduce the chemical dependence and input.

Solution:

A fully integrated, IPM/ICM based, control strategy, effectively managing late blight with reduced chemical inputs:

Diversity and sanitation: rotation and crop order to prevent soil borne sources of inoculum (oospores). Use high quality seed, timely remove volunteer potatoes and timely cover potato dumps. Destroy infected plants immediately.

Cultivar choice: grow cultivars with multiple host resistance genes allowing for (much) lower chemical inputs.

Soil management: aim to prevent oospore and volunteer related inoculum sources.

Monitoring and evaluation: rely on decision support systems to predict infection risk, optimise intervention timing and guide management decisions.

Targeted control: ensure appropriate chemical or biological treatments are applied, only when necessary, to minimise pesticide use and slow resistance- and virulence development.

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme. Associated country partners are funded by SERI & UKRI. However, the views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

UK Research and Innovation

Integrated approach:

By combining more resistant cultivars, cultural practices, real-time monitoring, decision support and precision interventions, the IPM/ICM framework addresses both conventional and organic systems. This integrated approach aligns with Farm to Fork policy goals for pesticide reduction, adapts to evolving pathogen populations, and protects yields, tuber quality, and environmental sustainability, offering a resilient, proactive solution to the challenges posed by late blight.

Benefits:

- **Reduced pesticide use**
  Lowers fungicide applications while maintaining effective late blight control, supporting EU reduction targets.
- **Sustained disease control**
  Reduces selection pressure on *Phytophthora infestans*, slowing resistance and virulence development.
- **Improved yield and tuber quality**
  Protects foliage and tubers, limiting yield losses and defects across production systems.
- **Greater system resilience**
  Integrates resistance, cultural practices, monitoring and targeted interventions to address evolving pathogen populations.
- **Lower input costs and dependency**
  Optimised treatment timing reduces chemical costs and reliance on limited fungicide options.
- **Environmental and societal benefits**
  Decreases contamination risks, supports biodiversity and improves public acceptance.
- **Broad applicability**
  Suitable for conventional, low-input and organic farming beyond sanitation-only approaches.

Practical recommendations:

1. **Rotation and sanitation**
   Use diverse rotations, remove volunteers, manage waste piles and destroy infected plants to reduce inoculum sources.
2. **High-quality seed and resistant cultivars**
   Plant certified seed and select varieties with stacked resistance genes to lower disease risk and input needs.
3. **Soil and field hygiene management**
   Prevent survival of infected tubers and minimise carry-over of oospores between seasons.
4. **Monitoring and decision support**
   Apply weather-based forecasting and risk tools to optimise timing of interventions.
5. **Targeted, integrated control**
   Use chemical or biological treatments only when necessary within an IPM/ICM framework.

Visit the IPMorama website

For more practice abstracts, see our Insights Corner

Federal Department of Economic Affairs, Education and Research EAER
UK Research and Innovation
Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement GA No. 101135348.

4. IPM control strategies for late blight: Reduce fungicide use by 45–100%

Practice Abstract # 4

IPM control strategies for late blight: Reduce fungicide use by 45–100%

Problem statement:

Late blight is an extremely destructive potato disease, causing severe yield and quality losses. Experimental, fully integrated, control strategies combine diversity enhancing methods with sanitary measures, more resistant cultivars, soil management, monitoring & evaluation and targeted control to create more durable cultivation methods that allow for a strongly reduced chemical dependency and input.

2025 Demonstrations:

Three demonstrations of the IPM/ICM late blight control strategy were carried out in Invergowrie (Scotland), Ploudaniel (Brittany, France) and Bobrowniki (northern Poland). A range of cultivars representing host resistance levels from "susceptible" to "highly resistant" (but not immune) were grown in each location.

	Disease pressure:	High	Normal	Low
Cultivar resistance group	Treatement	France Ploudaniel	Poland Bobrowniki	Scotland Invergowrie
All	Common practice	9	13	12
Group S	ICM	6	13	11
Group R2	ICM	5		1
Group G	ICM		7	
Group A	ICM	5	8	0
Group B	ICM	5	1	0
Group C	ICM	5	1	0
Group D	ICM		1	0
Group E	ICM		1	0
Group F	ICM		1	
Group I	ICM		1	

Table 1. Cultivar resistance groups and the number of fungicide applications necessary to keep a healthy crop in three locations in 2025. More information on cultivar resistance groups can be found here.

The first spray application was delayed on more resistant cultivars while disease pressure was low. The higher the resistance level, the longer the delay. In addition, spray timing was determined using a decision support system (DSS).

In France, the climate was wet, in Scotland it was dry and in Poland it was "normal". In addition, common practice was compared to IPM. The results are summarized in the table.

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme. Associated country partners are funded by SERI & UKRI. However, the views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

UK Research and Innovation

ipmorama.eu

By deploying a fully integrated late blight control strategy (described in IPMorama Practice Abstract #3), the dependency as well as the number of sprays could be significantly reduced in all three 2025 IPMorama demonstrations. The main responsible components were a **dedicated decision support system (Farmmaps BlightApp,** www.farmmaps.eu**) plus the cultivation of more resistant cultivars**. The reduction in fungicide use realised on more resistant cultivars was 45% in France, ranged from 38-92% in Poland and from 92-100% in Scotland.

The climate is a major influence on the potential reduction of the fungicide input. Wet weather in France "only" allowed for a 45% reduction whereas the dry Scottish 2025 weather allowed for a near 100% reduction of the fungicide input on more resistant cultivars.

A **zero tolerance mind-set** also is an important component: without epidemic development, the *P. infestans* potential for adaptation (virulence and fungicide resistance development) is severely hindered, **strongly benefitting durability of the IPM control strategy**. Fungicide applications thus serve to protect the host resistance genes and vice versa.

Benefits:

- **Reduced fungicide** use by 45–100% on highly resistant cultivars.
- **Improving cost efficiency**, sprays applied only when necessary.
- **Enhanced disease control** through optimised timing of interventions.
- **Improved long term sustainability** of late blight management through pathogen monitoring.
- **Aligns with societal and policy goals** for reduced chemical reliance.
- IPM/ICM is **relevant to both organic and conventional production** systems.

Practical recommendations:

1. **Cultivar Selection:** Prioritise varieties with (multiple) late blight resistance genes.
2. **Sanitation Practices:** Remove volunteers, potato dumps and infected plants.
3. **Decision Support Systems:** Use weather DSSs to guide timely interventions.
4. **Targeted Treatments:** Apply direct control agents ONLY when risk thresholds are met.
5. **Cultural Practices:** Adjust irrigation to reduce leaf wetness and rotate crops 1:4 or wider to minimize pathogen carryover.
6. **Monitoring:** Regularly scout fields to detect early symptoms and support *P. infestans* population monitoring.

Visit the IPMorama website

For more practice abstracts, see our Insights Corner

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra
Swiss Confederation
Federal Department of Economic Affairs, Education and Research EAER
State Secretariat for Education, Research and Innovation SERI
UKRI UK Research and Innovation
Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement GA No. 101135348.

5. Delay the spray: DSS, late blight and the weather

IPMorama

Practice Abstract # 5

Delay the spray: DSS, late blight and the weather

Problem statement:

Decision support systems (DSS) are powerful tools that analyse local weather conditions to predict disease risk and guide targeted interventions. Potato yield and quality can be severely reduced by late blight (*Phytophthora infestans*), a highly destructive disease. Traditionally, it has been controlled using short-interval preventive sprays, resulting in 12–15 applications per season in the Netherlands. This strategy aims to fully protect foliage throughout the growing season. However, the spread and impact of fungal arable pathogens are highly dependent on weather: wet conditions usually promote epidemics, whereas dry conditions can slow or even stop their progression.

DSS predict potential disease outbreaks and provide timely guidance for Integrated Pest Management (IPM) strategies. Sprays are applied just before predicted infection events. In Northwest European conditions, on susceptible potato cultivars, DSS-guided IPM typically reduces the number of sprays by 2–3 per season compared with traditional weekly applications while maintaining the same level of disease control.

2025 IPMorama demonstrations:

Interface of the Farmmaps potato late blight DSS. Weather data and infection events (purple line) are given in the graph. Here, an infection event is calculated for 24 May. The colours in the top bar indicate the spray advice. Green: no spray advice, Yellow: preventive spray advice, orange: curative spray advice and red: eradicant spray advice. Preventive spray advice is given for 23 May.

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme. Associated country partners are funded by SERI & UKRI. However, the views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

UK Research and Innovation

ipmorama.eu

DSS played a key role in IPMorama's late blight control demonstrations in Poland, Scotland, and France. Preventive sprays were applied only prior to predicted infection events. On susceptible cultivars, spraying began from the emergence of the first symptoms, while on more resistant cultivars, the first spray was delayed—the higher the resistance level, the longer the delay.

Decision Support on More Resistant Cultivars

More resistant potato cultivars can also become infected by late blight, which can lead to unwanted erosion of resistance. However, infections on these cultivars generally occur later than on susceptible varieties, and the timing of the first spray is influenced by weather conditions. DSS-guided control strategies exploit this difference by calculating the optimal delay before starting sprays, ensuring fungicides are applied only when necessary. Once spraying begins, timing follows DSS recommendations, helping to maintain effective disease control while reducing selection pressure on the pathogen and preserving cultivar resistance

The Farmmaps BlightApp offers the possibility to delay the 1st spray application on more resistant cultivars. This delay is weather dependent and calculated by the DSS. The user has to purposely activate this functionality and supply the date when late blight is first found in the area. This date is used as a starting point to calculate the delay of the 1st application.

	Verdeler/Handelshuis	Rasnaam*
Groep		
A	Agrico	Carolus, Twinner, Twister
	Avebe	Antonia
	HZPC	Cayman
	Meijer Potato	Sound, Lady Jane
B	Agrico	Alouette, Ardeche, Nofy
C	Agrico	Levante
	Geersing Potato Specialist	Camillo, Cammeo, Esperanto
	Plantera	Vitabella
D	Agrico	Beyonce, Sevilla
	Geersing Potato Specialist	Peter Pan
	Meijer Potato	Acoustic
E	Agrico	Jacky
	Solana Holland	Nola
F	Avebe	Aveline, Avenger, Avito
G	HZPC	Invictus
H	Solana Holland	Connect

Source: https://www.bo-akkerbouw.nl/files/Pdfs-algemeen/Schema-rassen-met-verbeterde-resistentie.pdf

Federal Department of Economic Affairs, Education and Research EAER
UK Research and Innovation
Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement GA No. 101135348.

Benefits:

- **Reduced pesticide use:** DSS-guided timing reduces the number of sprays by 2–3 per season on susceptible cultivars.
- **Targeted interventions:** Sprays are applied only when and where disease risk is high, increasing efficiency.
- **Sustained disease control:** Maintains the same protection as traditional preventive strategies.
- **Adapted to cultivar resistance:** Spray timing adjusts based on the susceptibility of each cultivar.
- **Resistance preservation:** On more resistant cultivars, optimal spray timing reduces selection pressure on the pathogen and helps prevent erosion of resistance.
- **Environmentally friendly:** Minimizes unnecessary fungicide applications and reduces chemical exposure.
- **Economic savings:** Lower input costs without compromising yield or quality.

Practical recommendations:

- Use DSS to monitor **local weather conditions** and predict potential late blight outbreaks.
- Apply IPM sprays **only before predicted infection events**, rather than on fixed intervals.
- For susceptible cultivars, begin spraying from the **emergence of the first symptoms**.
- On more resistant cultivars, **delay the first spray** according to DSS guidance, taking into account cultivar resistance and weather conditions.
- Once spraying begins, **follow DSS recommendations for timing and frequency** to maximize disease control and protect resistance.
- Integrate DSS guidance into existing farm management practices to **optimize timing, reduce costs, and maintain effective disease control**.

Visit the IPMorama website

For more practice abstracts, see our Insights Corner

Federal Department of Economic Affairs, Education and Research EAER
State Secretariat for Education, Research and Innovation SERI
UK Research and Innovation
Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement GA No. 101135348.

Conclusion

This deliverable presents the first batch of EU CAP Network practice abstracts developed under the IPMORAMA project, providing a structured, practice-oriented synthesis of key plant health challenges and Integrated Pest Management (IPM) solutions. By following the EIP-AGRI format—**Problem Statement**, **Solution**, and **Benefits and Practical Recommendations**—the abstracts ensure clarity, accessibility, and practical relevance for farmers, advisors, breeders, and other stakeholders.

The development process, including the use of a harmonised template, contributions from project researchers, and stakeholder engagement, ensured that outputs are scientifically robust, actionable, and aligned with EU CAP Network objectives. Dissemination via the project website and the EU CAP Network maximises visibility and facilitates adoption of digital tools, monitoring frameworks, and decision support systems developed within IPMORAMA.

Overall, this deliverable demonstrates the project's contribution to knowledge transfer, stakeholder engagement, and the promotion of sustainable crop protection practices across European agriculture. It lays a foundation for subsequent batches of practice abstracts, which will continue to support EU CAP Network objectives, enhance Integrated Pest Management uptake, and foster innovation within the European Agricultural Knowledge and Innovation System (AKIS).

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement GA No. 101135348.