What works in Horizon Europe: experiences, challenges and tips?

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Project PurPest
Plant pest prevention through technology-guided monitoring and site-specific control

What made PurPest a successful Cluster 6 proposal?

HORIZON-CL6-2021-FARM2FORK-01-04: Tackling outbreaks of plant pests

Expected Outputs

In line with the farm to fork strategy, for a transition to fair, healthy and resilient EU agriculture and forestry, including an ambitious target for the **reduced use of plant protection products**, proposals will support research and innovation (R&I) to help the agricultural / forestry sectors to remain productive and contribute to sustainable agriculture and/or forest health.

HORIZON-CL6-2021-FARM2FORK-01-04: Tackling outbreaks of plant pests

Expected Outcomes

- Find adequate responses to EU quarantine plant pests

- Enhance capacities to **prevent, monitor and (bio)control** important plant pests

- Support to relevant EU and Associated Countries' plant health policies

PurPest

Mendel University in Brno

Every proposal in this call should target EU quarantine and priority pests, contribute to the understanding of their diverse drivers (climate change, globalisation, ecosystem degradation), develop efficient surveillance methods and **strategies for early-detection and (bio)control,** extend the range of **tools/technologies** available for the development of **economically and environmentally** sound solutions for pest management in line with principles of **integrated pest management,** analyse the **social and economic implications** for farmers in both the **conventional and the organic sectors** and the **ecological impacts of plant pest(s) in a multiactor approach.**

The EU Commission is setting extremely high expectations and demands that are nearly impossible to be satisfied in a single 4-years and 7 million € project...

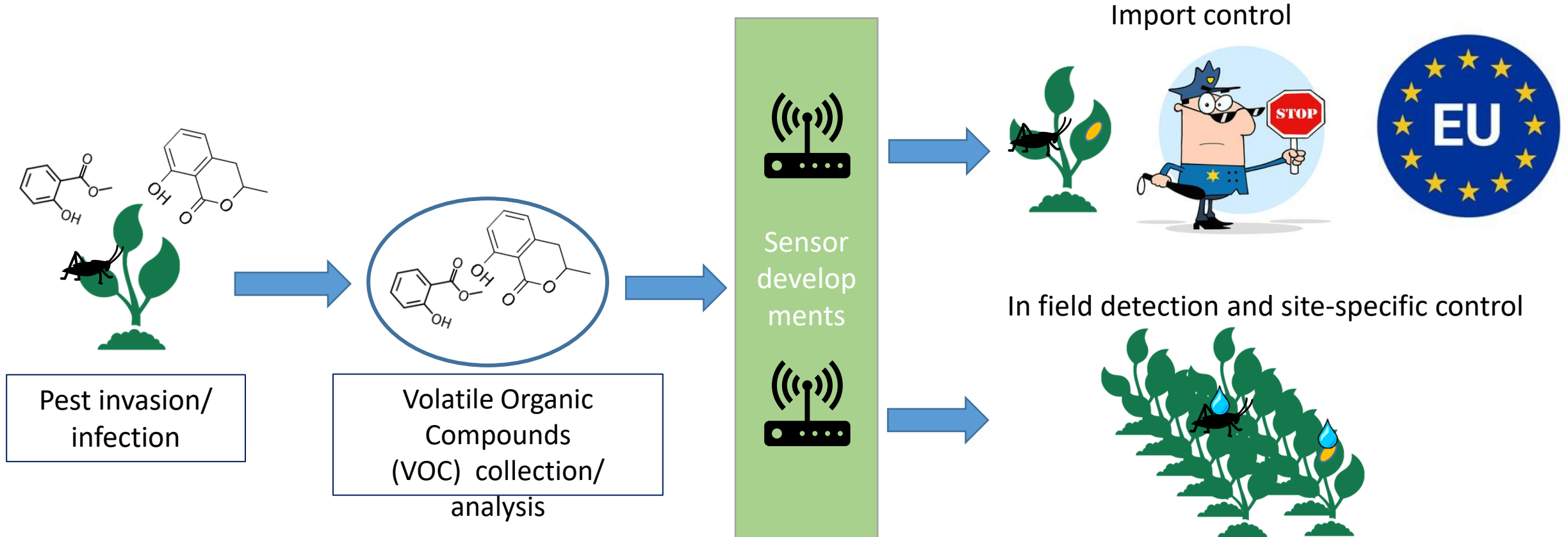**How did we tackle this conundrum in PurPest?**

The title and concept of PurPest

Plant pest prevention through technology-guided monitoring and site-specific control
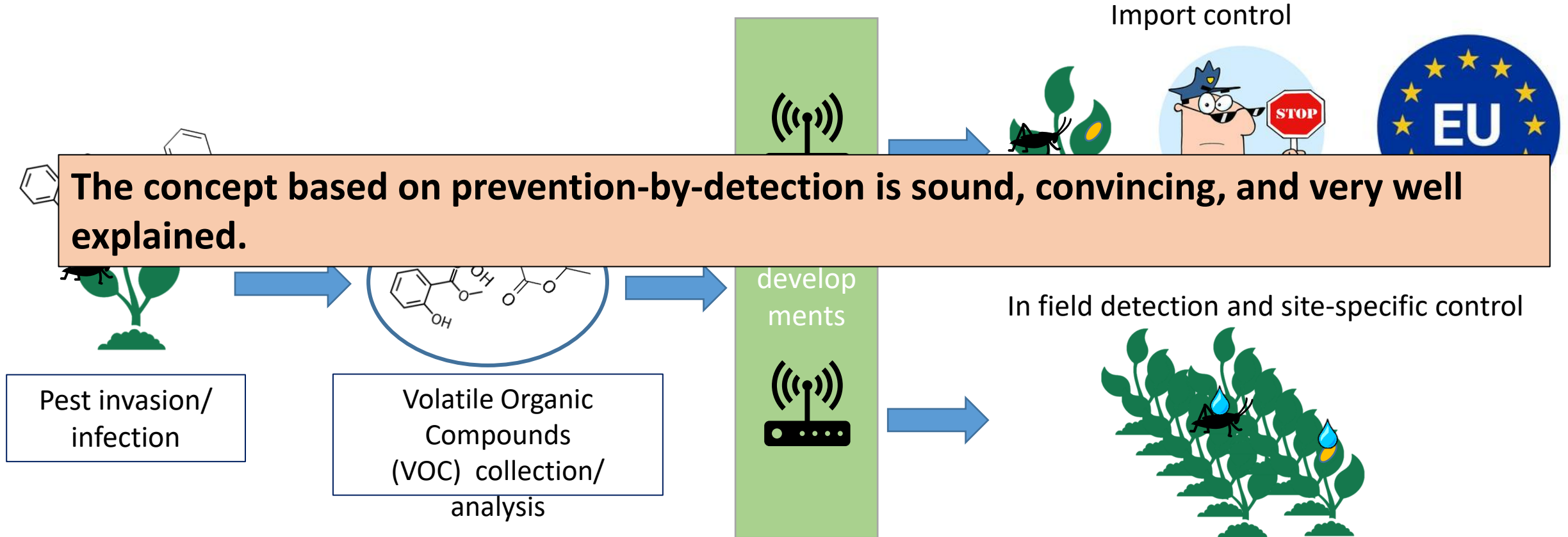
fitted perfectly to the scope of the call

HORIZON-CL6-2021-FARM2FORK-01-04: Tackling outbreaks of plant pests

Convincing concept: Detection of volatile compound signatures for import control and pest surveillance
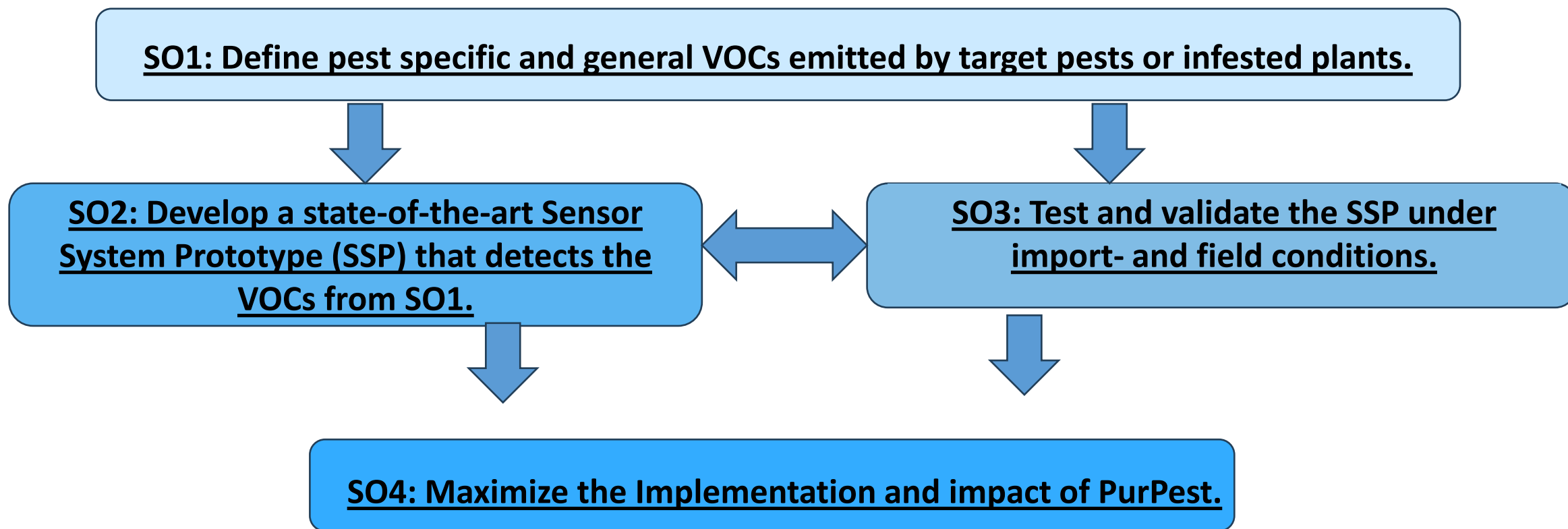

Import control

Sensor developments

In field detection and site-specific control

Pest invasion/ infection

Volatile Organic Compounds (VOC) collection/ analysis

Convincing concept: Detection of volatile compound signatures for import control and pest surveillance

Import control

The concept based on prevention-by-detection is sound, convincing, and very well explained.

develop
ments

In field detection and site-specific control

Pest invasion/
infection

Volatile Organic
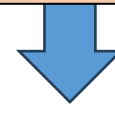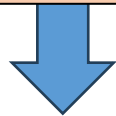Compounds
(VOC) collection/
analysis

EU

Objectives

The **main objective** of **PurPest** is to control serious plant pests during import and to manage them in the field by developing a unique concept enabling pest detection in a timely and non-invasive manner.

SO1: Define pest specific and general VOCs emitted by target pests or infested plants.

SO2: Develop a state-of-the-art Sensor System Prototype (SSP) that detects the VOCs from SO1.

SO3: Test and validate the SSP under import- and field conditions.

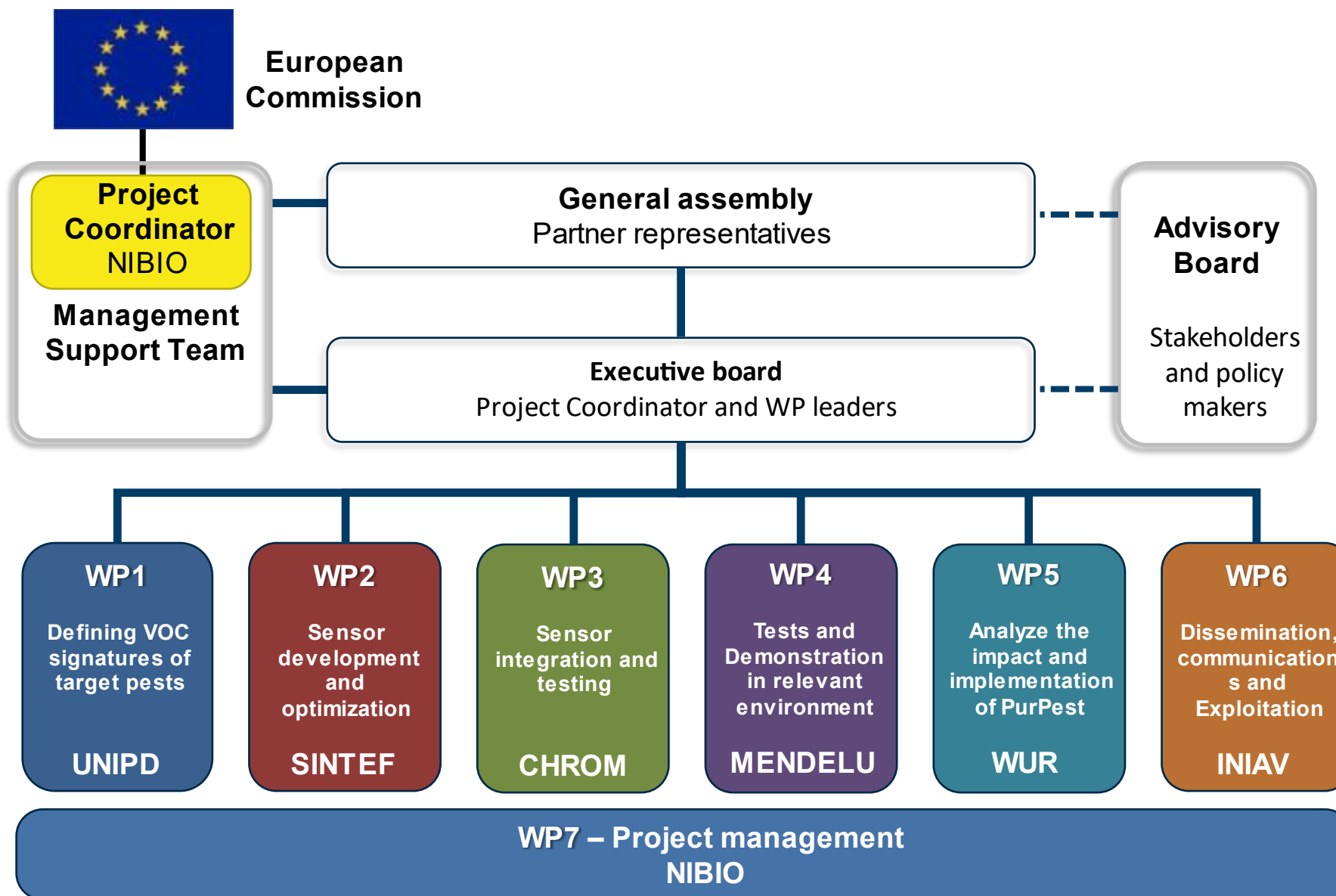**SO4: Maximize the Implementation and impact of PurPest.**

Objectives

The **main objective** of **PurPest** is to control serious plant pests during import and to manage them in the field by developing a unique concept enabling pest detection in a timely and non-invasive manner.

PurPest identifies clearly defined and achievable objectives to contribute to the

management of five important pests with potentially very high ecologic and economic

impact, menacing the agricultural and forestry activities in the EU.

**SO4: Maximize the Implementation and impact of PurPest.**

PurPest governance structure

European Commission

Project Coordinator NIBIO

Management Support Team

General assembly
Partner representatives

Executive board
Project Coordinator and WP leaders

Advisory Board

Stakeholders and policy makers

WP1

Defining VOC signatures of target pests

UNIPD

WP2

Sensor development and optimization

SINTEF

WP3

Sensor integration and testing

CHROM

WP4

Tests and Demonstration in relevant environment

MENDELU

WP5

Analyze the impact and implementation of PurPest

WUR

WP6

Dissemination, communications and Exploitation

INIAV

WP7 – Project management
NIBIO

12

Brown marmorated stinkbug

Fall armyworm on maize

The rationale for the selection of the target pests is very well founded.

P. ramorum
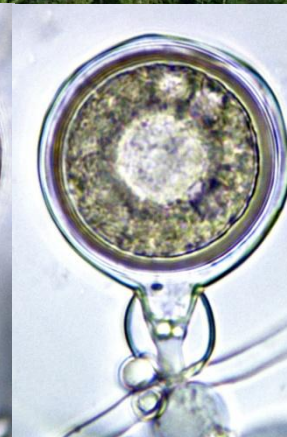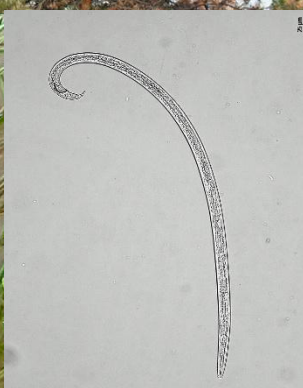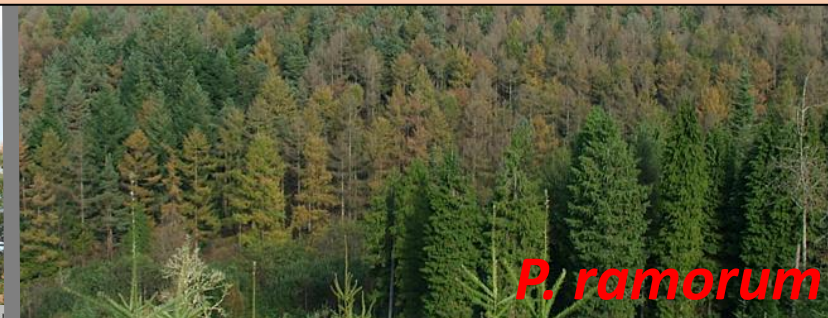
Cotton ballworm

Pine Wood Nematode

Phytophthora

PurPest

Plant Pest Experts

Technology Partners

Mendel University in Brno
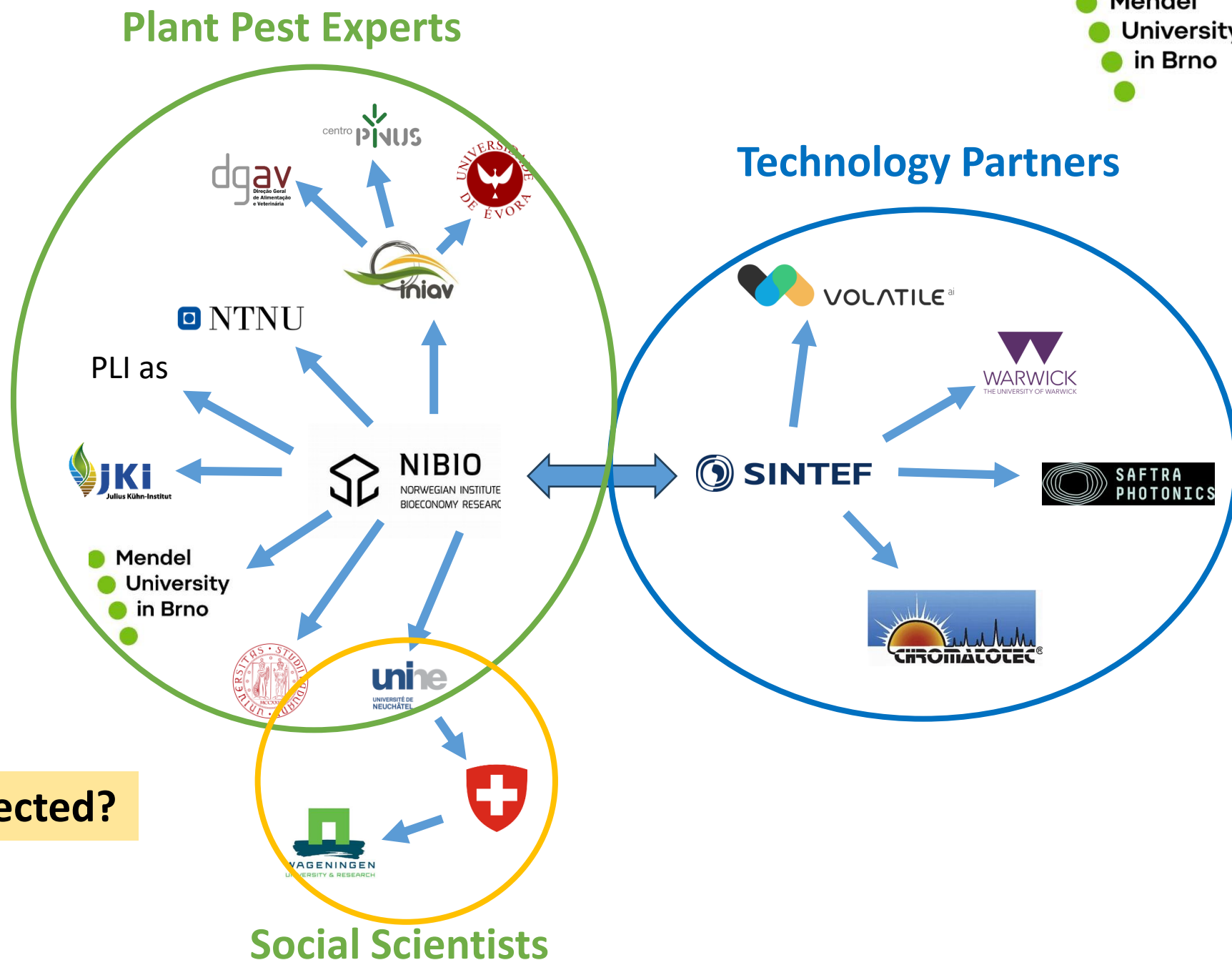
Strong multidisciplinary consortium with complementary expertise from:

7 universities,
5 research institutes,
4 SMEs,
2 governmental agencies,
10 countries

How were the partners selected?

Social Scientists

PurPest

Mendel University in Brno

Plant Pest Experts

Technology Partners

> **The interdisciplinary approach is significant and appropriate**, taking into account the **necessary disciplines to achieve the objectives,** including a very well suited **contribution of SSH disciplines** and enhancing **cross-fertilisation.**
> **The consortium includes all the expertise and skills needed to carry out the scientific, technical and management activities of the project.** The consortium brings together a **complementary and excellent group of research scientists and SMEs**, which are technology providers**.**

St…
co…
co…
fr…
7 …
5 …
4 …
2 …
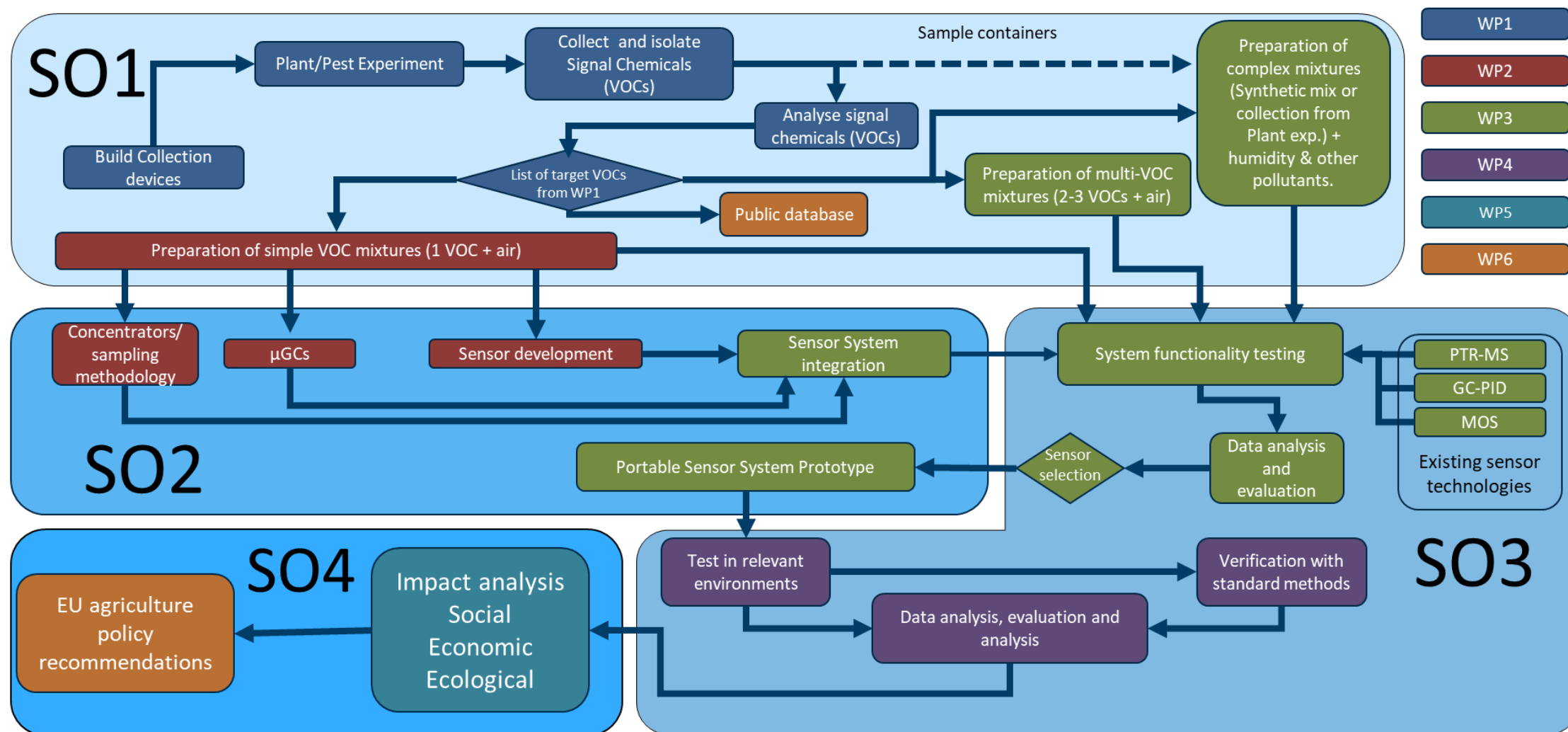10…

How were the partners selected?
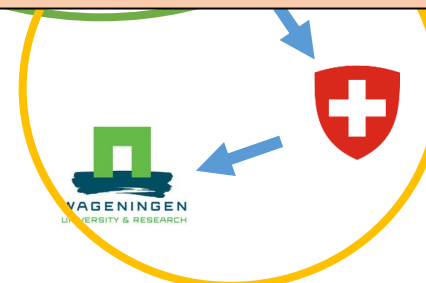
Social Scientists

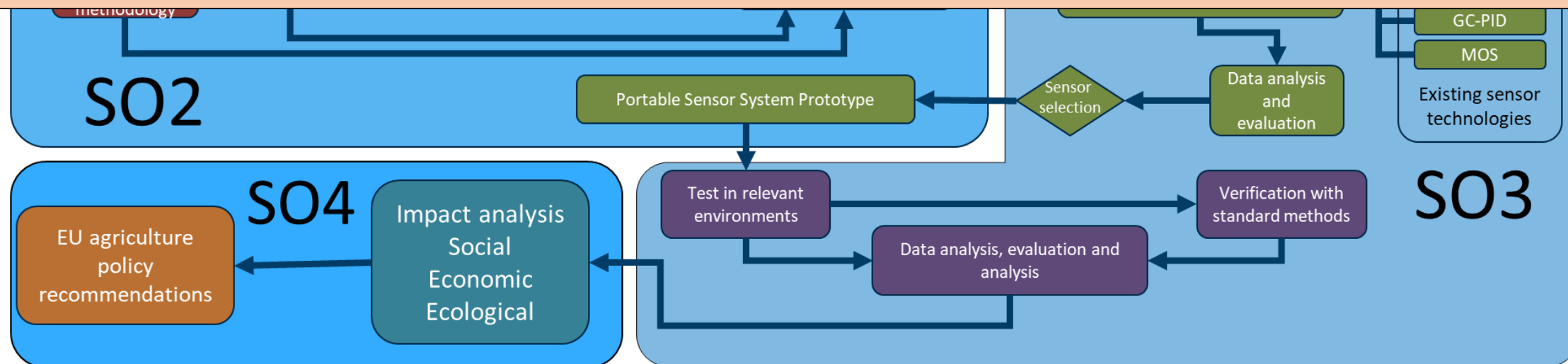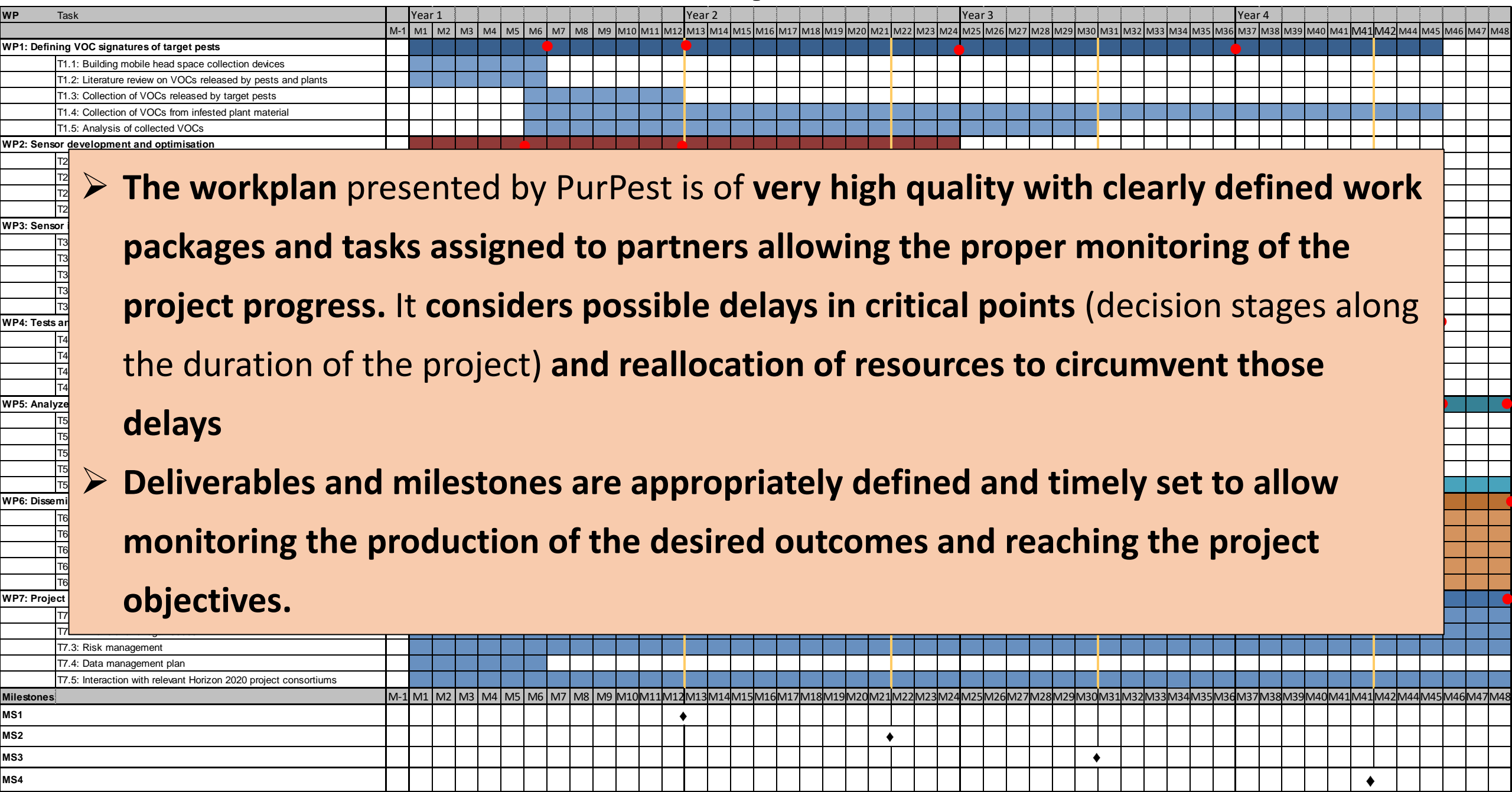Geographical distribution of the PurPest partners
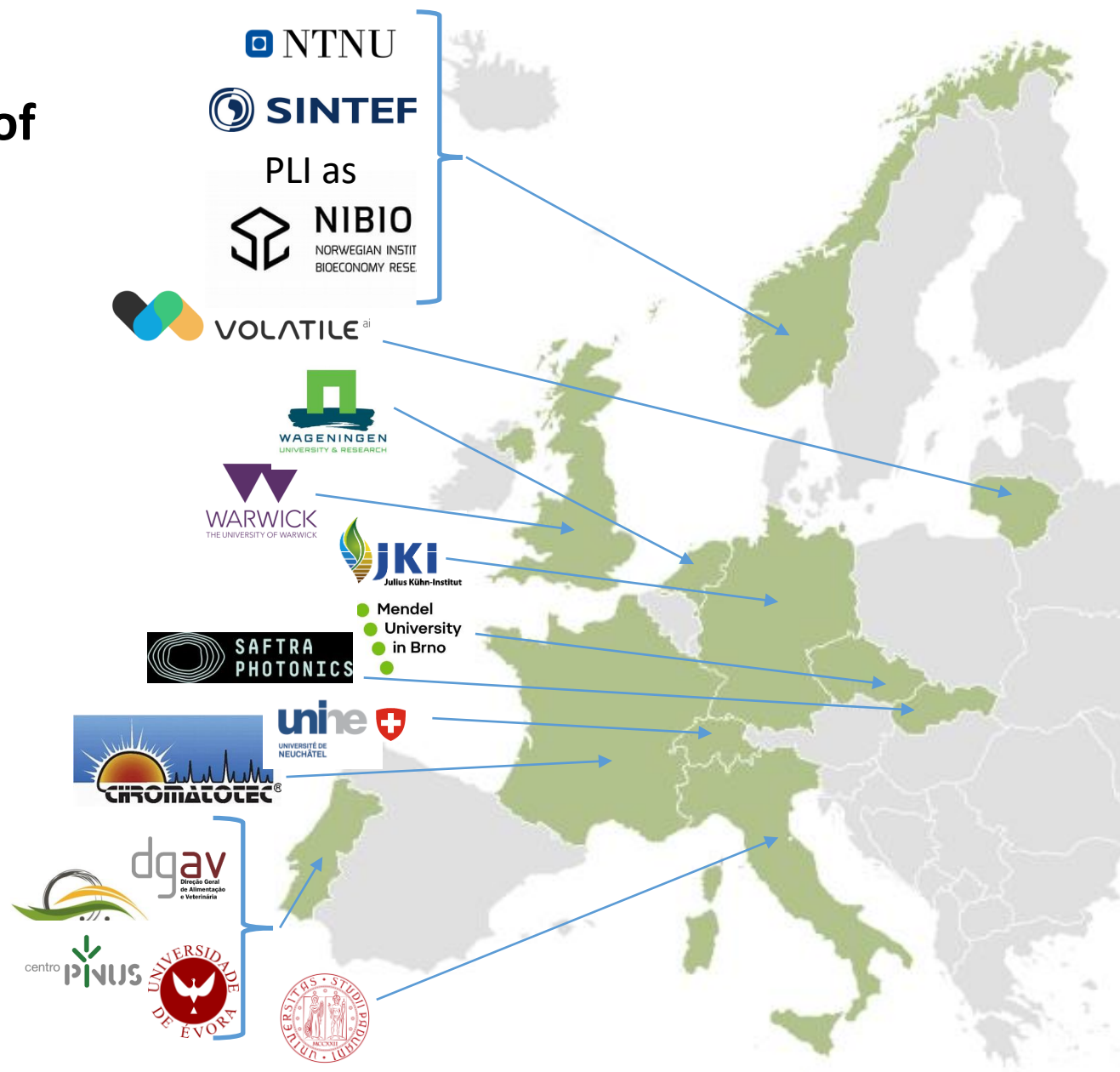
Workflow

Workflow

> **The workflow of the project describes an excellent approach to link the activities of the various work packages and ensure delivery of the project outcomes and achievement of objectives.**

> **The work packages are in perfect alignment with each partners' expertise and operational capacities.**

Workplan

WP	Task
WP1: Defining VOC signatures of target pests	
	T1.1: Building mobile head space collection devices
	T1.2: Literature review on VOCs released by pests and plants
	T1.3: Collection of VOCs released by target pests
	T1.4: Collection of VOCs from infested plant material
	T1.5: Analysis of collected VOCs
WP2: Sensor development and optimisation	
	T2.1: Evaluating Pre-concentrators
	T2.2: Evaluation and adaptation of μ-GC technologies
	T2.3: Coating development
	T2.4: Sensor development and optimization
WP3: Sensor integration and verification	
	T3.1: Sensor System Integration
	T3.2: Preparation of VOC mixtures for sensor system testing
	T3.3: System functionality testing and benchmarking
	T3.4: Data analysis and evaluation
	T3.5: Fabrication of Sensor System Prototypes
WP4: Tests and demonstration in relevant environment	
	T4.1: Testing the prototype under controlled conditions
	T4.2: Testing the prototype under transport/import conditions
	T4.3: Testing the prototype under field conditions
	T4.4: Prototype evaluation and feedback
WP5: Analyze the impact and implementation of PurPest	
	T5.1: Literature review on impacts
	T5.2: Assesment of regional costs
	T5.3: Stakeholder Survey
	T5.4: Cost-benefit analysis of management strategies
	T5.5: Management recommendations
WP6: Dissemination, communications and Exploitation	
	T6.1: Communication, Dissemination and Exploitation Plan (PERD)
	T6.2: International cooperation network
	T6.3: Communication actions
	T6.4: Dissemination and technology transfer
	T6.5: Socio-economic barriers and policy recommendations
WP7: Project management	
	T7.1: Day-to-day coordination.
	T7.2: Financial and legal issues
	T7.3: Risk management
	T7.4: Data management plan
	T7.5: Interaction with relevant Horizon 2020 project consortiums

Timeline columns: Year 1 (M-1, M1–M12), Year 2 (M13–M24), Year 3 (M25–M36), Year 4 (M37–M48)

Milestones

MS1	M12
MS2	M21
MS3	M32
MS4	M45

Workplan

WP	Task
WP1: Defining VOC signatures of target pests	
	T1.1: Building mobile head space collection devices
	T1.2: Literature review on VOCs released by pests and plants
	T1.3: Collection of VOCs released by target pests
	T1.4: Collection of VOCs from infested plant material
	T1.5: Analysis of collected VOCs
WP2: Sensor development and optimisation	
WP3: Sensor	
WP4: Tests a	
WP5: Analyze	
WP6: Dissemi	
WP7: Project	
	T7.3: Risk management
	T7.4: Data management plan
	T7.5: Interaction with relevant Horizon 2020 project consortiums

Year 1 — M-1 M1 M2 M3 M4 M5 M6 M7 M8 M9 M10 M11 M12
Year 2 — M13 M14 M15 M16 M17 M18 M19 M20 M21 M22 M23 M24
Year 3 — M25 M26 M27 M28 M29 M30 M31 M32 M33 M34 M35 M36
Year 4 — M37 M38 M39 M40 M41 M41 M42 M44 M45 M46 M47 M48

Milestones	
MS1	
MS2	
MS3	
MS4	

Work Package 1

Analyze the VOCs released by the target pests and by infested plants

Fall Army Worm infested maize plants

VOC's collection in Mexico

Prof. Ted Turlings

undamaged   damaged

- Plants were infested or not with FAW larvae on day 1.

- Collections were done during the next 2 days, each day 4 samples of FAW-damaged, undamaged and background collected.

- First day of collection we could see differences, but not on the second day (big variation).
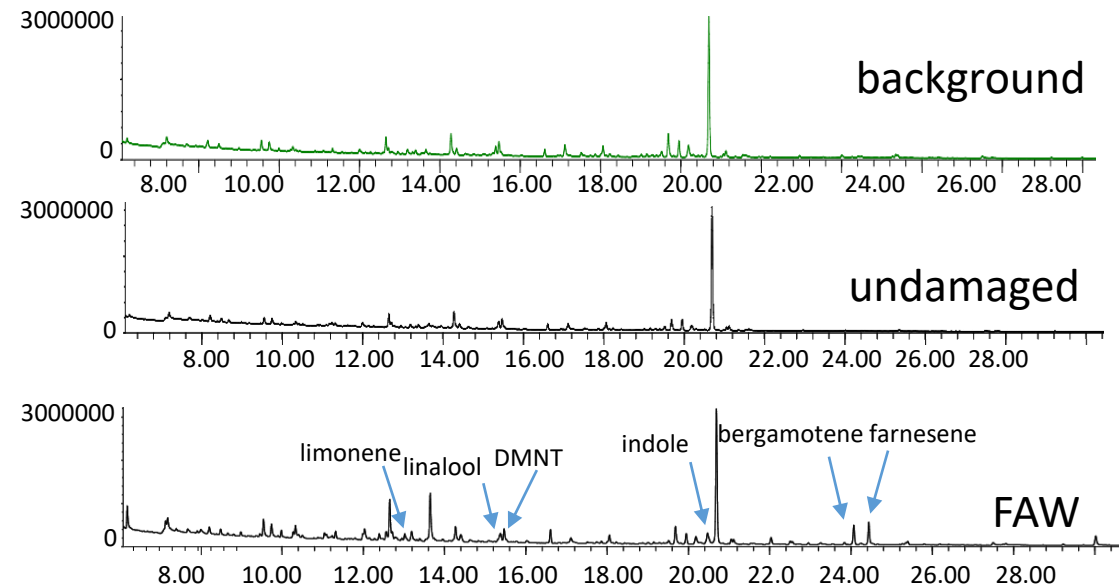
P. ramorum-NP2 (JP387)

Phytophthora plurivora

Co-infection *P. plurivora* + *P. ramorum*

Control　　　　*Phytophthora plurivora*　　　　*Phytophthora ramorum*

Alterations in the Volatilome of *Fagus sylvatica* Induced by *Phytophthora* Species

Beech

Miroslav Berka

▪ More Than 900 Distinct Features Identified Across Chemical Classes

Acetate esters
Sulphur compounds
Acetaldehydes
Ketones
Sesquiterpenes
Pyrazines
Hormone derivates
Unknown
Aldehydes
Polycyclic hydrocarbons
Monoterpenes
Alcohols
Esters
Alkanes
Aromatic hydrocarbons
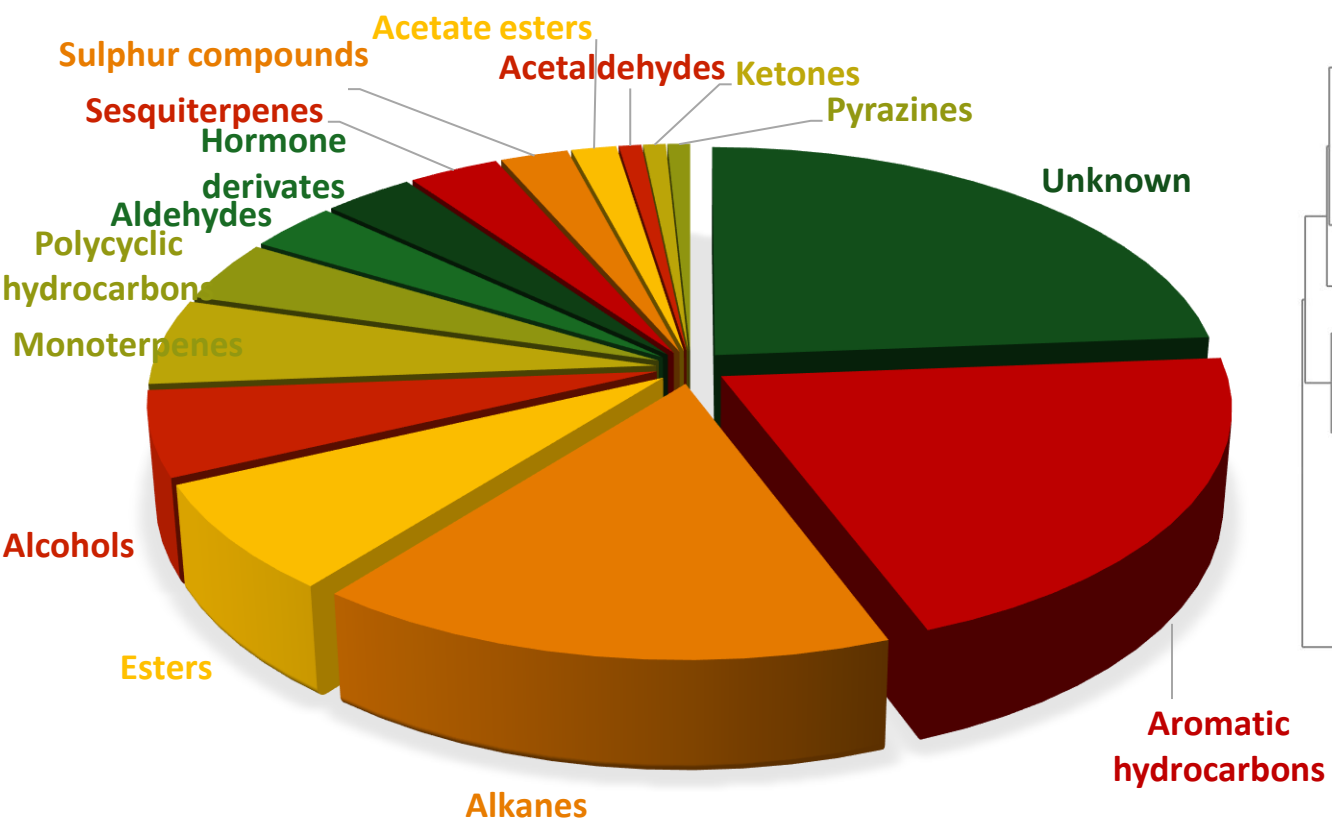
▪ Comprehensive Identification of 120+ VOCs
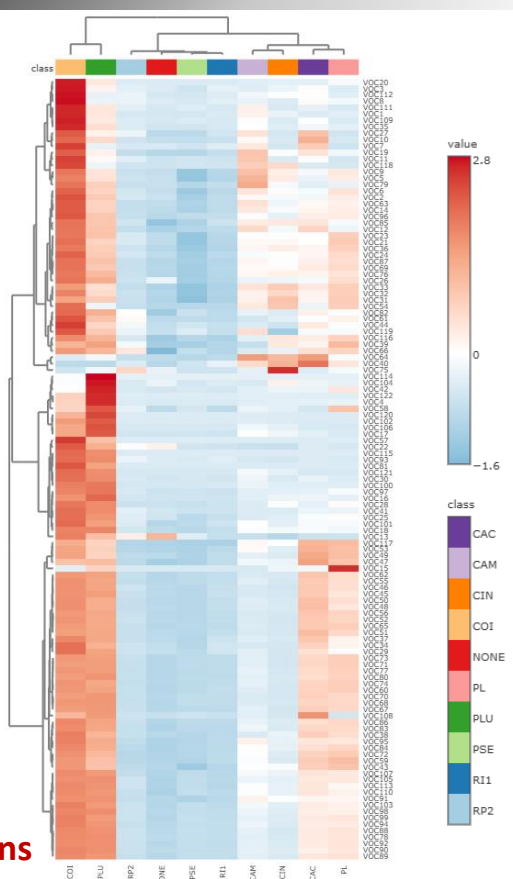
▪ Most Abundant VOCs in Controls

Name	ng/l *
Benzothiazole	1,47
Undecane	0,26
6-Methyltetralin	0,19
D-Limonene	0,23
2-Methyl-decane	0,12
C12H16	0,08
1-Ethylidene-1H-indene	0,08
4-Ethyl-1,2-dimethylbenzene	0,06
p-Cymene	0,05
Acetic acid, hexyl ester	0,02

*acetic acid, heptyl ester equivalent

Discovering Novel VOC Markers Through Correlation Analysis

Beech

Cluster Analysis Highlights Most Aggressive *Phytophthora* Isolates
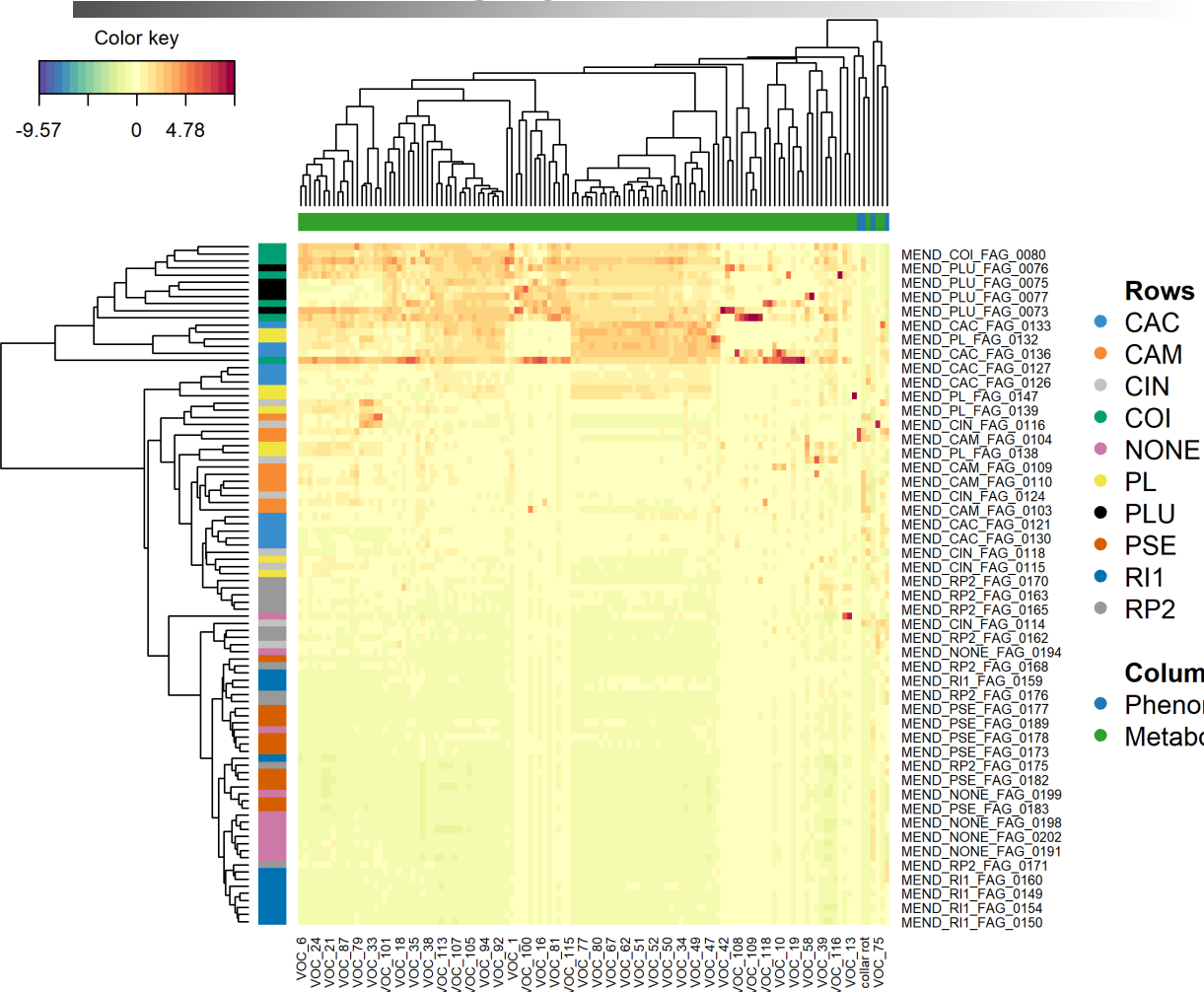
VOC Correlation Patterns Reveal Root Infection Dynamics
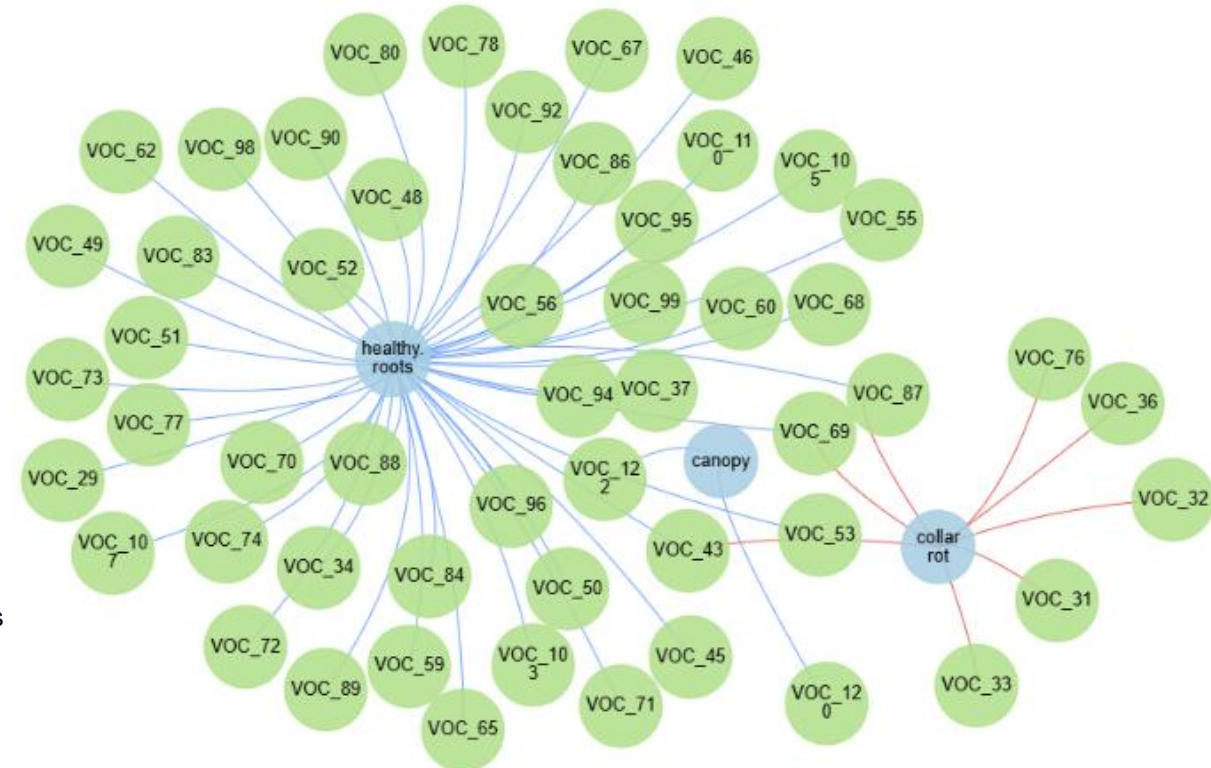
Work Packages 2 & 3

Develop a state-of-the-art Sensor System Prototype (SSP) that detects the VOCs from the target pests

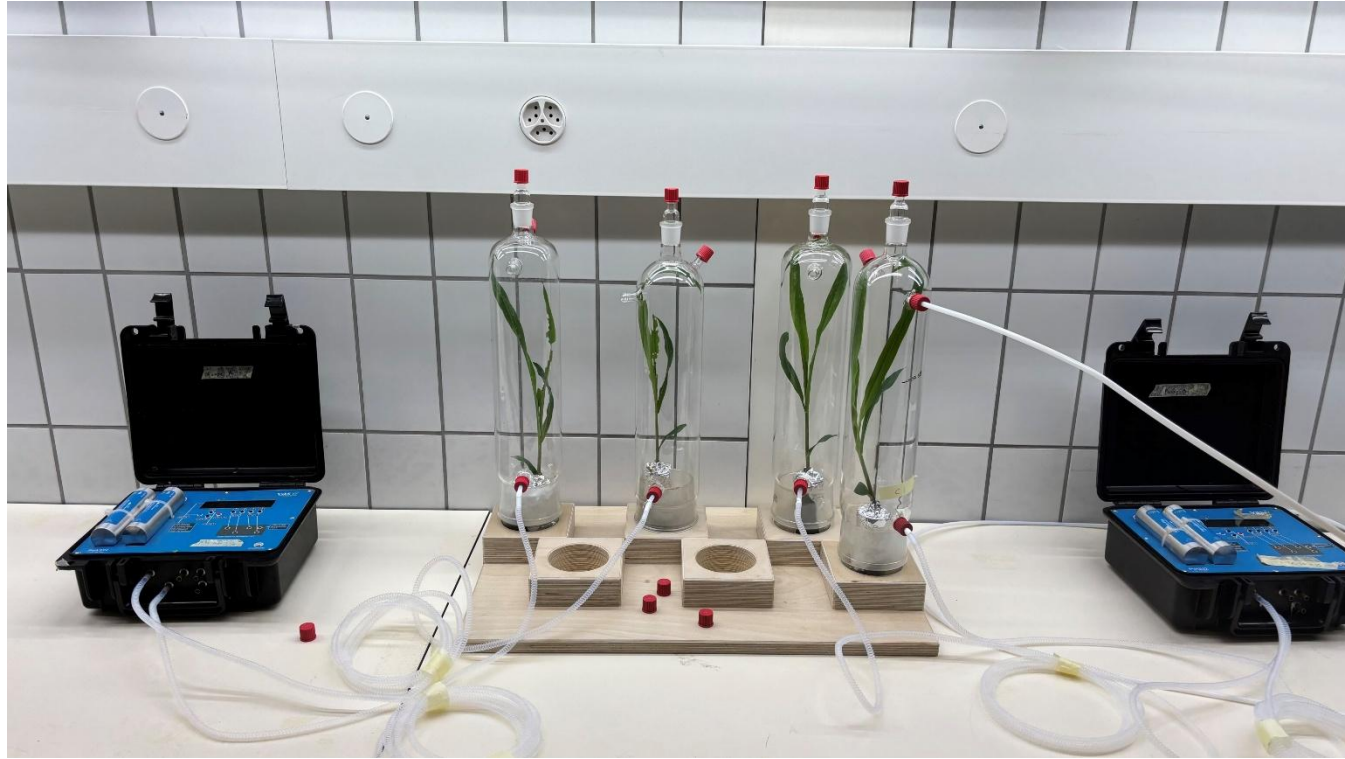# Technical cooperation

Sensor development

Coating captures VOC

VOC

Metal organic framework

Resonator micro balance

Raman spectrum

Chromatographic column

Reversible vapour absorption

Vapour Molecules

Thin polymer coating

Solidly Mounted Resonator

Portable Raman spectrometer

laser excitation

SERS signal collected

VOC sample in

SERS substrate

Frequency change

No VOC   VOC

GHz

Spectrum change

No VOC   VOC

Raman shift

VOC 1   VOC 2

Time

Ionization

UV lamp

Amplifier

The ion current is collected and converted into ppm reading (100ppm)

VOC 1   VOC 2

Time

MOF (CPO-27-Ni) illustration from Karl Ronnby, Tydall, in GENENIS project

Indole image: Jynto (talk) – Own work, made with Discovery Studio Visualizer., CC0, https://commons.wikimedia.org/w/index.php?curid=15402370

Compiling the SSP

Carrier gas: N$_2$ (where cylinder is attached

Pre-concentrator: carbotrap mixture

Injection valve

Photoionization detector

Oven gradient:
35 to 200 °C

Battery

Electronic board and computer

Sampling staff
With LED screen

Sampling pump

Work Package 4

Test and validate SSP under controlled and import- and field conditions
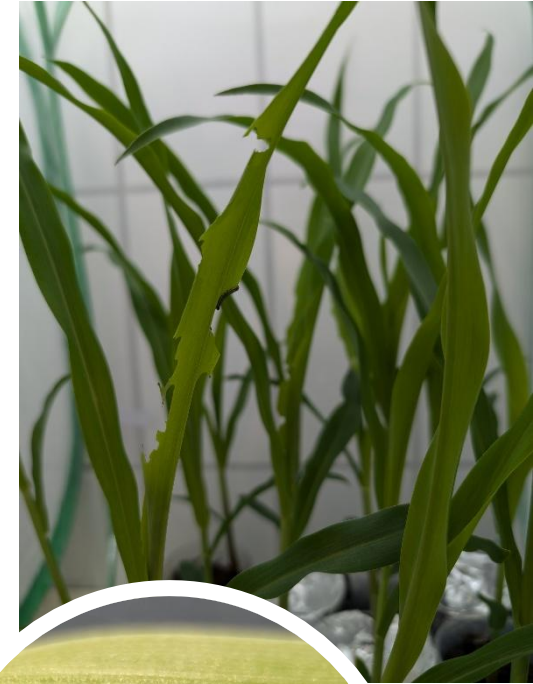
- *S. frugiperda*-damaged 2/16 plants («Low»)
- *S. frugiperda*-damaged 8/16 plants («High»)
- Undamaged plants

PTR-TOF-MS
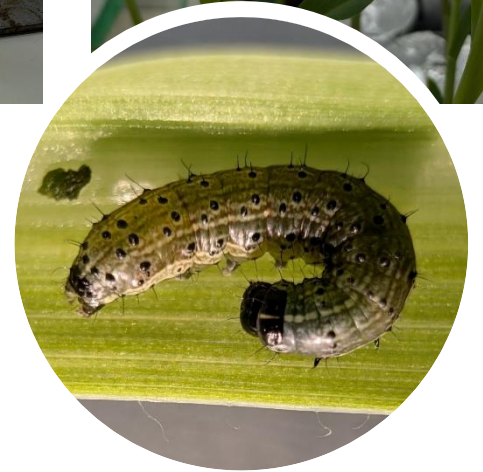
- 1-minute measurements for each sample.
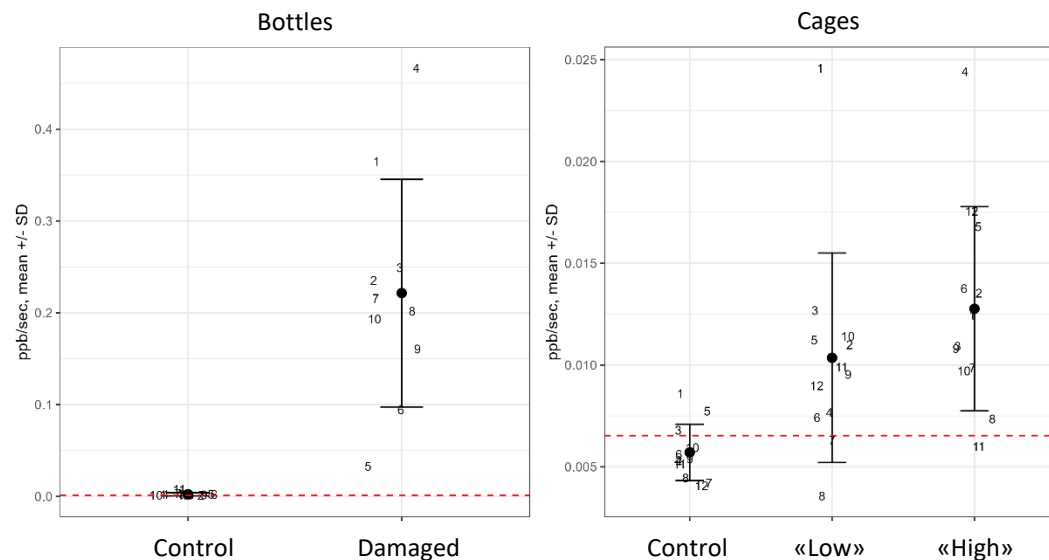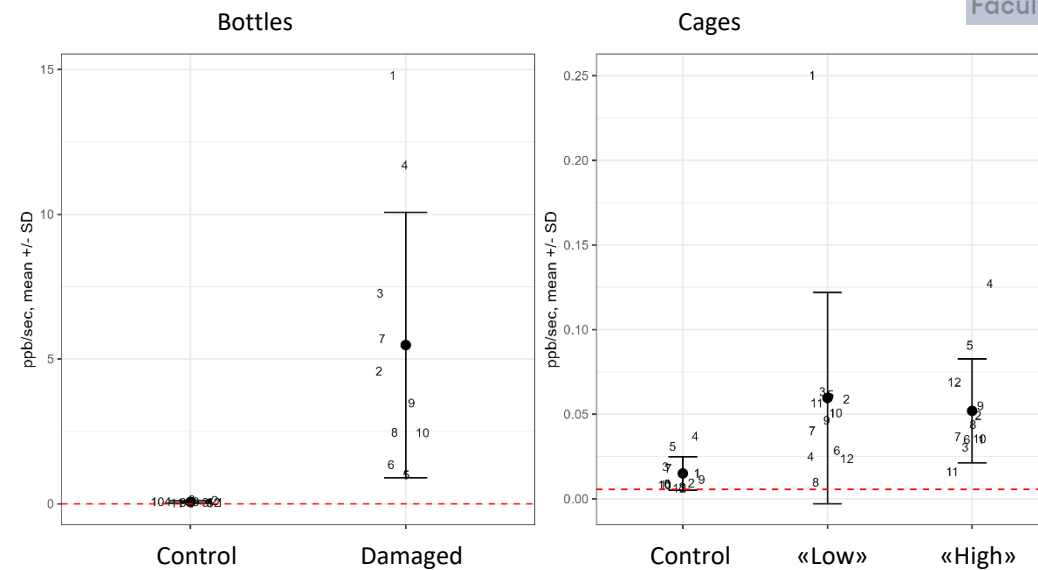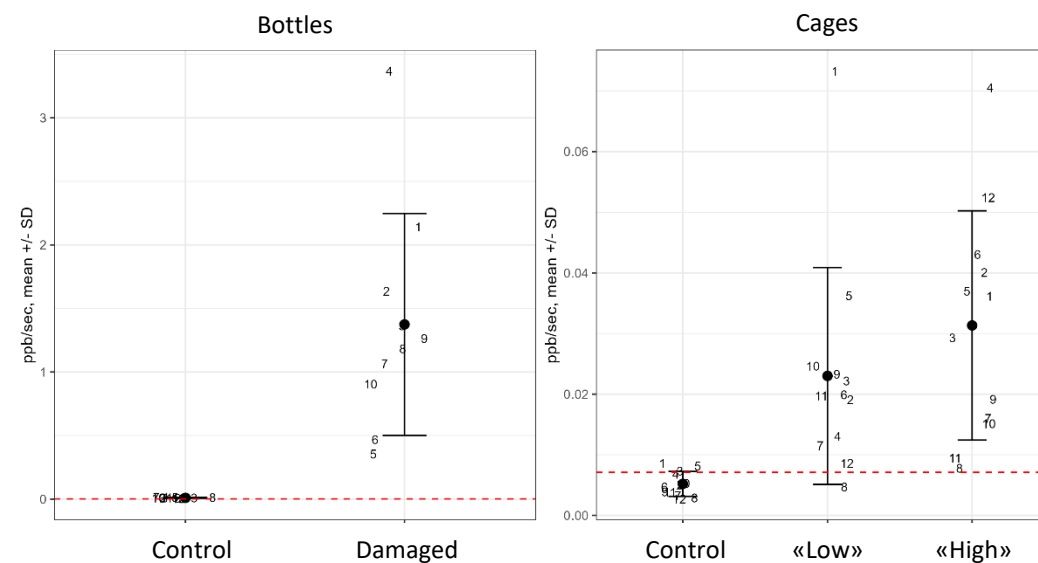
Work Package 5

Analyze the impact and implementation of PurPest

1. Exploring the environmental impacts of five case-study species

In-depth literature reviews of three globally relevant insect agricultural pests:

- Environmental impacts of agricultural pests are underreported.

- Forest pathogens showed more direct and severe documented impacts.

- Management actions can themselves lead to environmental impacts.
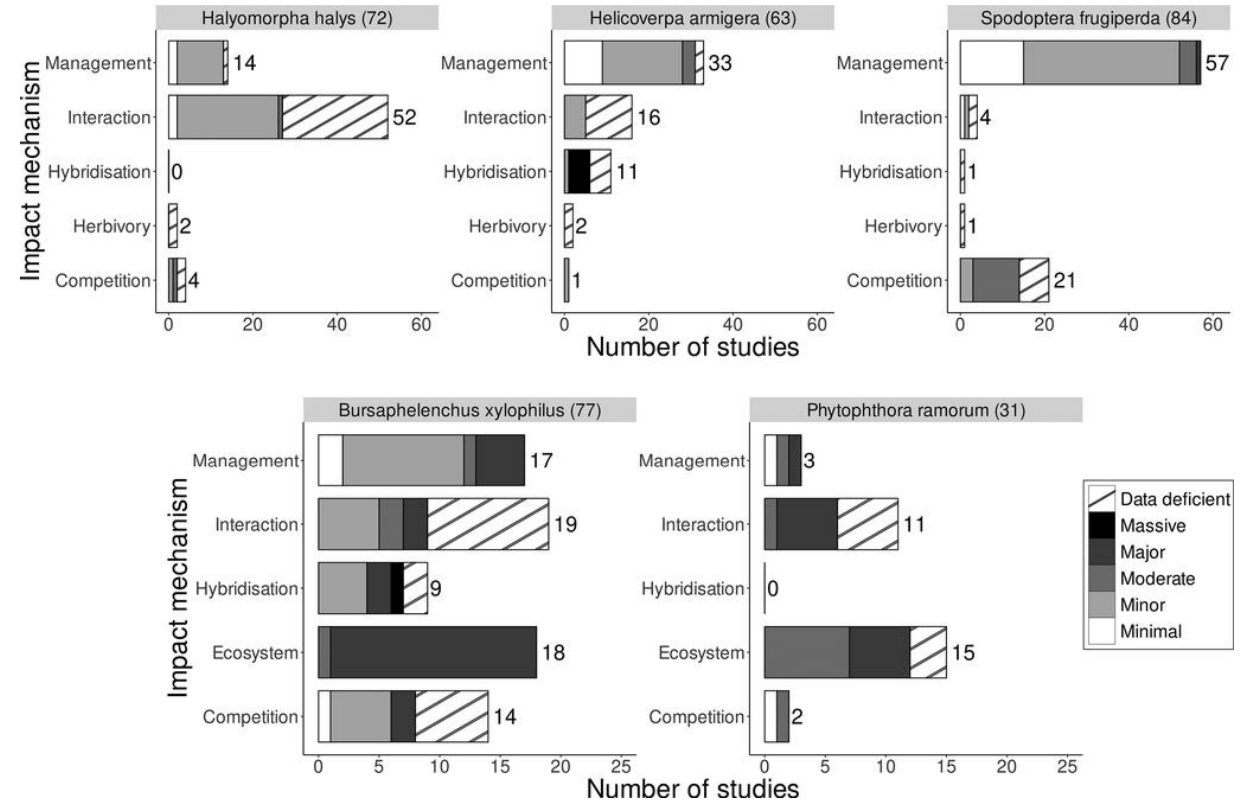
Number of studies from systematic searches for each impact mechanism for each case-study organism (Horrocks et al. 2025)

2. Migration extent of the fall armyworm in Europe

- The pest (*Spodoptera frugiperda*) was first detected in Europe in 2023.

- Highly polyphagous and can fly long distances.

- Permanent establishment possible along the Mediterranean regions (yellow-red zones).

- Seasonal migration (+damage) may reach most of Europe (blue zones).

Ecoclimatic Index (EI) Growth Index (GI)

Marginal	Marginal
Moderate	Moderate
Suitable	Suitable
Optimal	Optimal

Distance from positive EI
465 Km (50th Percentile)
2118 Km (Max. distance)
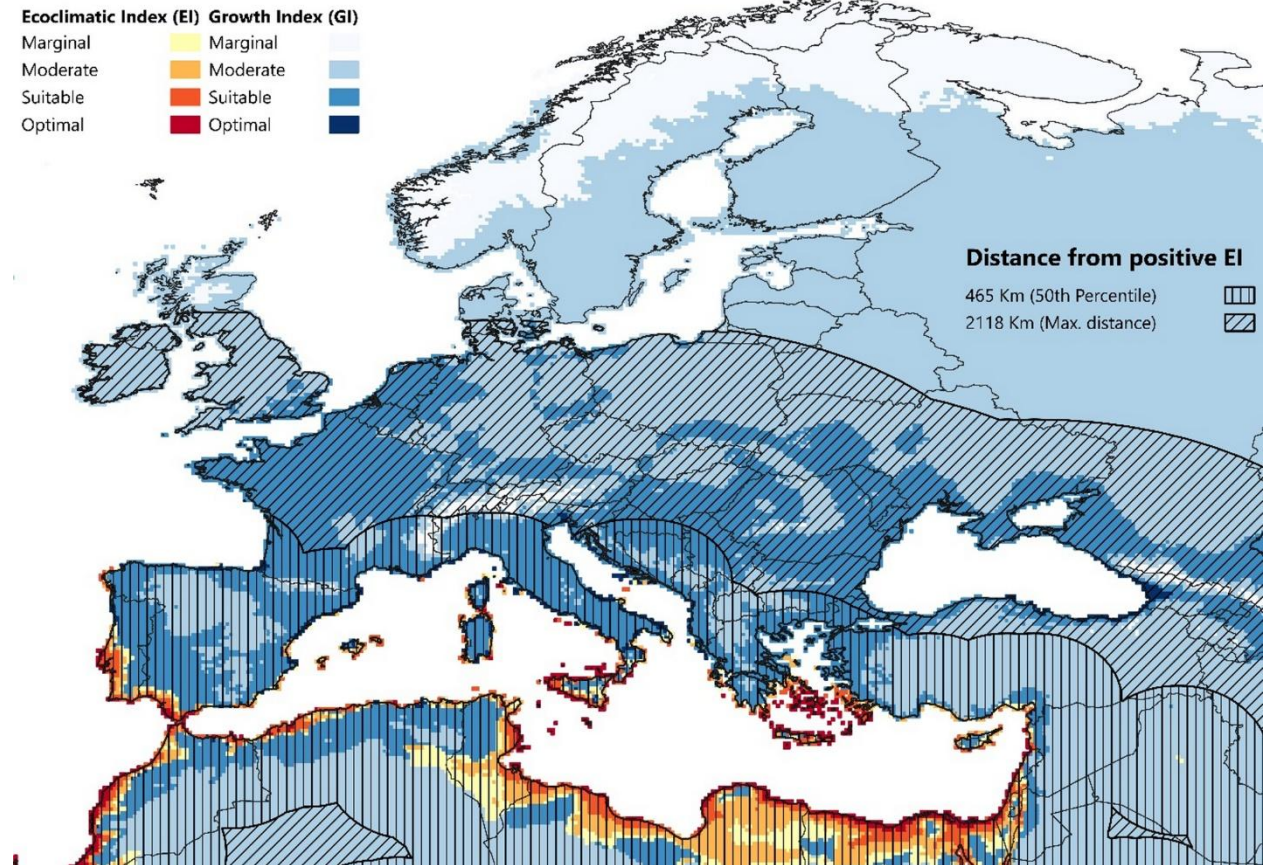
Projected climatic suitability of *Spodoptera frugiperda* in Europe (Kartakis et al. 2025).

2. Potential economic impact of the fall armyworm on European grain maize

Potential direct economic impacts on grain maize gross margins could reach:

- **Greece, Portugal, Italy,** and **Spain** are the most vulnerable Member States. In the worst case, losses exceed **€546/ha** in Greece.

However, in **million €** the picture is slightly different:

- **France, Italy, Hungary, and Greece** bear the highest risks, since they have the largest grain maize production in the EU.
- **€236 million/year** (moderate case) and up to **€901 million/year** (worst case)

Direct economic impact of FAW on European grain maize (Million €)

Scenario: Best Case, Moderate Case, Worst Case
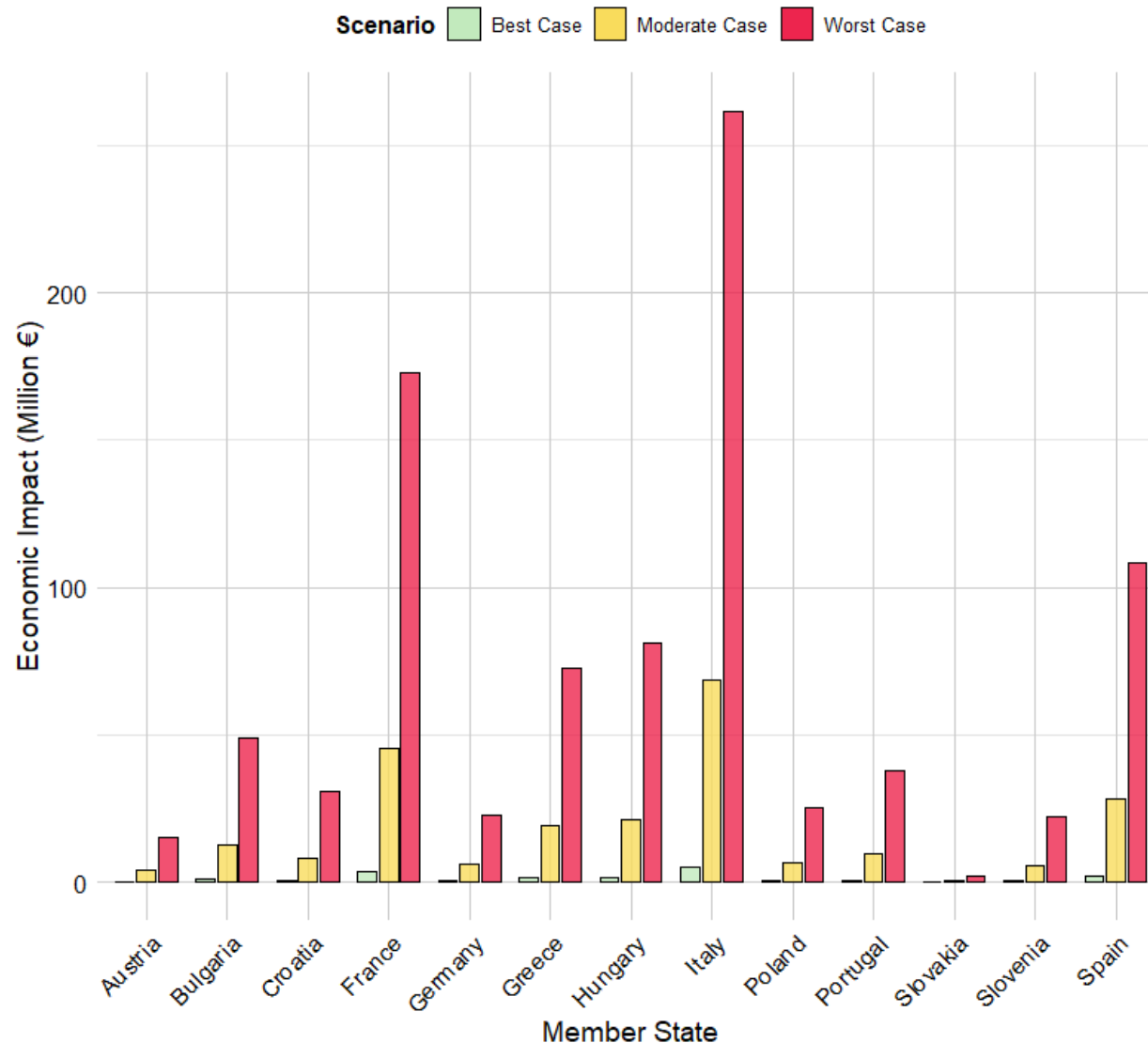
The annual direct economic impacts (in million €) of *Spodoptera frugiperda* on grain maize production in different EU Member States (Kartakis et al, 2025).

3. Modeling disease expression of *Phytophthora ramorum* in European forests

- *Phytophthora ramorum* is a threat to European forestry and the nursery industry.

- **Larch species and European beech are both highly susceptible to *P. ramorum.***

- **10% of Europe is climatically suitable for disease expression.**

- Risk areas are clustered along the Atlantic façade, including the British Isles, coastal France, the Netherlands, Belgium, and northwestern Spain and Portugal, southern Scandinavia and parts of the Alps and other mountain ranges.
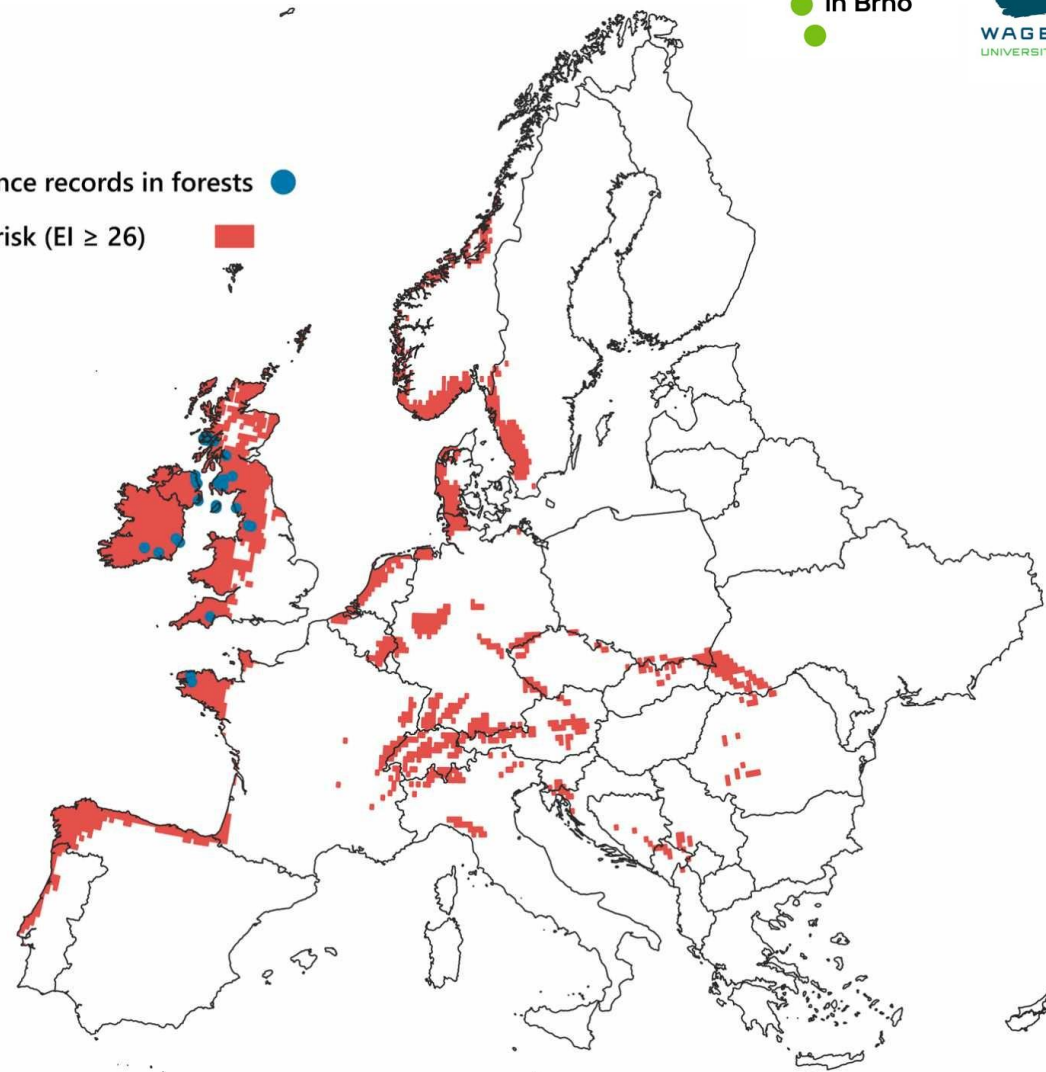
Binary climatic suitability map for *Phytophthora ramorum* in Europe (Kartakis et al., 2026).

3. Estimating potential direct economic impacts of *Phytophthora ramorum* in European forests

Worst-case average annual direct damage costs:

- **€106–117 million per year** (larch)
- **€96–130 million per year** (beech)

- Countries facing the highest risks:
  - **United Kingdom, Austria, Italy (larch)**
  - **Italy, Germany, Austria (beech)**
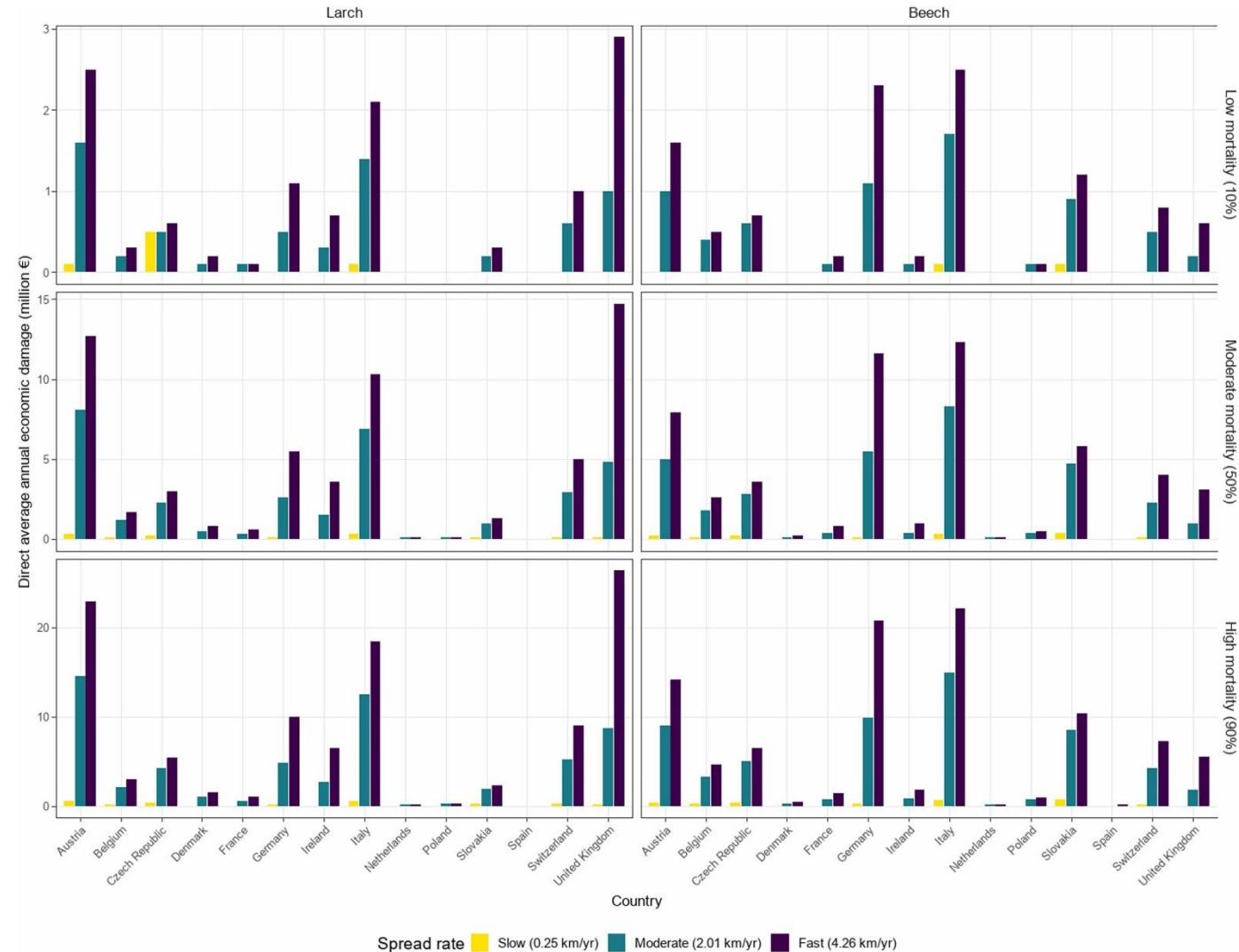
Average annual direct damage costs (€ million yr⁻¹) due to *Phytophthora ramorum* for *Larix* spp. (left panels) and *Fagus* spp. (right panels) by country (Kartakis et al. 2026)

4. Adoption potential of the VOC-sensor among EU nurseries

- We surveyed **343 nurseries**, distributed across 4 EU countries:
  - Italy: 81
 - Romania: 66
  - Germany: 106
  - France: 90

Nurseries have a **direct interest** in ensuring the movement of pest-free plant material.

- **The questionnaire included five components:**
  - i. Nursery characteristics
  - ii. Discrete choice experiment
  - iii. Experience with introduced alien species (IAS)
  - iv. Opinions on existing detection methods/responsibility and trust attitudes
 - v. Socio-demographic characteristics

Which characteristics of a VOC sensor affect the adoption decisions?

	Italy	Romania	Germany	France
	Coefficients			
Time to receive results	-0.298***	-0.204**	-0.007	-0.187***
Detection reliability	0.022***	0.016	0.024***	0.009**
Cost per inspection	-0.134***	-0.117***	-0.104***	-0.096***
Certification potential	0.148	0.641**	-0.342***	0.241***
Ownership (Purchased)	-0.194	0.237	-0.164	-0.041
Ownership (Co-owned)	0.025	-0.271	0.095	0.111
ASC (alternative-specific constant)	0.403	1.958*	-0.800*	0.797*
	Standard deviations			
Time to receive results	-0.011	0.287**	-0.000	0.140**
Detection reliability	0.004	0.037***	0.000	0.000
Cost per inspection	0.069***	0.068	-0.000	0.032
Certification potential	0.005	1.618***	0.368**	0.004
Ownership (Purchased)	-0.003	0.111	0.001	0.001
Ownership (Co-owned)	-0.004	-0.736**	-0.009	-0.000
ASC	0.020	6.508***	-0.204	-0.007

Has your nursery ever experienced problems related to invasive pests or pathogens?
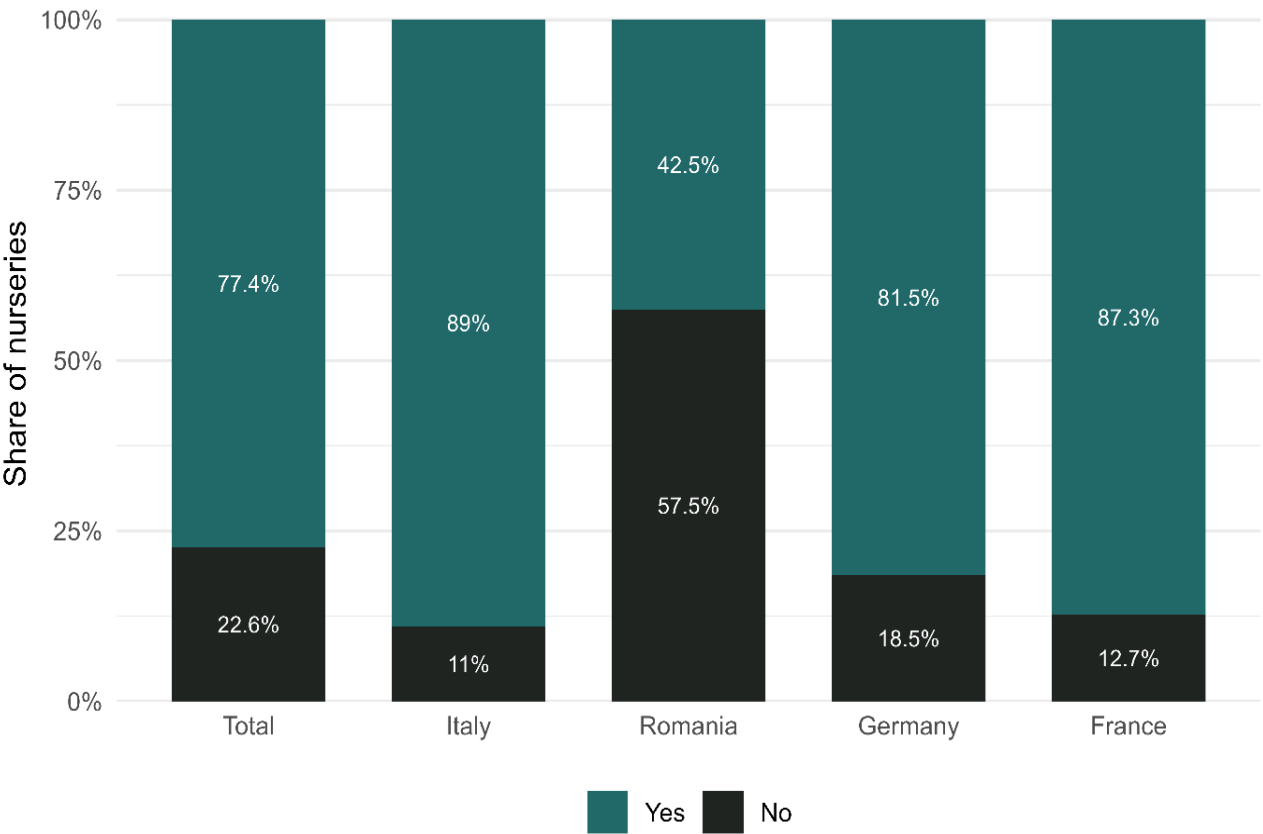
Do you perform inspections on incoming plant consignments at your nursery?
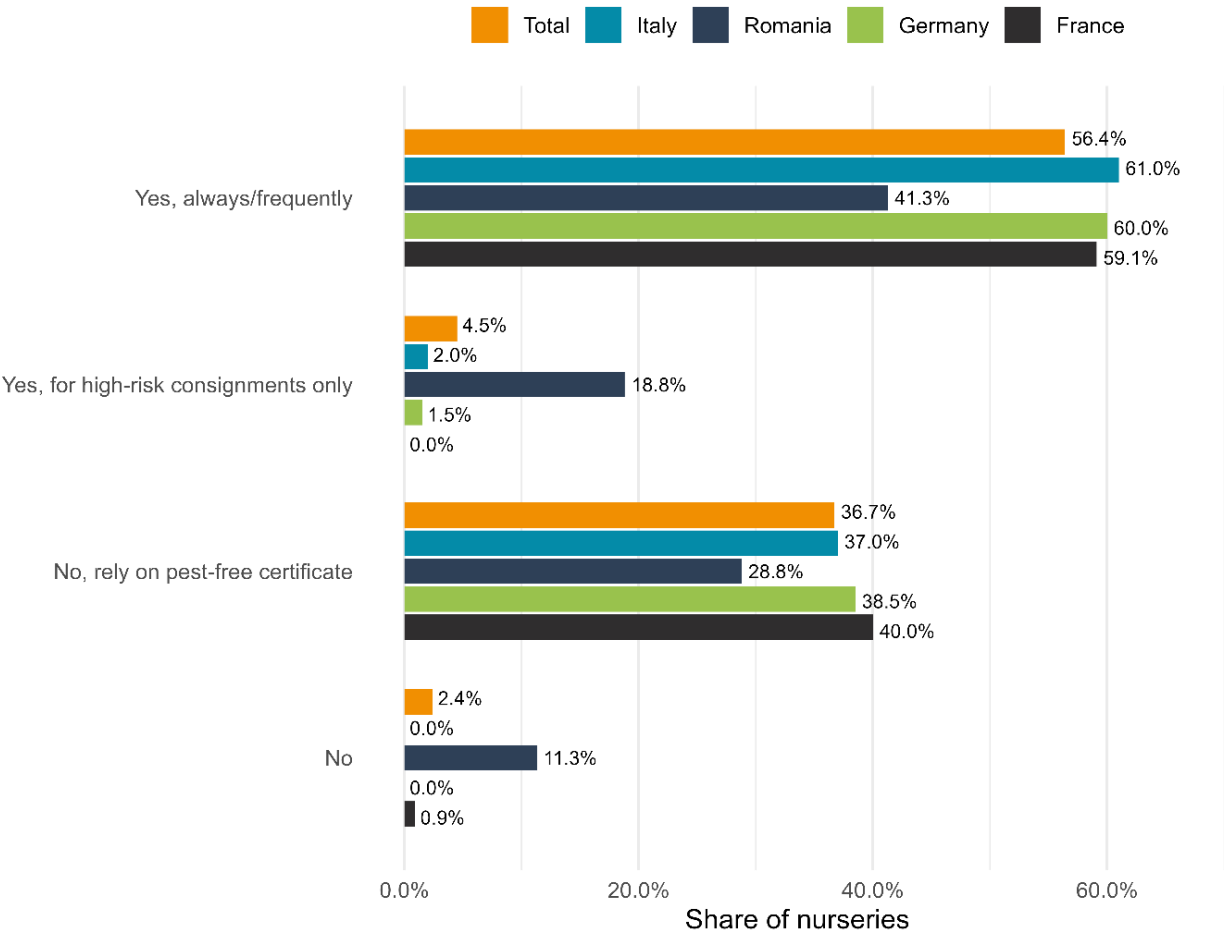
Methodology

➢ The **methodology proposed is sound and credible**, involving the development of a Sensor System Prototype (SSP) that can detect pests and pest attacks on plants. It presents a **clear and verifiable pathway** through various stages of the project and their respective contribution to achieving the overall and specific objectives and includes an **in-depth description of the components and equipment** to be used or developed during the duration of the project.

➢ **Cost-benefit analysis** is foreseen **to evaluate the socio-economic implications** of the developing solutions for farmers, which is positive.

➢ **Critical risks** have been **accurately identified** by the project **and credible and pragmatic remediation measures** are being **proposed.**

Multiactor approach

Sensor companies

The Multi-Actor approach is appropriately addressed in the proposal, which embraces all relevant key actors (nurseries and plant producers, import companies, NPPOs, farmers, foresters, researchers and companies who are technology providers) either as project partners or as members of the Stakeholder Advisory Board, ensuring an adequate involvement of actors to create co-ownership of results.

Supporters

Work Package 5

Dissemination, Communication and Exploitation

- **The draft plan for the dissemination and communication is well elaborated. Dissemination and communication measures are appropriate, tailored to different target audiences, adequate to the scale of the project and effective to maximise the impact of the project**. The results will be made available to academia, industry and other stakeholders through scientific and technical papers and selected internationally recognised events.
- The **mandatory and recommended open science approaches are very well integrated into the project methodology**. All the research data will be shared among the consortium partners and made **publicly accessible as soon as possible**, using the open data repository BIRD.
- **Data management procedures are very well explained**...

Excellent team spirit

➢ **Coordinator with outstanding leadership skills:**

diplomatic, empathic, supportive, ability to make clear – if necessary – tough decisions

➢ **Supported by a co-coordinator with excellent technical and data management skills**

➢ **Efficient dedicated WP leaders**

➢ **Very pleasant chemistry between all PurPest partners!**

Evaluation results

➢ **Total score 14/15 (Threshold 10)**

➢ **Criterion 1 (Excellence) Score: 4.50 (Threshold 3/5.00)**

The project objectives **do not adequately tackle all topic requirements**, in particular they do not adequately cover the contribution to the understanding of the drivers of plant pest spread under evolving climatic and socio-economic conditions. This is a shortcoming.

➢ **Criterion 2 (Impact) Score: 4.50 (Threshold 3/5.00)**

PurPest proposes a credible approach to improve the capabilities to prevent and monitor the dissemination and establishment of the five selected target pests through field demonstration and stakeholder networking. However, **how project results will contribute to the enhancement of capacities to (bio)control target pests over the medium term is not convincingly substantiated**, because the proposal only mentions that open access to VOC database could be further exploited by chemical companies to develop new plant protection products. This is a shortcoming.

➢ **Criterion 3 (Quality and efficiency of the implementation) Score: 5.00 (Threshold 3/5.00)**

Evaluation results

➢ **February 2022 Information letter by European Research Executive Agency (REA)**

Having recently completed the evaluation, we would like to inform you that — although it has **in principle received a favourable evaluation** — it is unfortunately **currently not high enough in the ranking to be funded** (given the budget limit of the call).

Your proposal has however been put on the **reserve list** (proposals that might be invited to grant preparation, if higher ranked proposals drop out or additional funding becomes available). In this case, we would contact you and invite you for grant preparation.

➢ **6 months later invited to prepare a Grant Agreement**

➢ **Similar experience in 2015 with Horizon 2020 project POnTE**

 'Pest Organisms Threatening Europe'

Evaluation results of PestDetect

> **Total score 5.50 / 10 (Threshold 0)**

> **Criterion 1 (Excellence) Score: 2.50 (Threshold 4/5.00)**
> 1 serious weakness, 1 weakness, 3 shortcomings and 1 minor shortcoming.

> **Criterion 2 (Impact) Score: 3.00 (Threshold 4/5.00)**
> 3 shortcomings.

"I am more surprised than disappointed at this stage, as I find it difficult to understand the reviewers' concerns. Either the reviewers misunderstood the call or we did."

The evaluation results are strongly depending on the subjective opinions, preferences and scientific quality and expertise of the reviewers which makes HE applications - to a considerable extent - a gamble!

Take-away message

➢ **Convincing and unique research idea that fits perfectly to the scope of the call**

➢ **Coordinator with outstanding leadership skills**

➢ **Strong and complementary team**

➢ **Excellent methodology and clear and feasible workplan**

➢ **Convincing pathway to impact**

➢ **Contingency plan to mitigate critical risks**

➢ **Multiactor approach and stakeholder involvement**

Plant pest prevention through technology-guided monitoring and site-specific control