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

Scope of the call

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.**

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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?

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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

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

Import control

develop ments

In field detection and site-specific control

Pest invasion/ infection

Volatile Organic Compounds (VOC) collection/ analysis

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



Brown marmorated stinkbug

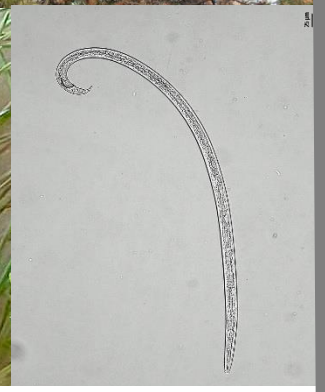


Fall armyworm on maize

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

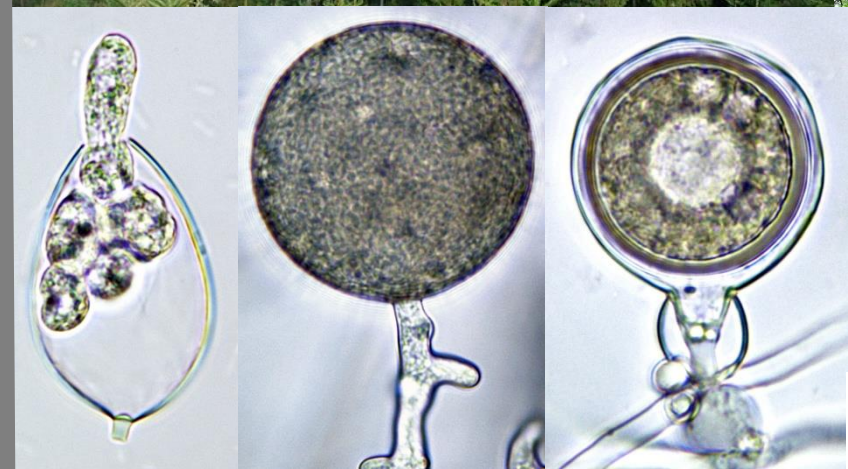

Cotton ballworm





Pine Wood Nematode

P. ramorum




Phytophthora

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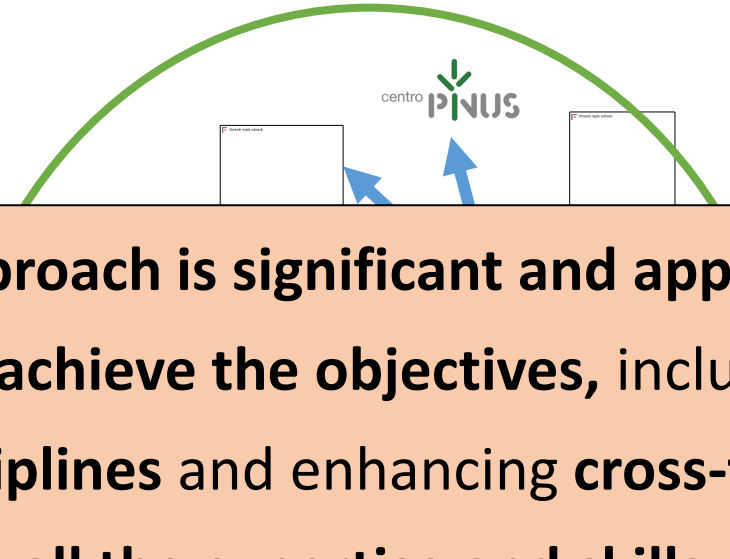
Plant Pest Experts



Technology Partners

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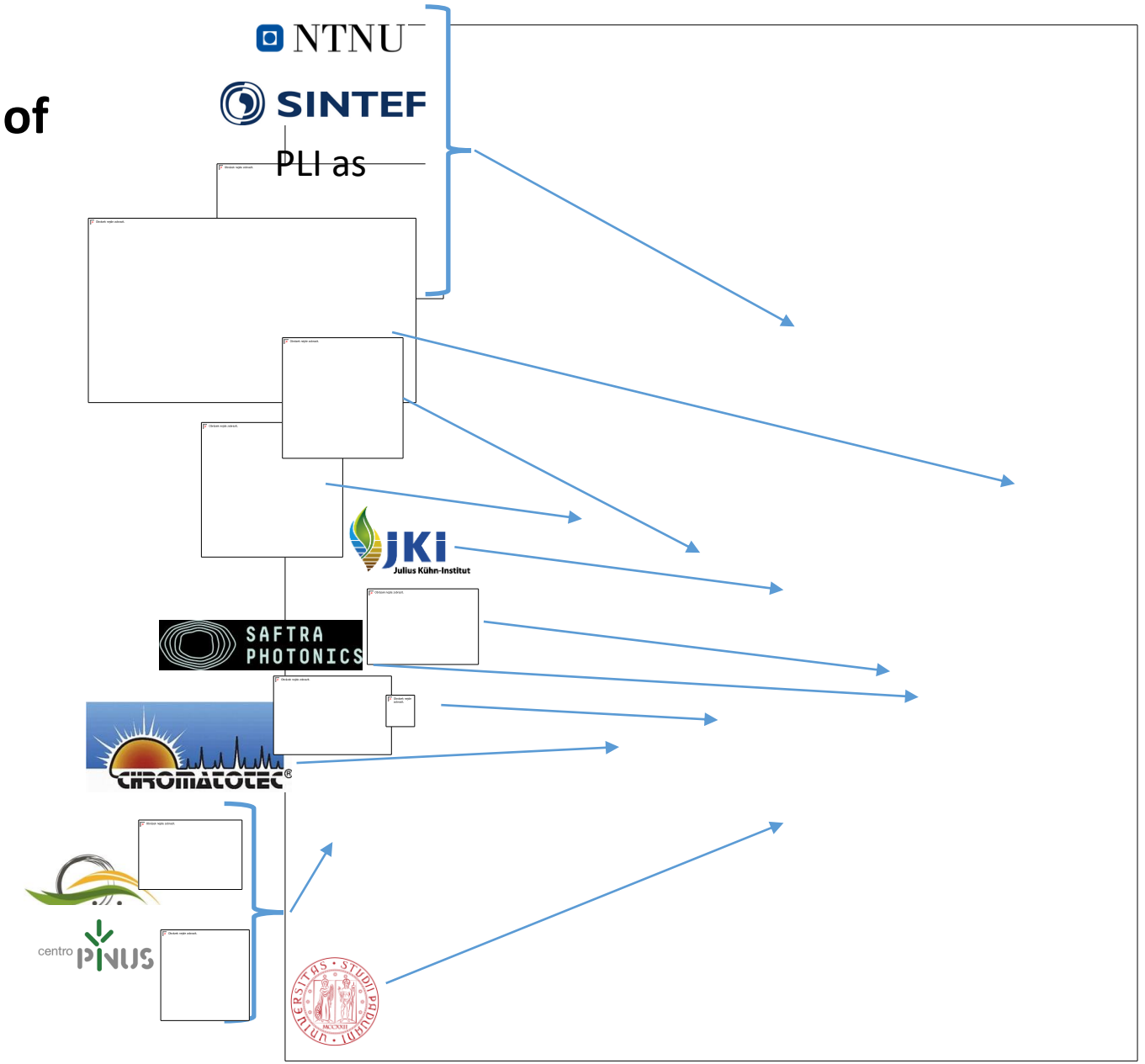
10

- **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**.**

How were the partners selected?

Social Scientists

Geographical distribution of the PurPest partners



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

- **The workplan** presented by PurPest is of **very high quality with clearly defined work packages and tasks assigned to partners allowing the proper monitoring of the project progress.** It **considers possible delays in critical points** (decision stages along the duration of the project) **and reallocation of resources to circumvent those delays**
- **Deliverables and milestones are appropriately defined and timely set to allow monitoring the production of the desired outcomes and reaching the project objectives.**

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Work Package 1

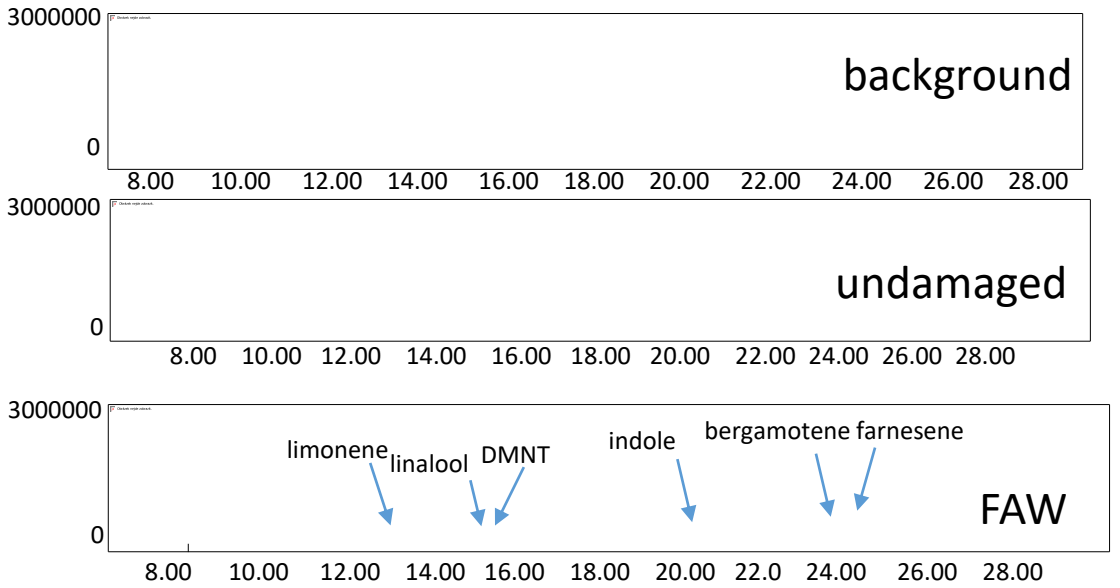
Analyze the VOCs released by the target pests and by infested plants

Fall Army Worm infested maize plants

VOC's collection in Mexico

Prof. Ted Turlings

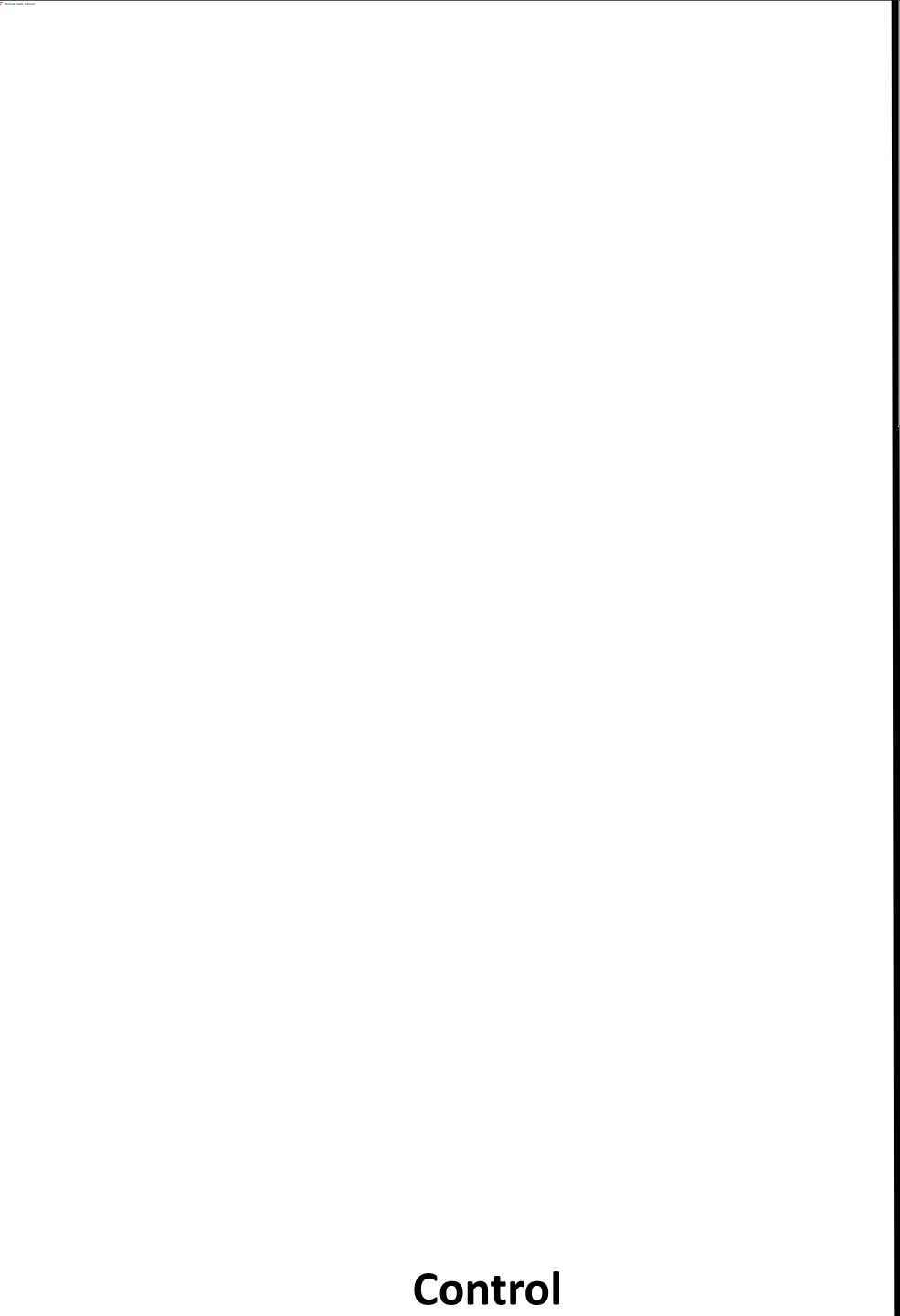
- Plants were infested or not with FAW larvae on day 1.
- Collections were done during the next 2 days, each day 4 samples of FAW-damaged, undamaged and background collected.
- First day of collection we could see differences, but not on the second day (big variation).



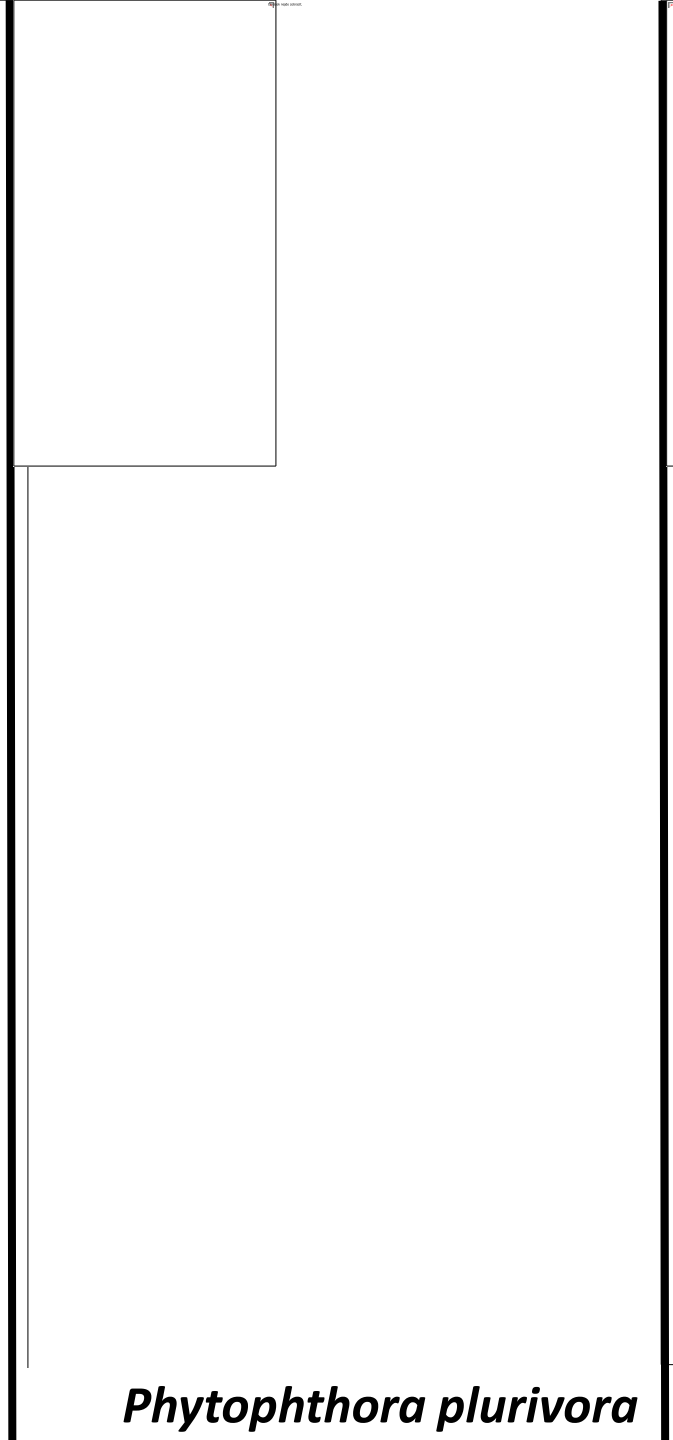
P. ramorum-NP2 (JP387)

Phytophthora plurivora

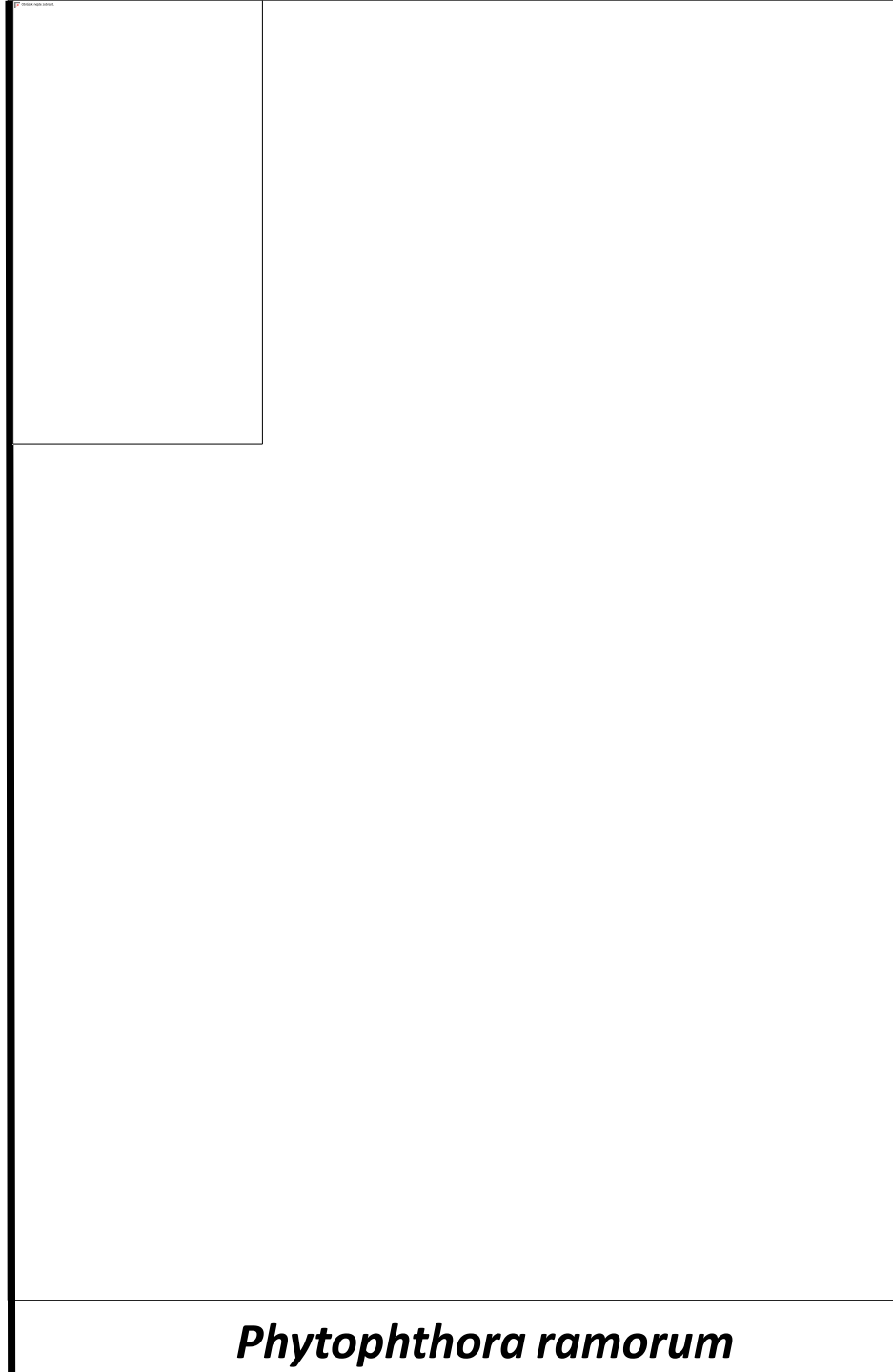
Co-infection *P. plurivora* + *P. ramorum*



Control



Phytophthora plurivora

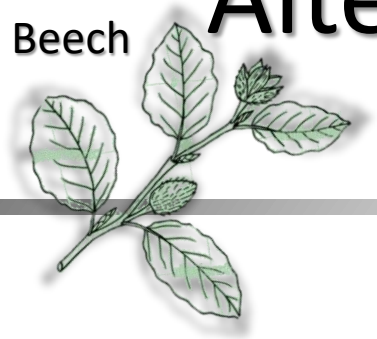


Phytophthora ramorum

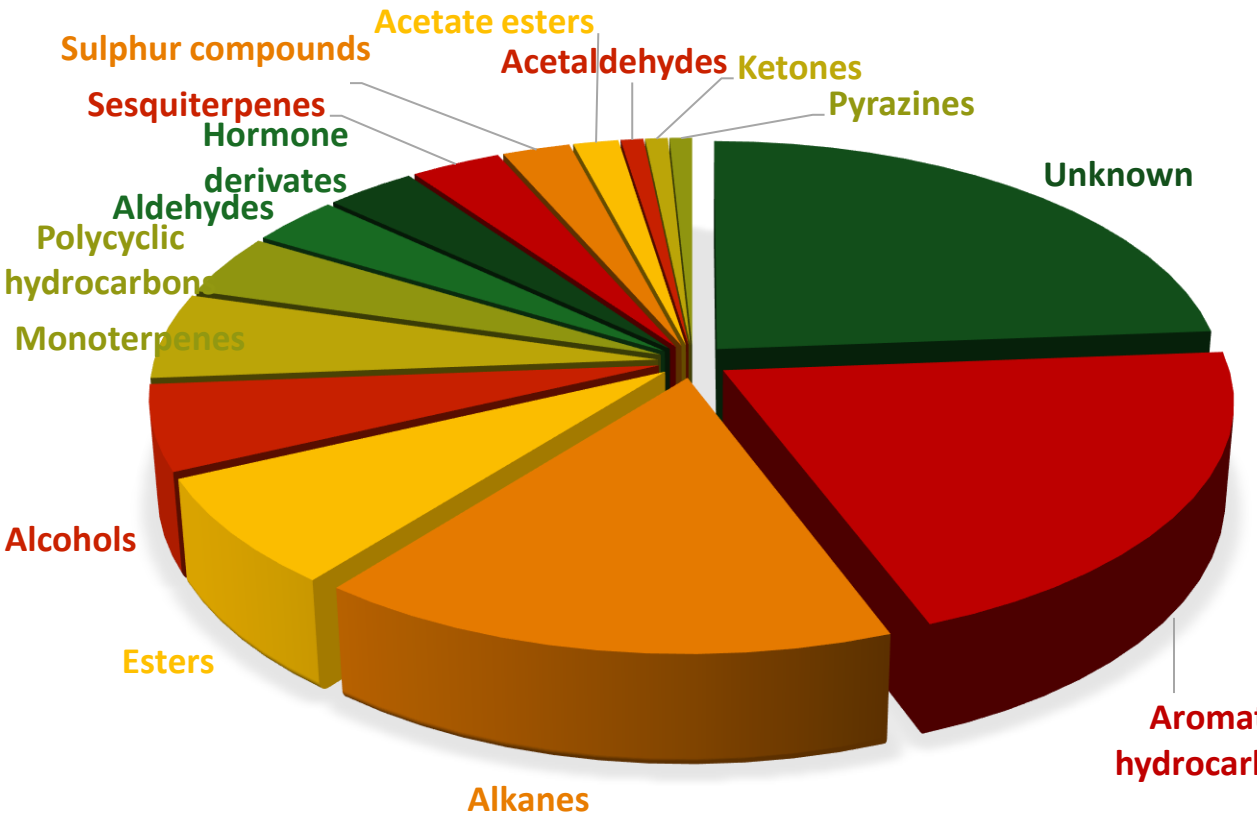
Alterations in the Volatilome of *Fagus sylvatica* Induced by *Phytophthora* Species

Miroslav Berka

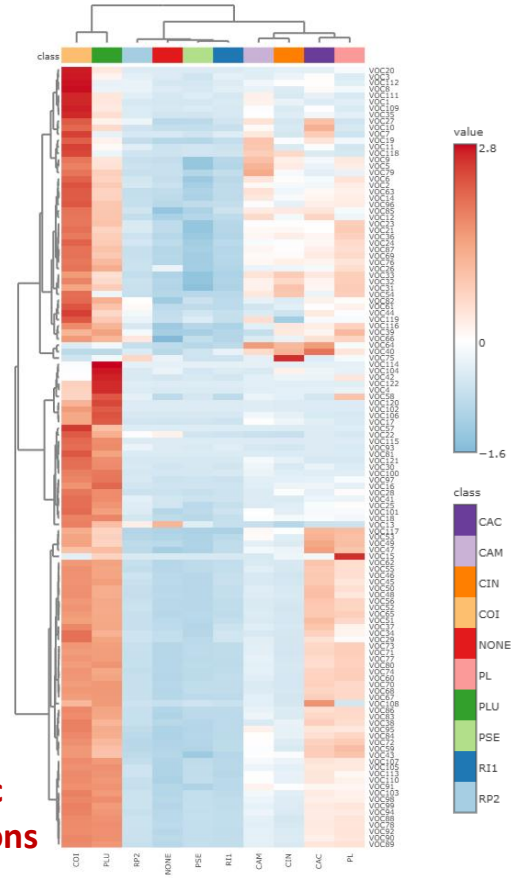
Beech



- **More Than 900 Distinct Features Identified Across Chemical Classes**



- **Comprehensive Identification of 120+ VOCs**



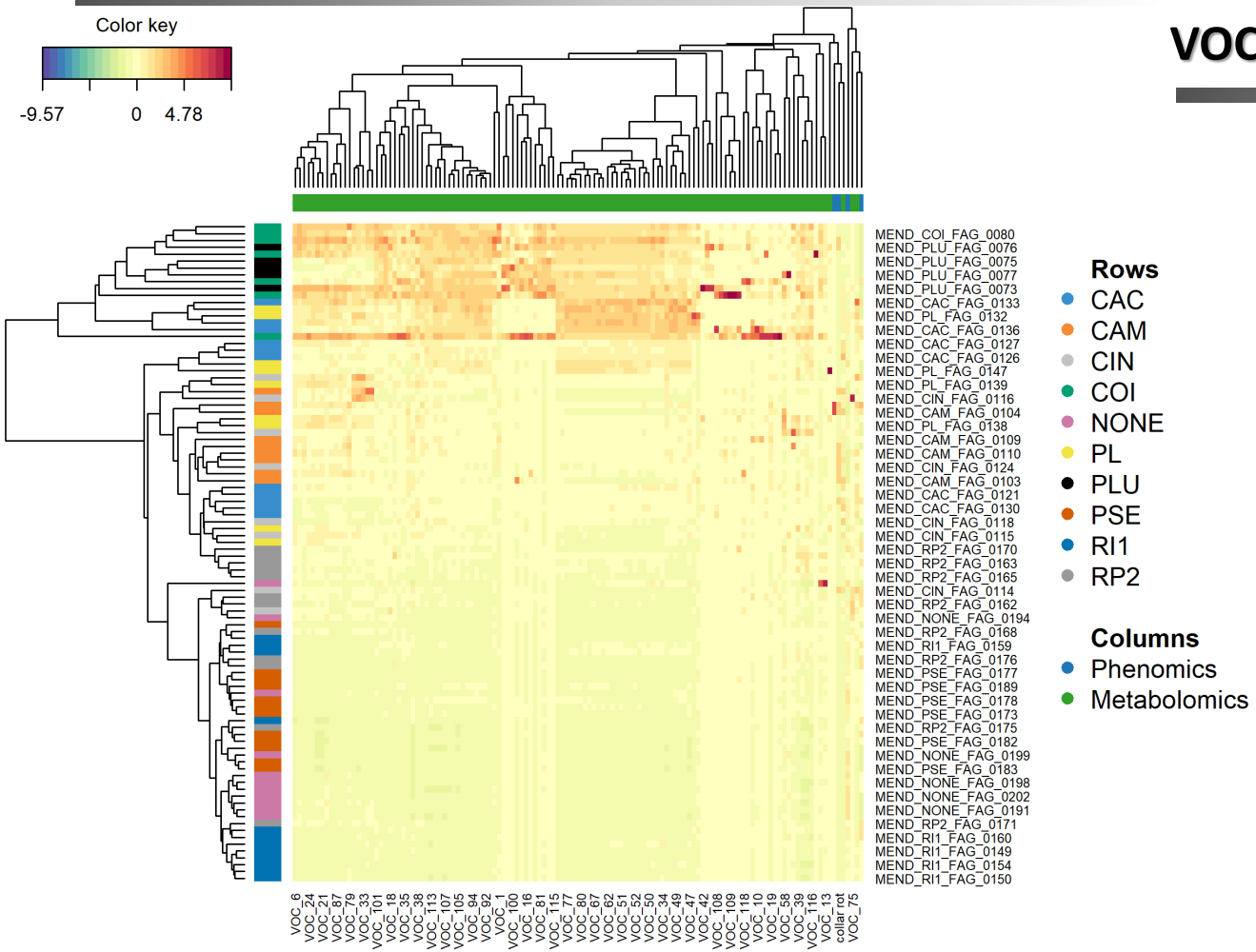
- **Most Abundant VOCs in Controls**

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

Cluster Analysis Highlights Most Aggressive *Phytophthora* Isolates

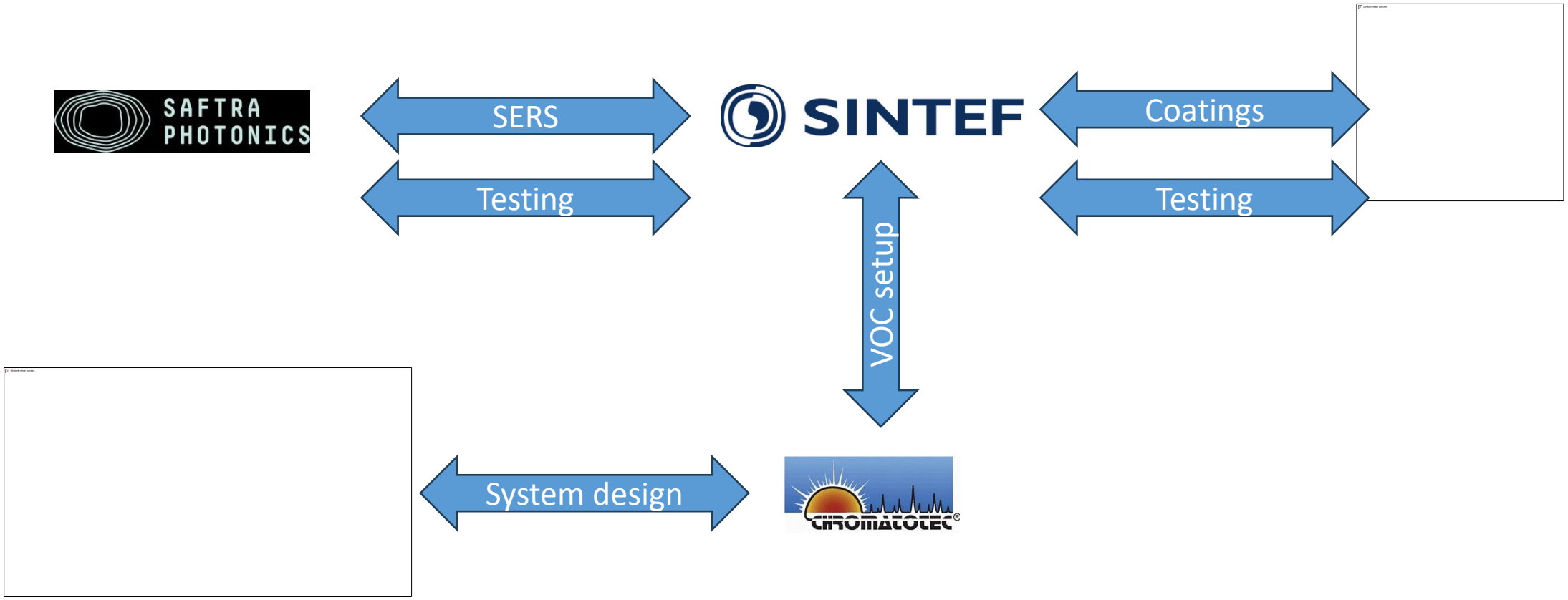


VOC Correlation Patterns Reveal Root Infection Dynamics

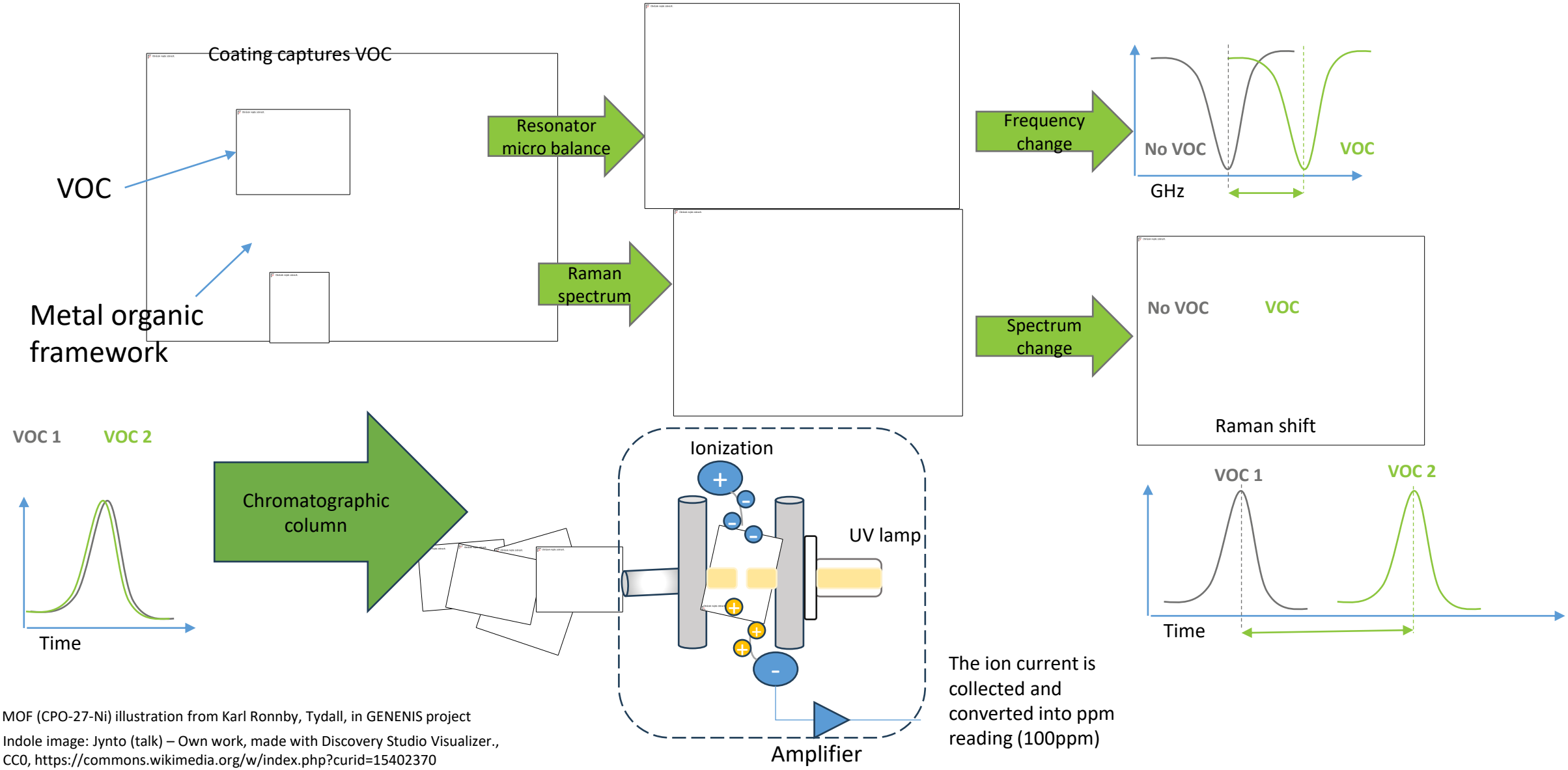
Work Packages 2 & 3

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

Technical cooperation



Sensor development

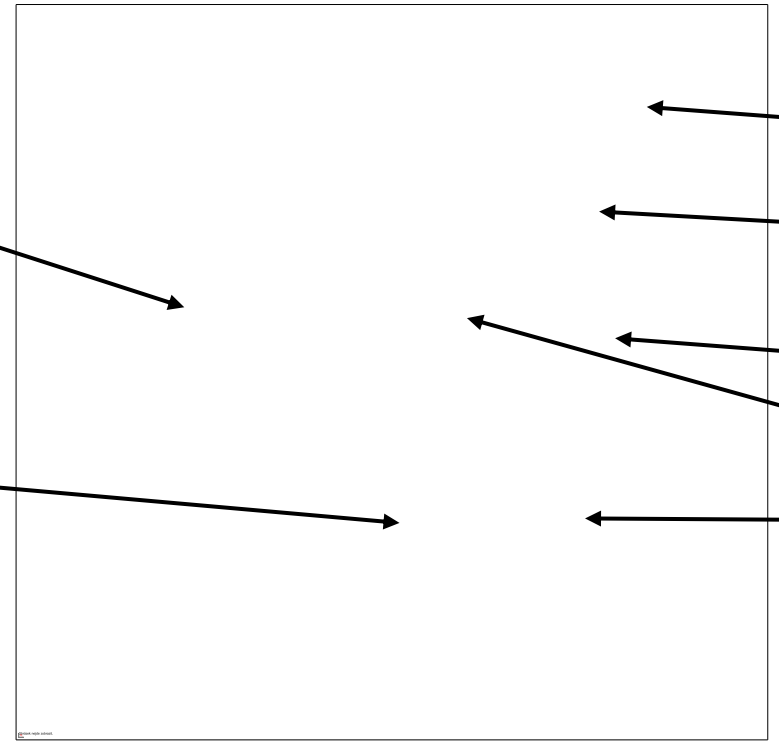


The ion current is collected and converted into ppm reading (100ppm)

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



Sampling staff
With LED screen

Sampling pump

Carrier gas: N_2 (where cylinder is attached

Pre-concentrator: carbotrap mixture

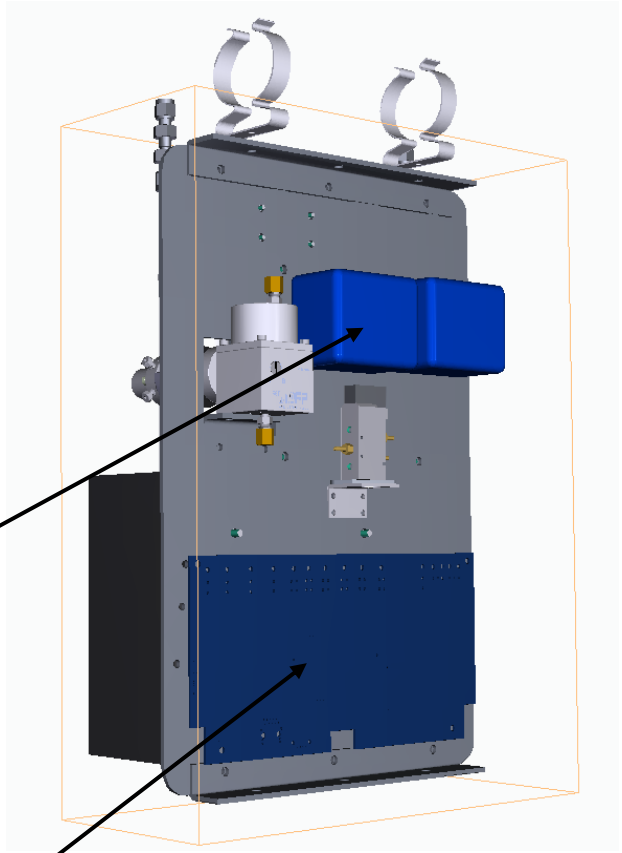
Injection valve

Photoionization detector

Oven gradient:
35 to 200 °C

Battery

Electronic board and computer



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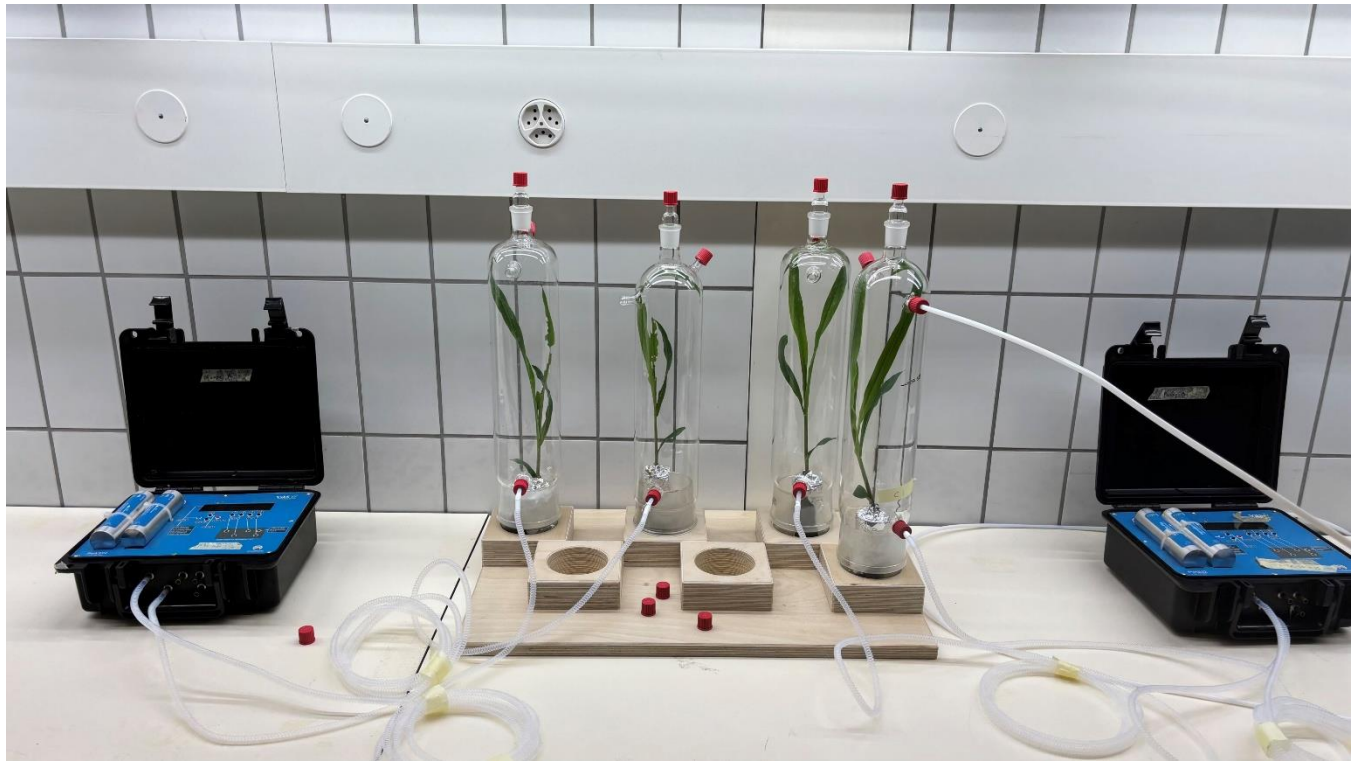
Work Package 4

Test and validate SSP under controlled and import- and field conditions

Fall Army Worm – 2 test systems

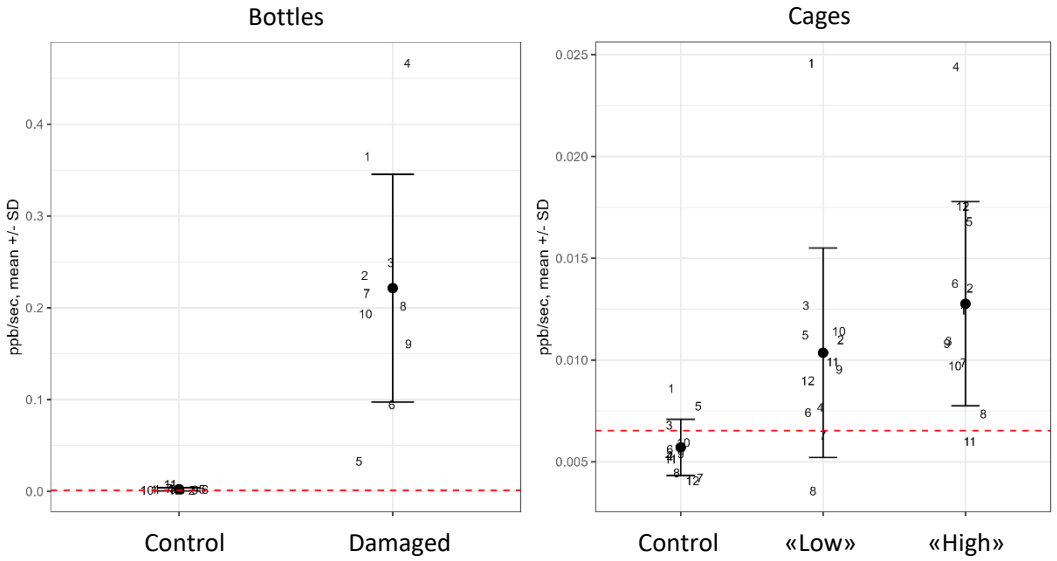


- *S. frugiperda*-damaged 2/16 plants («Low»)
- *S. frugiperda*-damaged 8/16 plants («High»)
- Undamaged plants

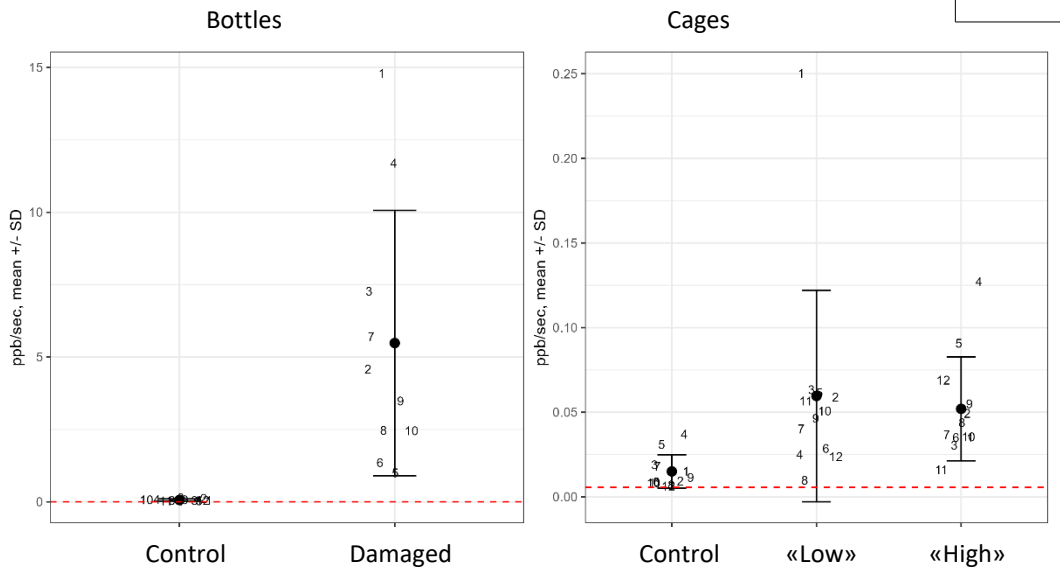
PTR-TOF-MS

- 1-minute measurements for each sample.

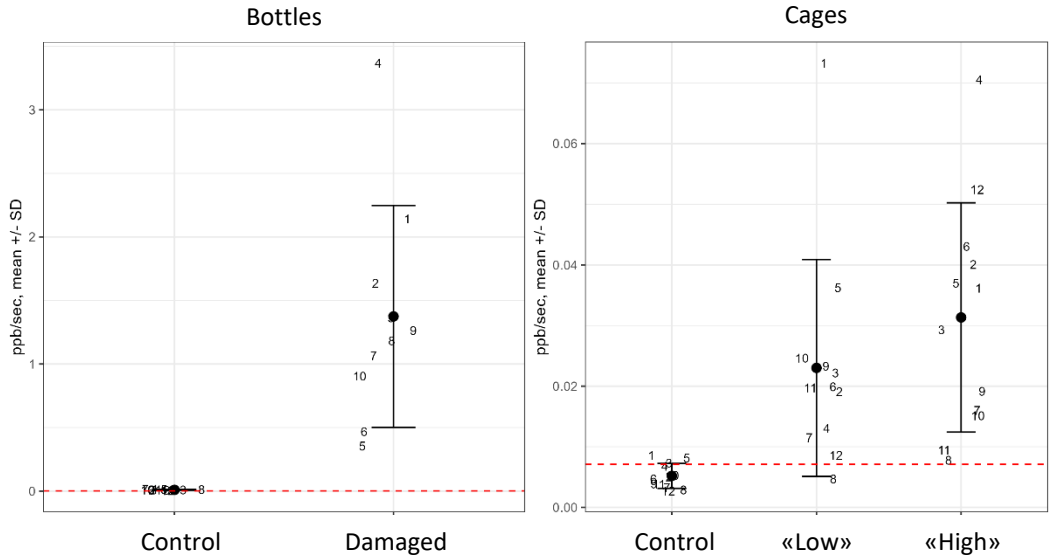
DMNT



Indole



Sesquiterpenes



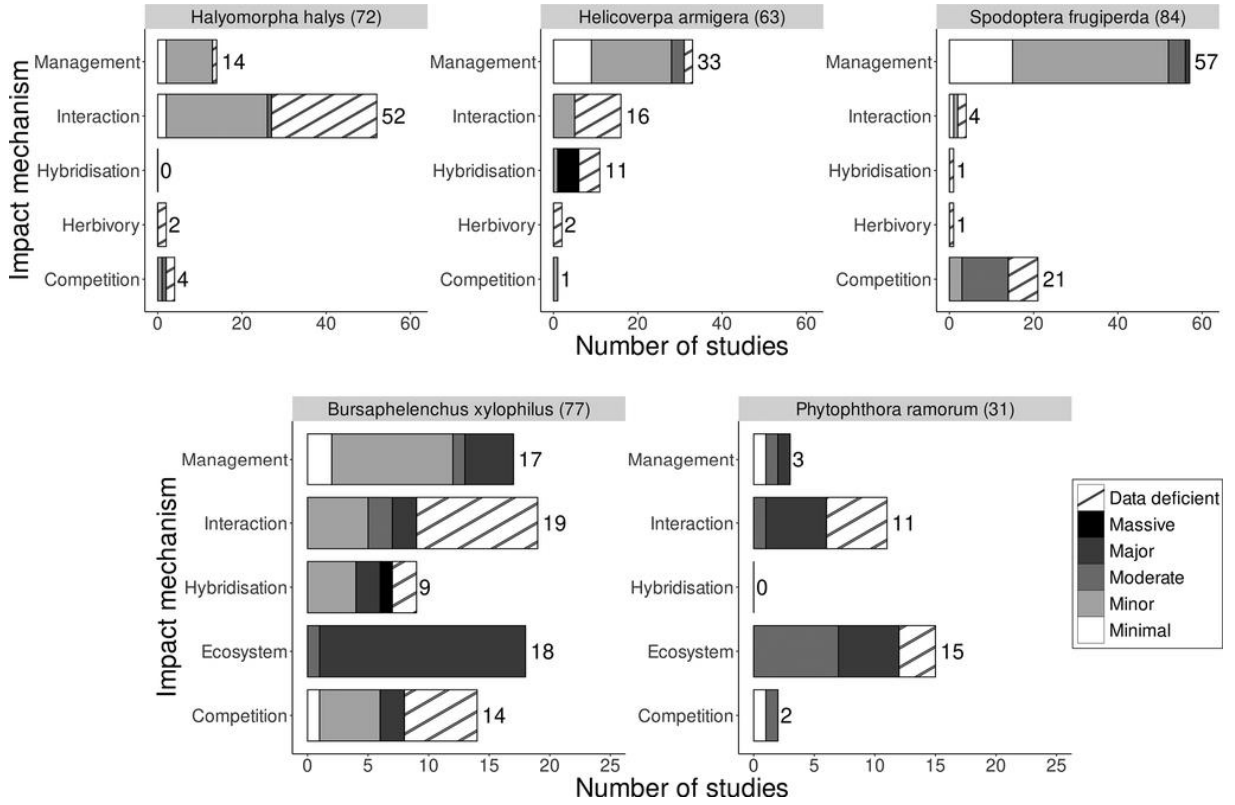
Work Package 5

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.

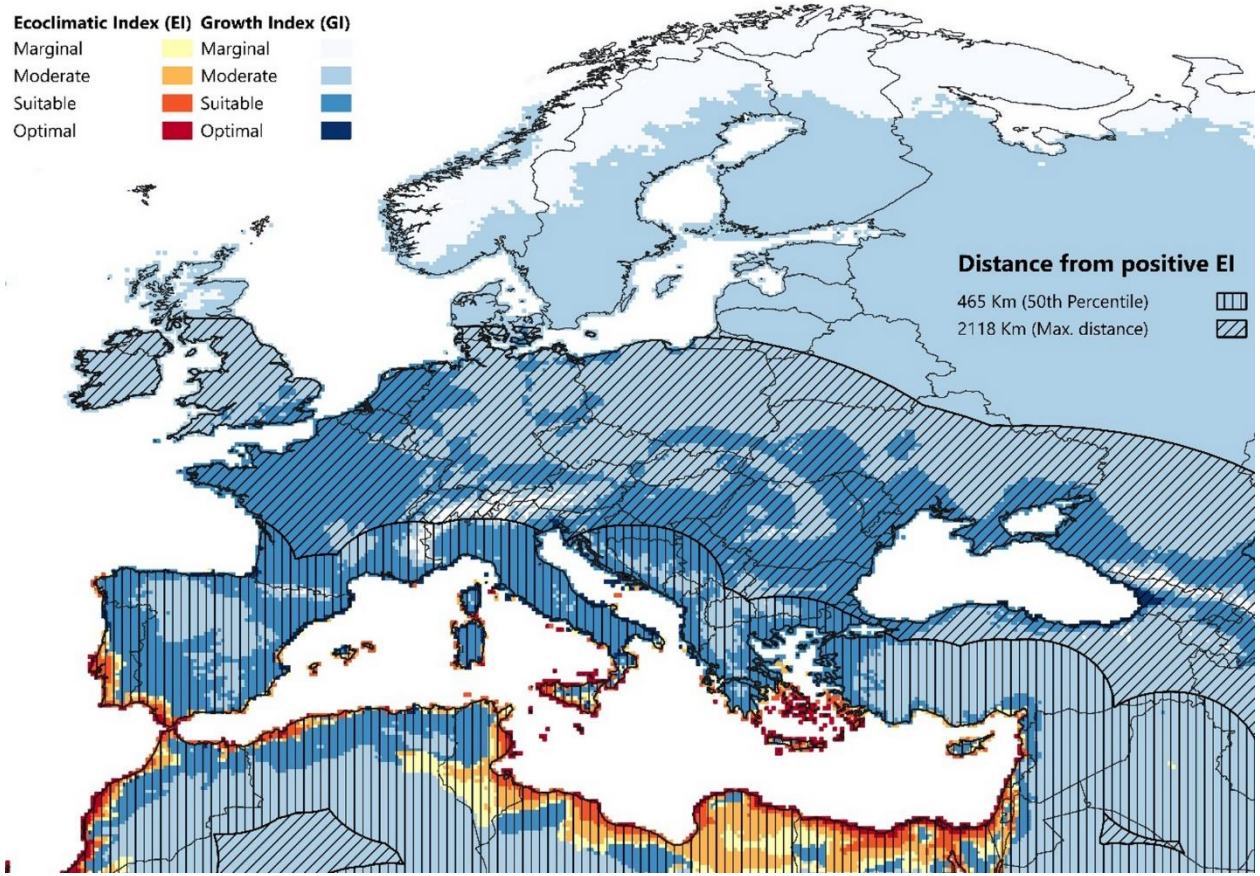


Number of studies from systematic searches for each impact mechanism for each case-study organism (Horrocks et al. 2025)

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).



Projected climatic suitability of *Spodoptera frugiperda* in Europe (Kartakis et al. 2025).

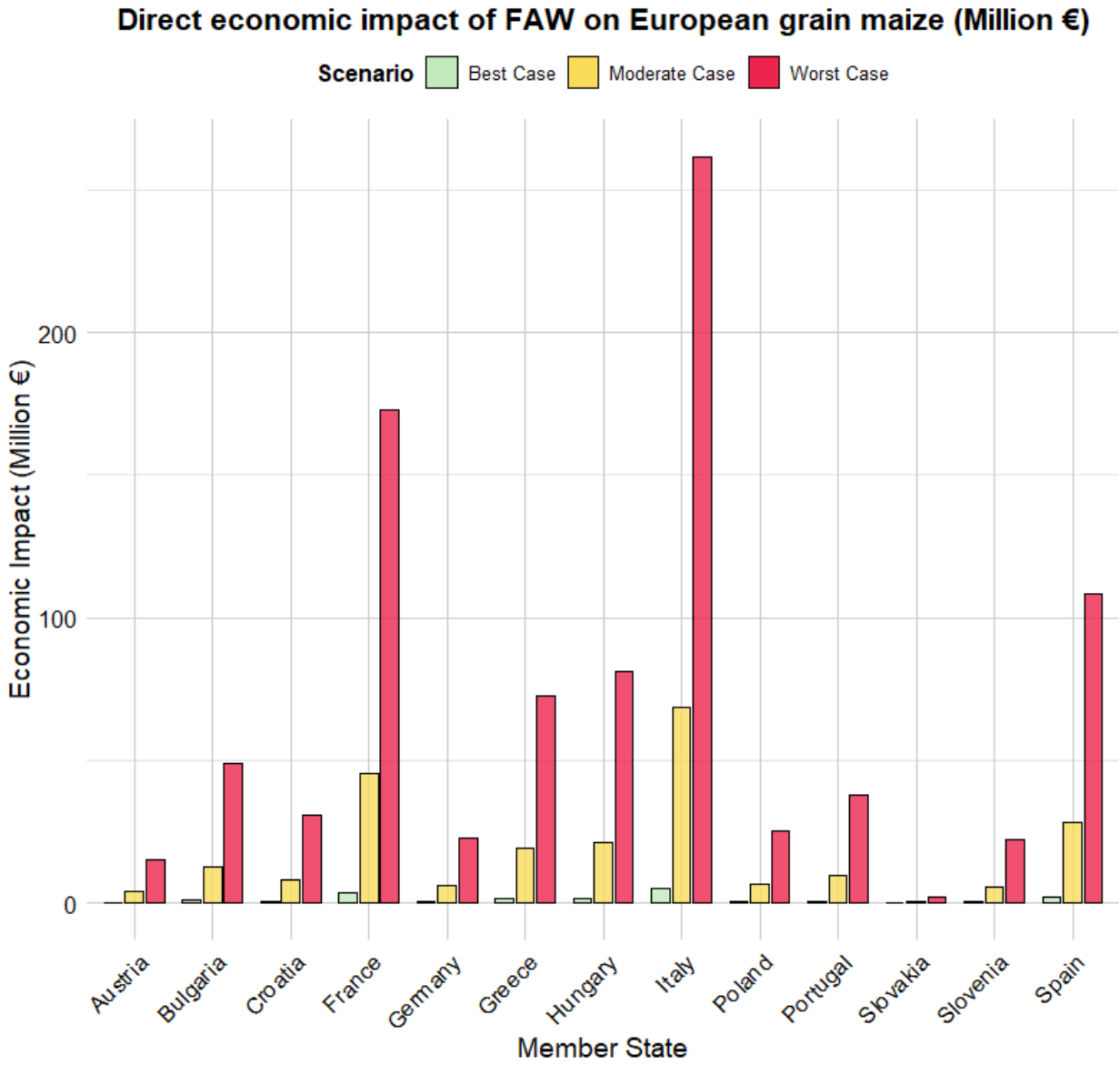
2. Potential economic impact of the fall armyworm on European grain maize

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)

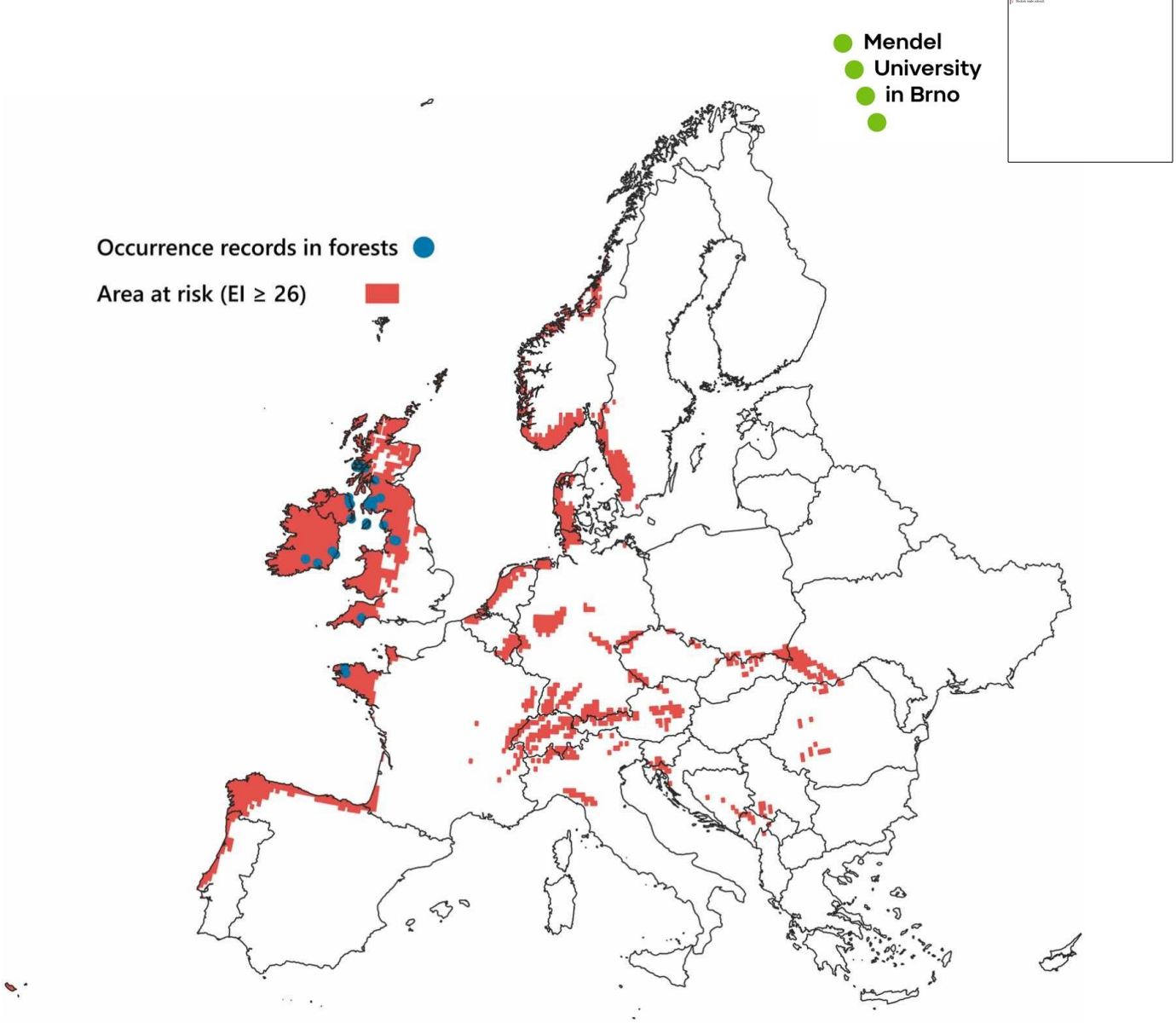


The annual direct economic impacts (in million €) of *Spodoptera frugiperda* on grain maize production in different EU Member States (Kartakis et al, 2025).

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.



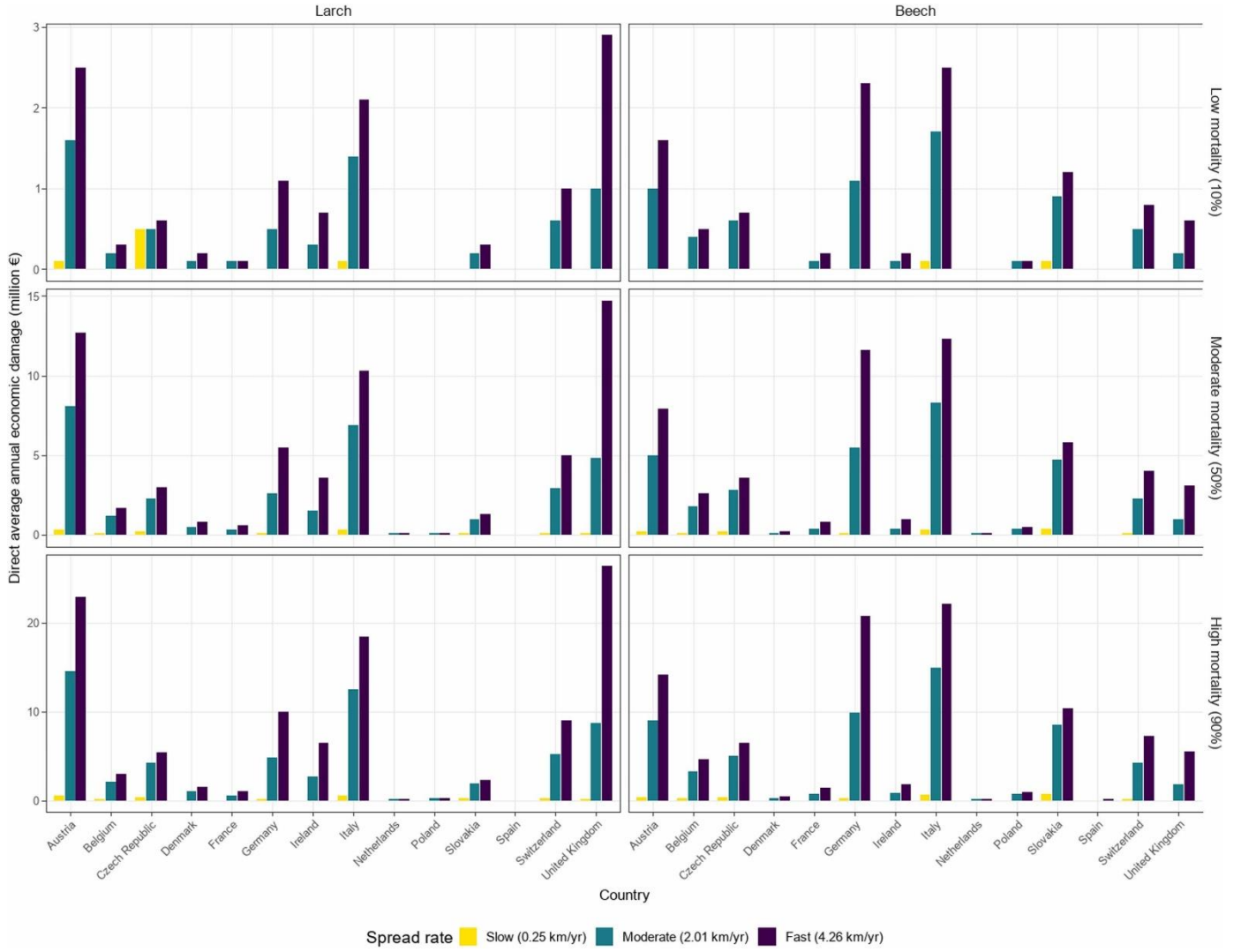
Binary climatic suitability map for *Phytophthora ramorum* in Europe (Kartakis et al., 2026).

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

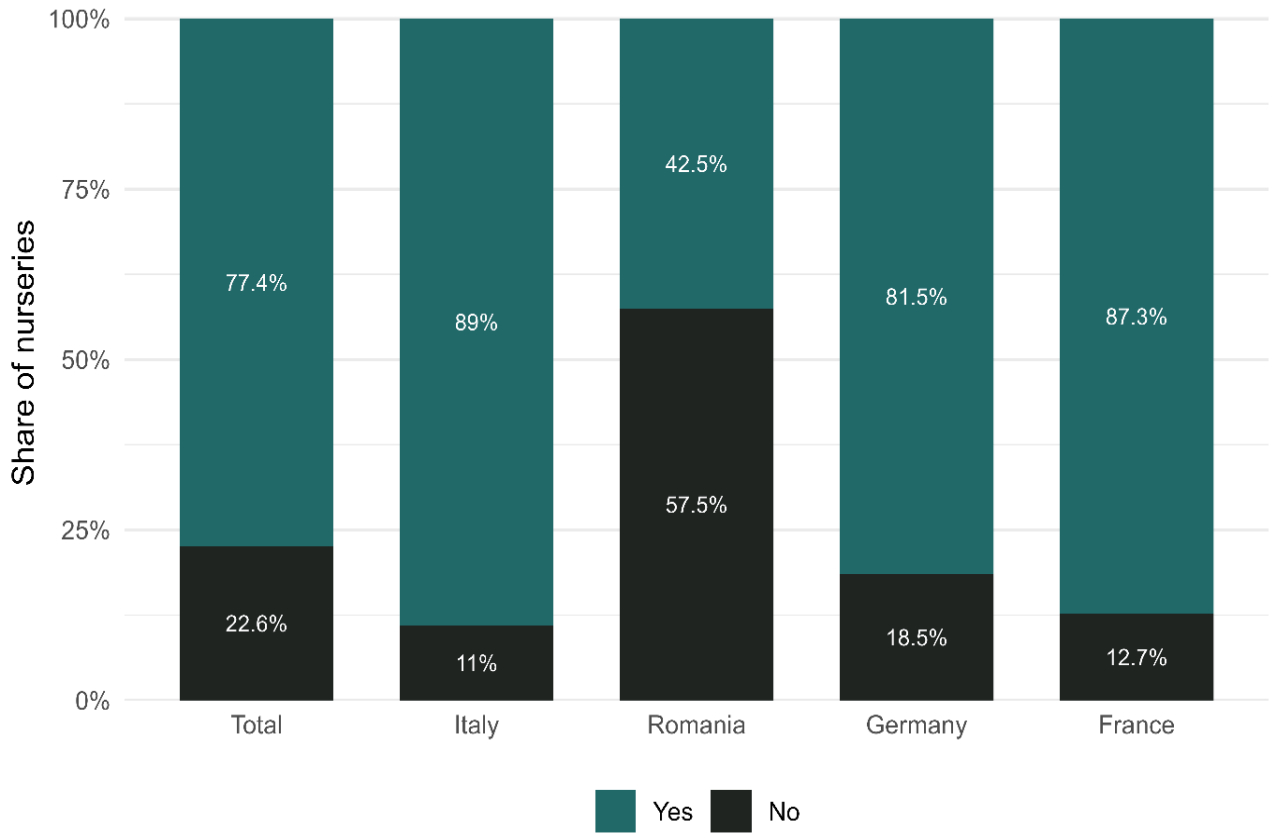
Nurseries have a **direct interest** in ensuring the movement of pest-free plant material.

- **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

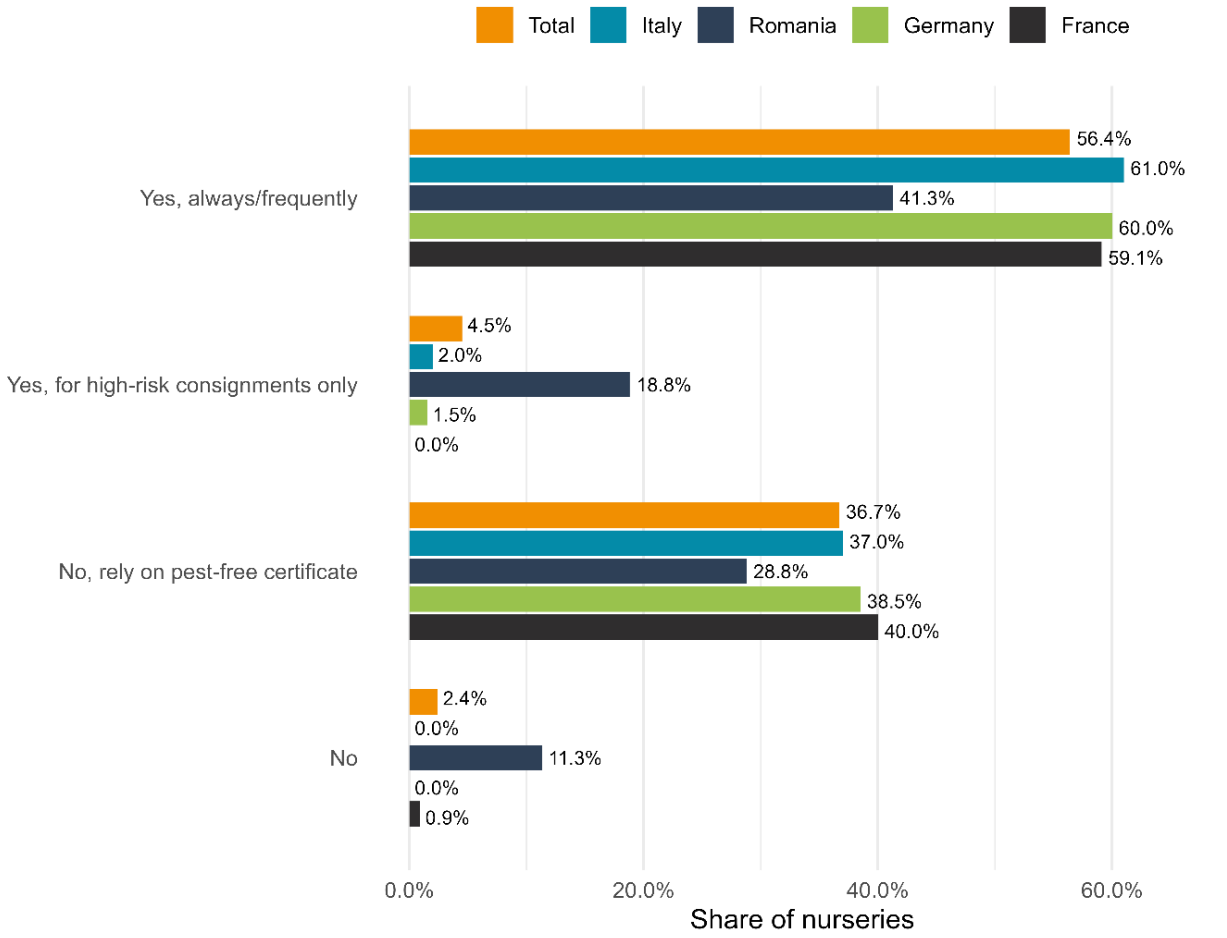
Which characteristics of a VOC sensor affect the adoption decisions?

	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’**

PurPest

Mendel University in Brno

Adaptation of the one-stage proposal PurPest to the two-stage proposal PestDetect

HORIZON-CL6-2021-FARM2FORK-02-02-two-stage: Emerging and future risks to plant health

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

PurPest

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