Final Report

Project title (Acronym)
Early detection of *Phytophthora* in EU and third country nurseries and traded plants (ID-PHYT)

Project duration:

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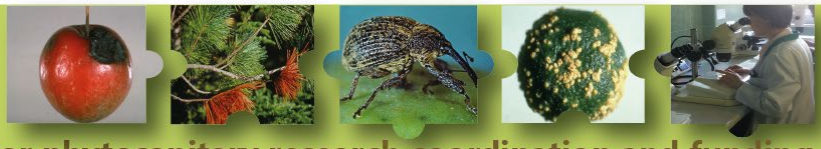

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2. Short project report

2.1. Executive summary

Invasive *Phytophthora* pathogens are causing significant economic damage to agricultural, horticultural and forestry crops worldwide, as well as ecological damage to native plant species in wider environments. Traded plants are a well-documented pathway for *Phytophthora* pathogens, facilitating their spread both nationally and internationally. The goal of the ID-PHYT project was to develop a co-ordinated strategy for the early detection of *Phytophthora* pathogens in plant nurseries and traded plants for planting across EU and third countries to inform best practice.

Protocols for nursery sampling and detection of *Phytophthora* using an eDNA metabarcoding method plus a traditional baiting method were successfully shared and validated across project teams in six partner countries (FR, GB, GR, IE, IT, USA) with RU conducting baiting analyses only. All nine partner countries (including AT and NZ), contributed to the development of a stakeholder map and a subsequent online stakeholder survey, translated from English into eight different languages, which sought to gain insight into sector perceptions on biosecurity and best practice.

The final nursery sampling dataset consisted of 1011 pooled samples collected from thirteen plant nurseries across six countries. This included 647 root samples and 364 water samples with 627 samples analysed by baiting and 384 samples analysed by metabarcoding. Sample metadata and a set of key nursery management data were also collected for downstream analyses conducted using hierarchical Bayesian mixed models. A high diversity of *Phytophthora* (65 known *Phytophthora* species including quarantine-regulated species and some first country records) was detected across the 13 sampled nurseries. *Phytophthora* was found in the irrigation water at several of the nurseries highlighting water management as a key priority area for improvement. High risk hosts with consistent *Phytophthora* associations included *Fagus, Ligustrum, Thuja, Lavandula, Quercus* and *Choisya* spp. Other nursery risk factors which increased the likelihood of *Phytophthora*-positive samples included reliance on greater than 50% imported plant stock and growing a high diversity of plant genera. Analyses were also able to identify *Phytophthora* species' sensitivities to substrate (water versus root), nursery latitude and detection method (baiting versus metabarcoding) which assists understanding of their lifestyle and habit and sensitivity to detection method, facilitating further prediction of risk.

The stakeholder survey elicited 97 responses from individuals in a range of roles associated with the plant trade across eight countries. Respondents listed over 100 different pests and pathogens of concern, with *Phytophthora* species and *Xylella fastidiosa* most frequently cited. Boot washing, quarantining plants and training staff in plant health were seen as important biosecurity management. Communicating how biosecurity practices can and do reduce the risk and impact of plant pests and pathogens increased uptake of important phytosanitary measures by the sector. For example, one of the UK nurseries, upon realising that their open irrigation reservoir held eight different *Phytophthora* species, subsequently invested in sinking a borehole to access clean groundwater for irrigation.

One major outcome of the project was the co-design of a concise, best-practice guidance document based on scientific evidence translated from English into partner country languages and disseminated through each country's trade association channels. The best practice guidance highlights the key plant biosecurity considerations for growers and focuses on the need to understand high risk hosts and pathways, improved water management and plant growing conditions, awareness of symptoms and the importance of having staff trained in plant health knowledge.

2.2. Project aims

The overall aim of this research project was to develop a co-ordinated strategy for the early detection of *Phytophthora* pathogens in plant nurseries and traded plants for planting across EU and third countries in order to inform best practice, complement phytosanitary regulation and to enhance engagement on Plant Health with traders operating in different countries.
The main objectives were:

- Validate across participating countries the sampling and metabarcoding *Phytophthora* detection methods already developed and applied successfully in the United Kingdom along with baiting methodology.
- Link data on *Phytophthora* findings in each country's nurseries to management practice and host species so that 'high risk' practices can be identified.
- Identify key perceptions underlying risky behaviours and ways in which management practices can be improved for better biosecurity.
- Share information on 'high risk' trading and management practices as well as feasible alternative approaches to good biosecurity.
- Co-design a 'best practice' guidance flier, translated into each partner country's languages and disseminated to stakeholders through trade association channels.

2.3. Description of the main activities

The project had five main areas of activity as outlined below.

2.3.1. Project management, co-ordination and communication

Monitoring of project progress was achieved through regular virtual meetings of the project board comprising the project co-ordinator, project administrator, and the project leads on technical protocols and social science. Virtual meetings with all project partners were held twice a year to discuss protocols, progress, technical problems arising and report on results. A virtual workshop with project partners and industry stakeholders was held in the last month of the project to co-develop best practice guidance across partner countries and agree dissemination of outputs.

2.3.2. Refinement and dissemination of sampling and metabarcoding protocols

The UK partners (Forest Research [FR] and James Hutton Institute [JHI]) jointly refined the nursery sampling and sample processing methodology used in a previous UK ('Phyto-threats') project to develop a protocol that was disseminated to participating countries. This protocol targeted key locations on each nursery (e.g. water source and run-off collection points, roots from high-risk hosts) where highest *Phytophthora* diversities were found based on outcomes from the Phyto-threats project. The protocol precisely defined methods for sampling, metadata collection, DNA extraction, nested PCR and Illumina library preparation and MiSeq DNA sequencing, as well as baiting. Baiting was included to enable comparison of both methods and to confirm presence of species detected by metabarcoding. These protocols were disseminated to all project partners and a virtual meeting held to discuss and finalise the protocols and identify nurseries to be tested. Countries without the resources to process their own samples for metabarcoding sent *Phytophthora*-positive sample DNA to the UK partner for processing.

2.3.3. Sampling and analysis of *Phytophthora* diversity and associated hosts in European and third country nurseries

Six partner countries (FR, GB, GR, IE, IT, USA) sampled 2-3 key plant nurseries (e.g. Figure 1) on two occasions during the course of the project. At each sampling occasion, up to 20 different samples were collected in triplicate (60 samples in total) for metabarcoding. Five to ten samples targeted water sources and water accumulation points around the nursery and

the remaining samples comprised roots collected from batches of plants that were symptomatic or which are typical *Phytophthora* hosts. The water samples were additionally tested for *Phytophthora* by baiting using the standardised protocol. For each sample, data were collected on associated host species, symptoms present at time of sampling, sample origin and location on nursery. This was supplemented by a short management questionnaire which gathered wider data from each nursery on propagation and trading practices, irrigation sources and disease management practice for downstream analysis to inform best practice.
Phytophthora species isolated by baiting were identified in each partner country by morphological methods and by PCR and DNA sequencing. Samples were sequenced on an Illumina MiSeq instrument and bioinformatics analyses conducted at JHI using the *Phytophthora* classification tool https://pypi.org/project/thapbi-pict/ developed as part of the Phyto-threats project.

Figure 1: Photographs of nurseries sampled in some of the partner countries

2.3.4. Influence of management practice and host species on *Phytophthora* incidence and diversity, and communication to relevant stakeholders

Results on *Phytophthora* species found at each nursery were reported back to nursery managers with information on implications of the findings for management and recommendations for improving practice. The combined *Phytophthora* species detections across partner countries and associated metadata including nursery management practices were compiled in a central database for statistical analyses. Variability among nurseries and

countries in *Phytophthora* richness and community composition were related to nursery practices, host species and sampling method by fitting hierarchical (accounting for non-independence of observations) Bayesian mixed models. Specifically, these models explored the effect of selected nursery management practice on number of *Phytophthora* positive samples, whether *Phytophthora* communities differed among water and plant samples and whether *Phytophthora* species showed different sensitivity to metabarcoding and baiting detection methods.

2.3.5. Stakeholder awareness of Phytophthora risks in trade and mitigation through co-design of best practice guidance across partner countries

Key nursery and industry stakeholders who are major players in nursery supply chains were identified in each country and a stakeholder map was developed for the project. A short online stakeholder survey which sought to gain insight into sector perceptions on biosecurity and how to shape best practice was developed and translated from English into eight different partner country languages and disseminated to stakeholders mapped in each country. A virtual workshop was held involving project teams and key stakeholders in each country to communicate and share project findings and to co-design a best practice guidance document. This best practice guidance was disseminated to key stakeholders in all languages of participating countries.

2.4. Main results

2.4.1. Individual project partner summaries

France: Three nurseries were sampled in the Grand Est region of France. Water and root samples were collected from each nursery and processed as indicated in the protocols provided by the UK partner. Collected samples included more than 20 species of forest trees and ornamental plants. More than 15 different Phytophthoras were identified by sequencing of these samples. This included the detection in river water of *Phytophthora ramorum,* for which non-European lineages are quarantine organisms in the EU. Other species detected by metabarcoding included *P. cinnamomi*, *P. cambivora*, *P. nicotianae* and *P. gonapodyides*, which are known to be important plant pathogens. The diversity of *Phytophthora* differed among the three sampled nurseries, which seems to be influenced by the different management strategies applied in each nursery and the type of plant material produced.

Greece: Three samplings were performed at two different nurseries located in Attica. Both nurseries trade (import/export) ornamental plants within the EU and third countries. The water sources used by the nurseries for irrigation included boreholes, collected rainwater and pond water, with one of the nurseries implementing a copper-based and desalination treatment prior to irrigation. In approximately half of the replicate samples tested (including roots from twenty-four different ornamental plant species tested as potential hosts, irrigation sources and nursery water effluents), common (e.g., *P. nicotianae*) and less common (e.g., *P. alticola*) *Phytophthora* species were identified. Treatment of the source water prior to irrigation proved to be a sufficient measure to control viability of *Phytophthora* sporangia and consequently spread of the pathogen(s), as far as this specific stage (irrigation) is concerned. Based on the relative nurseries' feedback and the project's questionnaires results combined, issues regarding phytosanitary measurements and best practice management were discussed with both nurseries' representatives. Specific guidance for the management of diseases caused by oomycetes of the genus *Phytophthora* on plants, shrubs, and trees were also provided, as part of the BPI's official core-management instructions to growers.

Ireland: Surveys and sampling were carried out in two plant nurseries in Ireland. These were large nurseries, which grew a number of plants including several genera of trees and woody

shrubs. Working closely with the nurseries, sampling was conducted in 2021 and 2022. Metabarcoding revealed 17 different taxa of *Phytophthora* across the two nurseries. This included several new records for Ireland. There were no quarantine-regulated *Phytophthora* species detected, though several threatening species were found (e.g. *P. cinnamomi*, *P. plurivora*). Another concern was that the irrigation water at one of the sites was found to contain five taxa of *Phytophthora*. Overall, there was low similarity between the baiting/isolation results and the metabarcoding results. The project partners have been in contact with the nurseries and plan to visit in the near future to explain the results and provide some guidance on managing the risk from *Phytophthora*.

Italy: Potted plants showing *Phytophthora* spp. symptoms were selected and sampled, together with irrigation and runoff water from one commercial nursery in Tuscany during autumn and spring. The samples were processed for the diagnosis of *Phytophthora* species using the "baiting" isolation technique. The results showed high presence of the pathogen during the spring season, with eleven different *Phytophthora* species isolated from both potted plants and water, and where singular symptomatic ornamental potted plants were found to have up to four highly pathogenic *Phytophthora* species. The sample type with the highest number of species (seven) was the run-off water from the drainage canals, followed by flow-through of potted plants with irrigation water (three) and water collected from puddles (two). The study provided considerable evidence of the high incidence of *Phytophthora* in the ornamental nursery sector and underlined how a consistent taxonomical variety of the pathogen is potentially diffused around the nursery by the irrigation system.

United Kingdom: Two nurseries were each sampled twice during the project; once in summer and once in autumn. Both produce hardy nursery stock and import 30-50% of stock from EU and third countries. Nursery 1 sourced irrigation water from an open reservoir and Nursery 2 used mains water. Plants were mainly grown on Mypex over gravel although raised benches were used for home propagated stock. A high diversity of *Phytophthora* was detected in water and root samples from both nurseries (26 and 30 different known species) including the quarantine-regulated species *P. ramorum* and *P. austrocedri, P. uniformis* (parent of a damaging alder hybrid pathogen), two rare pathogens on ornamental plants, *P. occultans* and *P. pachypleura*, and DNA of a species not previously recorded in the UK (*P. macrochlamydospora/P. quininea*). Puddle water was contaminated with *Phytophthora* and irrigation water from Nursery 1 contained 11 different *Phytophthora* species. Results were reported back to nursery managers with recommendations around improving water management, inspecting and quarantining stock and raising plants off the ground. The project also identified a need for staff training and safer disposal of green waste. Following involvement in this project, Nursery 1 installed a borehole to replace its open reservoir.

United States of America: In California, two large ornamental plant nurseries were sampled, in 2020 and/or 2021, to test *Phytophthora* detection methods. Based on culture isolation, both sampled nurseries were infested with *Phytophthora* with more than a dozen species confirmed. Nursery one uses recycled irrigation water which is not treated prior to reuse. The recycled water is the main source of *Phytophthora* contamination of nursery stock, and best practice would require water treatment prior to use. In Nursery two, *Phytophthora* recovery was lower, restricted to the irrigation water in one greenhouse and a drainage pond. No *Phytophthora* species were cultured from any plant samples. To clean-up the water, treatment is recommended. Metabarcoding captured approximately 42% more taxa than baiting method. All detection methods were informative and complemented one another. Similar to the results from other nurseries in Europe, the tested methods are suitable for *Phytophthora* detection. Interactions with growers indicate that further work is needed to improve adoption of best management practices to prevent *Phytophthora* nursery infestations and disrupt the nursery stock pathway for plant pathogen introductions to landscapes and forests.

Russia: In 2020-2022 several nurseries and mother plants (Moscow region, Kaliningrad region) were investigated. Soil samples were taken from plants with symptoms of wilting and soil bio-baits were laid. DNA was isolated from necrotic leaves and classical PCR performed followed by Sanger sequencing. As a result, the following species were isolated from ornamental and fruit crops. Of the 17 soil samples of *Juglans regia* under study, 29.4% of cases were affected by root rot pathogens. The dominant species in the examined samples of *J. regia* was *P. cactorum*. Also, *P. plurivora* was found in a single case on *Juglans nigra*. In Kaliningrad Region, in a nursery growing plants of the genus *Chamaecyparis,* die-off of individual branches was observed, with DNA analyses subsequently establishing presence of *Phytophthora erythroseptica* and *Phytophthora cryptogea*. Necrosis of shoots of *Juniperus* sp. plants was associated with lesions of *Phytophthora* sp. and *Phytopythium helicoides* complex.

Combined results summary

Data were combined for analyses from 1101 samples (pooled replicates) collected from 13 nurseries sampled in FR, GB, GR, IE, IT, and US. This included 647 root samples and 364 water samples. Overall, 65 unique *Phytophthora* taxa were identified, and 86 meta barcoded samples contained unknown/unidentified *Phytophthora* species. The seven most frequently sampled host genera were *Rhododendron, Lavandula, Choisya, Fagus, Quercus, Juniperus* and *Pinus* and the seven most commonly detected *Phytophthora* species were *P. gonapodyides, P. chlamydospora, P. cryptogea/P. pseudocryptogea, P. cinnamomi, P. plurivora, P. cambivora* and *P. syringae.* Interestingly, the host genera most associated with *Phytophthora* infections and therefore of highest risk included *Fagus, Ligustrum, Thuja, Quercus, Lavandula* and *Choisya.*

Effect of management practices on *Phytophthora* detections

Although it was clear from individual country results that use of open, untreated water supplies resulted in high *Phytophthora* detections, the effect was not significant in the models, largely due to a lack of comparative data from nurseries using closed or treated water supplies (most used open and untreated water sources). The models did however find that nurseries with diverse plant stock and >50% imported plants had significantly more *Phytophthora*-positive samples and diverse *Phytophthora* communities.

***Phytophthora* species sensitivity to detection method, substrate and latitude**

Analyses revealed differences in *Phytophthora* species' sensitivity to the method of detection, with *P. hydropathica, P. nicotianae, P. citrophthora, P. plurivora, P. chlamydospora, P. lacustris, P. megasperma/P. crassamura* and *P. cinnamomi* more likely to be detected by baiting into live culture and *P. cambivora*, *P. cryptogea/P. pseudocryptogea, P. cactorum, P. uniformis* and *P. castanetorum* more likely to be detected by metabarcoding. This may reflect lifecycle and growth rate differences among species. Also reflecting preferred niche habitats was the finding that certain species were significantly more associated with roots and others more likely to be found in water (as illustrated in Figure 2). Of particular interest are the species equally likely to be found in roots as in water (e.g. *P. tubulina, P. cambivora, P. cinnamomi, P. syringae, P. plurivora*) (Figure 2) as these species may have traits enabling them to be more opportunistic colonizers of nursery environments. Analyses also found species significantly more prevalent at higher latitudes (*P. cryptogea*/*P. pseudocryptogea, P. castanetorum, P. quercina* and *P. tubulina*) and those more prevalent lower latitudes (e.g. *P. porri, P. nicotianae, P. multivora, P. citrophthora* and *P. cinnamomi*); these latter species may become more problematic at higher latitudes with global warming.

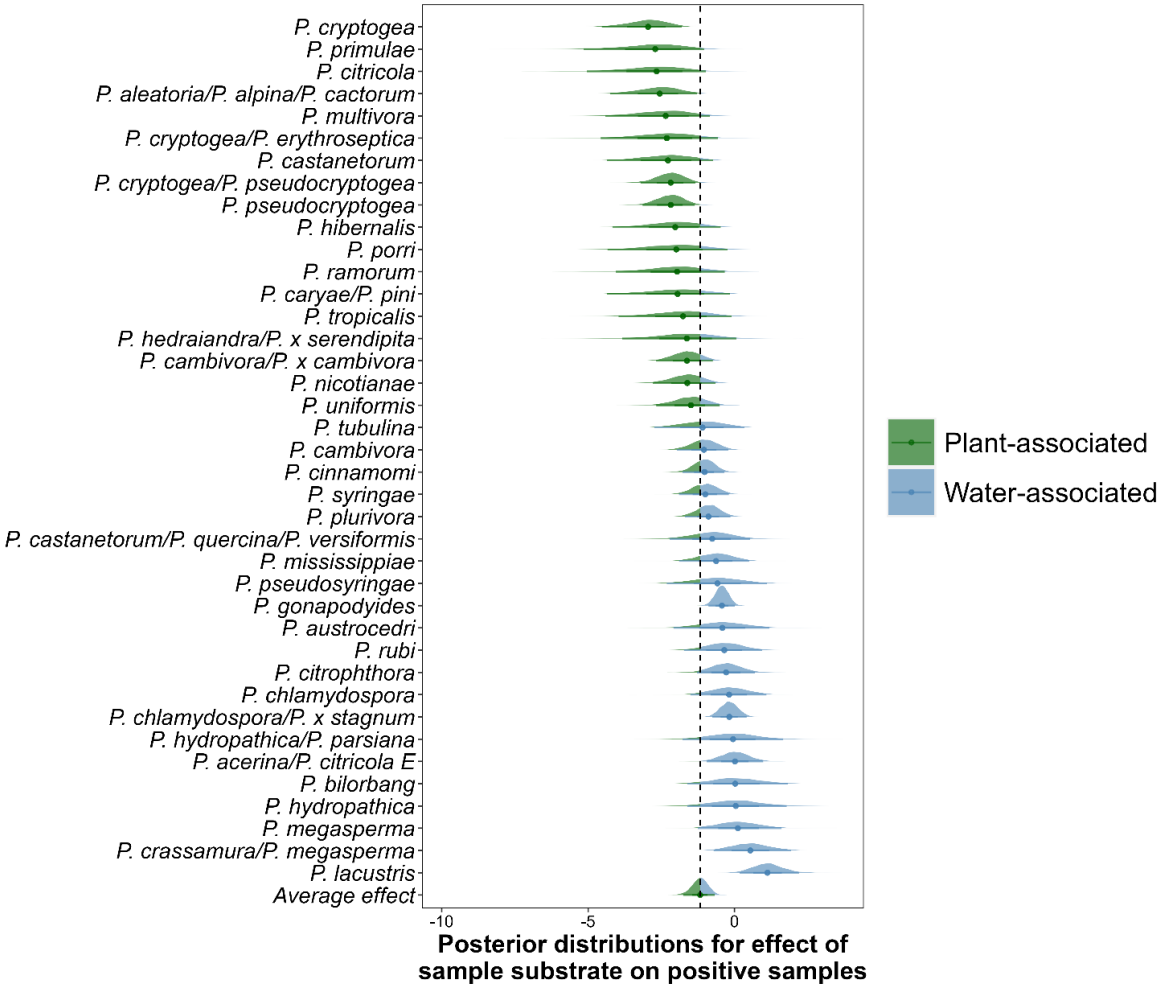

Figure 2: Effect of substrate (root ['plant associated'] versus water) on *Phytophthora* species detected.

2.4.2. Stakeholder mapping and survey

Stakeholder mapping: A stakeholder map was constructed which included 195 contacts in eight categories (retailer, suppliers, monitoring and detection, consumer, policy and regulation, site vector, and transport and storage) from organisations in six partner countries.

Online survey: To get an international perspective on the plant health attitudes and behaviours of people involved in the live plant trade, a short online questionnaire was developed in nine languages (Czech, Dutch, English, French, German, Greek, Italian, Russian, and Slovak) and disseminated to stakeholders in each of the partner countries except for the United Kingdom. In the United Kingdom, stakeholder responses to two very similar surveys had already been collated, analysed and published in the UK as part of the earlier 'Phyto-threats' project and one for the Scottish Plant Health Centre; (for example, see phc2019_04_final_report_biosecurity_risk_online_nonspecialist.pdf (forestresearch.gov.uk).

For the ID-PHYT project, a total of 94 responses was received across seven countries: Austria (12), France (25), Ireland (10), Italy (13), Russia (2), New Zealand (8), and USA (25). Reponses were analysed based on region (Europe, New Zealand, USA) and type of organisation the respondent represented: advisor (10), buyer of plants for planting (4), grower

(25), monitoring / detection of plant pests (25), policy / regulation (9), plant seller (10), user of planted sites (1), other(10).

Respondents were asked to name up to five plant pests or diseases which concerned them the most. There were 115 different plant pests and diseases named as concerning, with 67 respondents naming *Phytophthora spp.* as a concern. *Xylella fastidiosa* and *Hymenoscyphus fraxineus* were the next most commonly named pests of concern. Respondents were asked to rank the importance of potential pathways of introduction. *Imported for trade* was the pathway ranked highest for most respondents, except those based in New Zealand. *On vehicles*, *on wood packaging*, and *natural pest/disease expansion* were the next most frequently high-ranking pathways overall. In New Zealand, *natural pest/disease expansion* was the highest ranked pathway. *Tourists visiting / returning* and *other individual travellers* were the lowest ranked pathways for most participating countries.

The most important phytosanitary management actions available on site were perceived as *boot washing*, *quarantining*, and *staff training*. When asked about an appropriate quarantine period for domestic or imported plants, most respondents felt that domestic products should have a shorter quarantine period. Those who worked to monitor and detect pests broadly agreed with others on quarantine period for domestic products but did not agree on quarantine periods for imported products, which they felt should be longer.

Most respondents indicated that even if a wide range of management practices were universally applied, this would not result in a large reduction of risk from plant pests and diseases. The group who thought that implementing onsite management practices would reduce risk the most were those who grow or sell plants. There was a range of awareness of biosecurity best practice schemes within and across countries surveyed. In Austria, France, Italy, and Ireland some respondents indicated that there was a mandatory scheme, whilst others in the same country believed there was no scheme.

2.5. Conclusions and recommendations to policymakers

The key project findings from the nursery surveys were collated and used to develop a simple two-sided flier entitled 'Reducing *Phytophthora* risk in nurseries – key considerations' 23_0015_Flyer Reducing Phytophthora risk in nurseries_wip05 (forestresearch.gov.uk). This flier was translated into Greek, Italian, German and French and disseminated in all partner countries through trade association channels. The best practice flier highlights the importance of understanding origin of plant material being brought on to a nursery, regular monitoring of stock for symptoms, risks of poor water management (e.g. use of open, untreated water supplies, overwatering to allow excess runoff and puddling etc). The guidance also recommends the use of quarantine areas for imported stock, high levels of general nursery hygiene (including being free of weeds, spilt soil/potting mix and piles of soiled pots) and staff training in plant health knowledge. Since *Phytophthora*-contaminated open water sources was a major problem for most nurseries tested in this project, it is also recommended that policymakers and plant health authorities highlight the risks of using open water sources and direct resources into researching and promoting the most appropriate water treatment methods for nursery managers in their respective countries.

Given the high overall levels of *Phytophthora* detections across nurseries in the six countries, and the generally low levels of awareness of risk among nursery managers, it is recommended that, as policy priority, guidance and training on plant health risks and the importance of biosecurity is provided to those working in the sector across all partner countries. There are a wide range of pests and pathogens of concern, so emphasis should be on the benefits of best practice for tackling many different pests and pathogens. Phytosanitary actions seen as most important are cleaning, quarantining, and training, but many feel that performing these actions

will not have overall positive impact on risk reduction, which is possibly a reflection of a lack of knowledge as to what can be done to manage pest and disease risk. This lack of confidence may diminish practitioner motivation to perform phytosanitary actions, so it is key to show how best practice will lead to positive impact, for example by publicising successful case studies.

Another recommendation is for the further development of national phytosanitary certification schemes to improve biosecurity in the horticultural sector. Three of the partner countries in this project are developing, or have developed, such schemes. Two voluntary certification schemes, 'Plant Healthy' and 'Ready to Plant' are now available in the United Kingdom. Growers who join must adhere to the Plant Health Management Standard which underpins both schemes. Similarly, in New Zealand there is the 'Plant Pass' voluntary certification scheme for growers which aims to reduce the likelihood of new pests and pathogens entering the country, and California, US, has developed a set of guidelines to minimise *Phytophthora* pathogens in nurseries growing native plants for restoration projects. There could be greater international cooperation in the development of such schemes with advice and lessons learned passed on to countries in the very early stages of certification scheme development.

2.6. Benefits from trans-national cooperation

The project has resulted in sharing of knowledge and protocols and technology transfer across countries. It also facilitated useful discussion of methods and troubleshooting technical problems. One additional project output was the production of a protocol for *Phytophthora* baiting, led by the Italian partner and shared across project teams. The project has also highlighted the sheer ubiquity of *Phytophthora* in plant nurseries and the fact that many of the risk factors are common across countries, so that a single shared best-practice guidance document is relevant to all partners. Projects involving trans-national cooperation such as this one facilitate future scientific collaborations. For example, a joint scientific paper will be produced over the coming months involving all project partners.

3. Publications

3.1. Article(s) for publication in peer reviewed journals

None.

3.2. Grey literature/ best practice guidance

Phytophthora: una minaccia per il settore vivaistico internazionale.
Available from the WebMagazine AboutPlants.eu:
Phytophthora: una minaccia per il settore vivaistico internazionale | AboutPlants

3.3. Events

Cooke DEL, Randall E, Keillor B, Cock P, Pritchard L, Frederickson-Matika D, Green S (2023). The range and contribution of barcoding in Phytophthora and other oomycetes. Presentation at the 12th International Congress of Plant Pathology, Lyon, 20-25 Aug Lyon, France.

Green S. *et al.* (2022). ID-PHYT Early detection of *Phytophthora* in nurseries and traded plants in the EU and third countries. Presentation to the EPPO panel on diagnostics in Mycology, September 9th 2022.

Green S *et al*. (2022). ID-PHYT Early detection of *Phytophthora* in nurseries and traded plants in the EU and third countries. Presentation at the Society of American Forester's Annual Convention, Baltimore, Sept 20-24, 2022.

Kopina MB, Surina TA, Shukhin DI, Smirnova AV (2022). Regulated pests *Phytophthora* causative agents on ornamental crops of family Cupressaceae. Proceedings of XI international conference 'Problems of forest phytopathology and mycology', Petrozavodsk, 10-14 October 2022. - Petrozavodsk: Karelian Scientific Center of the Russian Academy of Sciences, 2022. - C. 30-32. - EDN LGHWFE.

Migliorini D, Pecori F, Arati G, Green S, Gnesini A, Begliomini E, Santini A (2023). Impressive taxonomic variability of Phytophthora spp. in commercial nursery stock. Presentation at the 12th International Congress of Plant Pathology, Lyon, 20-25 Aug Lyon, France.

4. Open Euphresco digital object

Reducing Phytophthora risk in nurseries-Key considerations.
Best practice guidance developed in the framework of the Euphresco Project Early detection of *Phytophthora* in EU and third country nurseries and traded plants (ID-PHYT). The document highlights the key plant biosecurity considerations for growers and focuses on the need to understand high risk hosts and pathways, improved water management and plant growing conditions, awareness of symptoms and the importance of having staff trained in plant health.

The leaflet in GB English is available from the Euphresco Digital Research Object Portal:
https://drop.euphresco.net/data/250f2445-d4f2-49d8-9d32-17358550994a

The leaflet in US English is available from the Euphresco Digital Research Object Portal:
https://drop.euphresco.net/data/2e5455aa-e47a-4bd8-bd66-23c37c0f7d97/

The leaflet in French is available from the Euphresco Digital Research Object Portal:
https://drop.euphresco.net/data/3df89e78-0b62-499d-9a90-3bbb3470df3a/

The leaflet in German is available from the Euphresco Digital Research Object Portal:
https://drop.euphresco.net/data/83a64ddb-166b-4489-8348-bfd0a1cb81c1/

The leaflet in Greek is available from the Euphresco Digital Research Object Portal:
https://drop.euphresco.net/data/7fe4b8ab-45bb-47b8-bf25-728895434825/