EUPHRESCO

Common Strategic Phytosanitary* Research Agenda

Assuring the future of Plant Health in Europe through coordinated research

Deliverable 5.1

***(quarantine/regulated plant health)**

Development process of the EUPHRESCO Common Strategic Phytosanitary Research Agenda

EUPHRESCO WP2: Report on the Mapping and Analysis of National Phytosanitary (quarantine/regulated Plant Health) Research Programmes (November 2007)

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EUPHRESCO internal Workshop in Prague (May 2008): Decision on a **'Future Research Agenda'**

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Discussion during EUPHRESCO project meetings in Prague (May 2008) and Vienna (November 2008)

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National Workshops in partner countries (February 2008 – April 2009)

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EUPHRESCO Europe-wide workshop in Braunschweig (May 2009):
'Building and influencing Trans-national Phytosanitary Research strategies for Europe'

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Authors: EUPHRESCO partner 15: Katrin Kaminski, Silke Steinmöller, Gritta Schrader, Ernst Pfeilstetter, Jens-Georg Unger (Julius Kühn-Institute (JKI), Germany), EUPHRESCO NMG
www.euphresco.org

Table of Contents

Preamble

This common strategic research agenda has been developed in the course of the ERA-NET project (European Research Area) EUPHRESCO. EUPHRESCO stands for **Eu**ropean **Ph**ytosanitary **Res**earch **Co**operation and is an EU project funded in the 6th framework programme. It is a policy-led coordination action, initiated by the EU Council Working Party of Chief Officers of Plant Health Services (COPHS). EUPHRESCO connects organisations involved in funding or managing of phytosanitary research from 17 countries: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Great Britain, Ireland, Italy, the Netherlands, Slovenia, Spain, Switzerland, and Turkey.

Coordination of this national research has not been done significantly before EUPHRESCO nor has there been any significant trans-national funding of research and no alignment with EU-funded plant health research. The aim of the initial EUPHRESCO project (2006-2010) is to better coordinate phytosanitary research at the European level and to support European plant health research policy. This implies to increase coordination and co-operation between nationally-based phytosanitary research programmes on EU-level for the first time through networking of research activities and potential mutual opening or collaboration between national programmes. EUPHRESCO has three main goals:

- Develop phytosanitary research policy at the EU-wide level,
- Optimise the research provision that underpins EU quarantine plant health policy development and implementation by reducing duplication and pooling resources.
- Increase the capacity of European phytosanitary science and research, in order to prevent the disappearance of EU expertise and maintain Europe's competitiveness in the global market. This supports EPPO's declaration of a *State of Emergency in Plant Health* in Madeira in 2004.

This document displays the vision of corporate research on plant health issues at the transnational level. EUPHRESCO partners contributed to its completion by way of answering questionnaires, discussions and through national and international workshops. The first workshop, held in Prague in May 2008, had a more internal character and resulted in the first ideas for the strategic research agenda. National workshops were held in the partners' countries to include stakeholders' views in the research agenda. An international workshop was held in Braunschweig in May 2009 as main consultation and to further progress strategy development with stakeholders. The common strategic research agenda is be finalised by EUPHRESCO and endorsed by the Governing Board of EUPHRESCO in 2010 (see Fig. 1).

The common strategic research agenda provides a basis for a common research network of EUPHRESCO partners and serves as a guideline for new partners. The visions and recommendations will be completed with an action plan, which is for implementation of visions and recommendations laid down in the research agenda.

Terms and definitions

Applied research	Original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective support system
Basic/fundamental research	Experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view
Commodity	A type of plant, plant product, or other article being moved for trade or other purpose [ISPM No. 5[1]]
ERA-Net	European Research Area – Networking, element of the FP6 specific programme aiming at integration and strengthening the European Research Area via coordination and mutual opening of national and regional research programmes
EUPHRESCO	EC sixth framework programme ERA-Net project 'European Phytosanitary (statutory plant health) Research Coordination'
FP7	EU seventh framework programme for Research and Technological Development
GB	Governing Board: steering committee of EUPHRESCO
Invasive alien species	An alien (non-native) species whose introduction and/or spread threaten

[1] https://www.ippc.int/index.php?id=13399&tx_publication_pi1[showUid]=2178262&frompage=13399&type=publication&subtype=&L=0#item

	biological diversity [Convention on Biological Diversity, CBD[2]] An invasive alien species (CBD) is an alien species (CBD) that by its establishment or spread has become injurious to plants, or that by risk analysis is shown to be potentially injurious to plants [IPPC context; ISPM No. 5, Appendix to Supplement No. 2]
IPPC	International Plant Protection Convention[3], as deposited with FAO in Rome in 1951 and as subsequently amended [ISPM No. 5]
ISPM	International Standard on Phytosanitary Measures; an international standard adopted by the Conference of FAO, the Interim Commission on phytosanitary measures or the Commission on phytosanitary measures, established under the IPPC [ISPM No. 5]
NMG	Network Management Group: Management Team of EUPHRESCO, consists of leaders and deputy-leaders of workpackages
NPPO	National Plant Protection Organisation; official service established by a government to discharge the functions specified by the IPPC [ISPM No. 5]
Pathogen	Micro-organism causing disease [ISPM No. 3[4], 1996]
Pest	Any species, strain or biotype plant, animal or pathogenic agent injurious to plants or plant products [ISPM No. 5] Here: including invasive non-native plants

[2] Convention on Biological Diversity, 1992. CBD, Montreal

[3] https://www.ippc.int/

[4] https://www.ippc.int/index.php?id=13399&tx_publication_pi1[showUid]=76047&frompage=13399&type=publication&subtype=&L=0#item

Pest risk analysis (PRA)	The process of evaluating biological or other scientific and economic evidence to determine whether a pest should be regulated and the strength of any phytosanitary measures to be taken against it [ISPM No. 5]
Phytosanitary measure	Any legislation, regulation or official procedure having the purpose to prevent the introduction and/or spread of pests, or to limit the economic impact of regulated non-quarantine pests [ISPM No. 5]
Phytosanitary certificate	Certificate patterned after the model certificates of the IPPC [ISPM No. 5]
Phytosanitary certification	Phytosanitary procedures leading to the issue of a Phytosanitary Certificate
Phytosanitary research	Research that deals with regulated quarantine pests, emerging pests with the potential to become quarantine pests (organisms new to countries, outbreaks in other countries, non-native invasive species relevant for or associated with, plants) and regulated non-quarantine pests (RNQP) in particular countries
Phytosanitary procedure	Any official method for implementing phytosanitary measures including the performance of inspections, tests, surveillance or treatments in connection with regulated pests [ISPM No. 5]
Phytosanitary regulation	Official rule to prevent the introduction and/or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests, including establishment or procedures for phytosanitary certification [ISPM No. 5]
Plant pest	See: pest

Plant products	Unmanufactured material of plant origin (including grain) and those manufactured products that, by their nature or that of their processing, may create a risk for the introduction and spread of pests [ISPM No. 5]
Plants	Living plants and parts thereof, including seeds and germplasm [ISPM No. 5] It shall also include alien plants
PRA	Pest Risk Analysis
Quarantine pest	A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled [ISPM No. 5]
Research	Includes basic and applied research and experimental development as defined by the OECD (OECD Frascati manual, 2002). Activities excluded from the definition of research are also defined by the Frascati manual (pages 30–46)
Regulated non-quarantine pest	A non-quarantine organism whose presence in plants for planting affects the intended use of those plants with an economically unacceptable impact and which is therefore regulated within the territory of the importing contracting party [ISPM No. 5]
Regulated pest	A quarantine or a regulated non-quarantine pest [ISPM No. 5]
Stakeholders	Organisations that have an interest in plant health research because they can affect or be affected by EUPHRESCOs' actions, objectives, and policies. It can be commercial firms, private organisations, or federal funding bodies that are not network partners

Standard	Document established by consensus and approved by a recognised body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context [ISPM No. 5]
Test	Official examination, other than visual, to determine if pests are present or to identify pests [ISPM No. 5]
Treatment	Official procedure for the killing, inactivation or removal of pests, or for rendering pests infertile or for devitalisation [ISPM No. 5]

Summary

The EUPHRESCO ERA-Net began in 2005 with the aim of better coordinating and structuring phytosanitary research in Europe. Previously, most research had done primarily at the national level, despite the fact that EU plant health policy is determined at the EU level. Research has a key role in underpinning all plant health activities, ranging from pest risk analysis, regulation, surveillance, taxonomy, diagnostics and actions at outbreaks (eradication and containment). It also helps to maintain and develop scientific expertise and infrastructures that support plant health.

The main over-arching strategic aims of EUPHRESCO are:

- To better coordinate national plant health research programmes with each other and with EU-funded research
- To provide better research support for EU policy and operations through transnational cooperation and collaboration (e.g. trans-national research projects) that optimises limited funds
- To better support European phytosanitary science capability through such transnational activities and research projects.

Context and background

Part of the EUPRHESCO project is the development of a Common Strategic Phytosanitary Research Agenda within the broader plant health context internationally and in Europe. The research agenda therefore provides an overview on international plant health, covering international bodies, regulatory frameworks, phytosanitary measures, infrastructure and important factors and drivers relevant to plant health and research (e.g. increase global trade and movement of plants and plant products, increased or changing trade pathways, climate change, pesticide withdrawal and pesticide resistance). It then describes the phytosanitary situation in Europe in relation to research, referring to the mapping and analysis[5] of national programmes and the European phytosanitary research landscape undertaken and published (2007) early in the EUPHRESCO project activity. This mapping and analysis highlighted: the limited national funding available (€15 million per year across 23 EUPHRESCO partners) and the need to optimise funds; little or no previous trans-national research cooperation between national programmes; ad hoc identification of research needs suitable for EU funding without any strategic overview; the small size of national projects and therefore the added value of pooling resources; the relatively small proportion of quarantine listed pests that were worked on; and the areas of research covered by national programmes, including gaps and opportunities that could be addressed through trans-national research.

[5] Report on the Mapping and Analysis of National Phytosanitary (Quarantine/Regulated Plant Health) Research Programmes. EU Sixth Framework ERA-NET Project EUPHRESCO. Deliverable 2.2. November 2007. http://www.euphresco.org/public/publications/index.cfm?id=28

Common research agendas and research needs

In preparation of the research agenda the EUPHRESCO partner countries held national workshops to define national research needs and priorities and to discuss themes that should be included in the research agenda. The results from different countries were similar and exposed roughly the same deficiencies and research requirements in the partner countries. The main common areas identified were:

- Detection and identification methods (diagnostics) for use both in the laboratory and on-site by inspection services. This contributes to early and accurate identification of regulated/quarantine pests such that action can be most effective.
- Support for pest risk analysis, both in terms of developing PRA science and filling in gaps and uncertainties in specific PRAs through research, to ensure evidence-based regulation and policy.
- Intervention strategies, i.e. development of eradication, containment and management methods for regulated/quarantine pests in an era where the availability of effective pesticides is decreasing due to pesticide withdrawal, increasing pesticide resistance, and increasing public and political pressure to reduce the use of pesticides.
- Support for infrastructures, especially collections and taxonomic infrastructures and expertise that provide the foundation for plant health policy and its implementation (PRA, diagnostics, etc.).
- The impact of climate change on plant health.

These common generic research areas constitute a framework against which trans-national research can be taken forward over the next 5–10 years in order to help protect European agriculture, horticulture, forestry and the environment from quarantine and emerging new pests. The transformation of the research needs, ideas and visions summarised in these agenda into real projects will be the future task for the EUPHRESCO partners. It will identify and prioritise research themes suitable for national, transnational or EU funding and define specific research topics. The research agenda will be complemented by a *modus operandi* for the future self-sustainable long-term network.

Strategy for implementation and achievement of goals

To help facilitate the delivery of trans-national research that achieve EUPHRESCOs strategic aims, the following strategic objectives and outcomes and strategies can be identified:

- To ensure that a long-term, self-sustainable network of funders can be maintained through the development and use of efficient and effective (light) mechanisms, processes and tools for network administration and research commissioning
- To enlarge the network of funders to ensure better regional (zonal) and sector-based participation. In particular, some regions are currently under-represented (e.g. the

Balkans and SE Europe, and the Baltic area) as are some key sectors related to plant health (e.g. forestry plant health)

- To directly link EUPHRESCO activities to EU-level initiatives, especially those from the COPHS, from the Commission's DG SANCO and its Standing Committee on Plant Health, and from EPPO and EFSA. This includes, for example, initiatives to improve phytosanitary infrastructures (e.g. collections) and scientific capability (e.g. improved cooperation and standardisation of methods between diagnostic laboratories)

- To ensure coordination between trans-national and EU-funded research to enable value for money and best research results. Trans-national funding would aim to address projects that were more applied, regional and/or responding to emergency situations. Conversely, EU-funding is considered more suitable for larger and/or more strategic projects of wider EU relevance. Trans-national projects additionally have the ability to complement EU-funded project, or add value to them by taking further their outputs when EU projects end.

- Improved agenda setting through improved dialogue with policy and industry stakeholders, thereby ensuring that research needs and priorities are better determined

- Increased cooperation with countries outside of Europe that have similar problems or are the source of regulated pests for the EU. In the case of the latter, research may enable exporting countries to minimise risks of sending quarantine pests to the EU; similarly, such countries may provide opportunities for research to done *in situ* in the pest's place of origin, thereby improving risk assessments and risk management approaches.

- To help facilitate improved linkages between plant health and less traditional scientific disciplines, e.g.: social sciences, especially economics; climate change research; mathematics, statistics and modelling; information technology.

Part A: Introduction to Plant Health

– General Background –

Plants take an important part in the daily environment. They are relevant economic goods, a considerable component of our environment and they influence the living culture. Agriculture, horticulture and forestry provide food, plant products and raw materials, as well as ornamental plants that contribute significantly to our quality of life.

Naturally all plants envisage different enemies in their natural habitat, from pests like aphids or beetles, to diseases caused by e.g., fungi, bacteria or viruses. Normally these pests and diseases are a native component of the environment. Quite often plants developed certain defence mechanisms, or beneficial organisms help to reduce the intensity of infestation from pests. If necessary a broad range of different mechanisms and biological or chemical agents are available to protect the crop against native pests and diseases.

But in addition to the plant protection problems growers naturally have to face an increasing problem arising from the introduction of new economically or environmentally damaging plant pests, diseases and invasive species. Mostly these new enemies are unacquainted, thus hardly any knowledge on biology, the behaviour in a new environment, as the dissemination potential or eradication measures, exists. Just as often these pests are very robust and therefore hard to control or eradicate by available means.

To avoid extensive damage in the natural environment or economy, measures have to be taken to prevent in the best case the introduction or at least to prevent the dissemination and establishment of new pests. These measures consist normally of legal restrictions resp. regulations concerning import of plants or plant parts, as well as procedures to eradicate newly introduced pests and diseases as soon as possible and to avoid there dissemination. These measures will be supported by pest risk analysis to estimate the potential emanating risks as well as research on the biology and possible eradication measures. The complex of all this measures and procedures is integrated under the term **Plant Health**, for legislative restrictions the term **Plant Quarantine** is used.

One of the most well-known historical examples for the impact of a new pathogen is potato blight caused by *Phytophthora infestans*. The introduction of this exotic plant pest caused the Irish potato famine in the 19th Century. The Dutch elm disease epidemics in Europe during the 20th Century, which devastated elm populations, also provide a salutary lesson from an environmental perspective. Currently, for instance the Western Corn Rootworm, *Diabrotica virgifera* (Coleoptera: Chrysomelidae) causes significant yield losses in maize production in many European countries. It was introduced in the 1990s into Serbia and has been spreading in Europe since then. This is only one example of newly introduced pests in the recent years.

The rate of introduction and establishment of new, economically or environmentally damaging plant pests, diseases and invasive species is steadily increasing in Europe as the volume and diversity of trade in plant material becomes more global and as new trade pathways develop. The current EC Plant Health Directive lists more than 300 named pests and there are many more currently unknown pests that may have future impacts. These problems may be exacerbated by climate change, which may increase the ability of some pests to establish and spread, and through expansion of the EU single market which will see

the creation of new borders and potential pathways. It is the role of Plant Health to protect Europe's plants from these new emerging threats.

1. Worldwide and European Plant Health systems

Combating the potential threats requires a range of regulations, measures and activities. Plant health policy-makers, inspection services, scientists and researchers are involved in maintenance of the phytosanitary sector and in protecting Europe from exotic and quarantine plant pests and invasive species.

1.1 Institutions and organisations

The Food and Agricultural Organisation of the United Nations (FAO) [6] is governed by a conference of Member Nations with the overarching aim to secure food safety. FAO's mandate is to raise levels of nutrition, improve agricultural productivity, better the lives of rural populations and contribute to the growth of the world economy. FAO's activities comprise information exchange and sharing policy experience. FAO has been actively promoting the integration of regulatory frameworks to address food safety and plant health through a joint programme of information exchange and capacity building. The contributions of the International Plant Protection Convention are a main component of this integrated programme managed by FAO.

The International Plant Protection Convention (IPPC) [7] is an international treaty to secure action to prevent the spread and introduction of pests of plants and plant products, and to promote appropriate measures for their control. It is governed by the Commission on Phytosanitary Measures (CPM) which adopts International Standards for Phytosanitary Measures (ISPMs) for safeguarding plant resources. The IPPC also provides information exchange related to import and export requirements, *pest status* and regulated pest lists provided by each member country. Developing countries also receive technical assistance to support their ability to implement the Convention and the ISPMs.

While the IPPC's primary focus is on plants and plant products moving in international trade, the convention also covers research materials, biological control organisms, germplasm banks, containment facilities and anything else that can act as a vector for the spread of plant *pests* — for example, containers, packaging materials, soil, vehicles, vessels and machinery.

The World Trade Organization (WTO) [8] is the only global international organization dealing with the rules of trade between nations. At its heart are the WTO agreements, negotiated and signed by the bulk of the world's trading nations and ratified in their parliaments. The goal is

[6] http://www.fao.org/
[7] https://www.ippc.int/
[8] http://www.wto.org

to help producers of goods and services, exporters, and importers to conduct their business. The WTO agreements, negotiated and signed by the bulk of the world's trading nations, provide the legal ground-rules for international commerce. They are essentially contracts, binding governments to keep their trade policies within agreed limits. The objective of the Agriculture Agreement is to reform trade in the sector and to make policies more market-oriented. A separate agreement on food safety and animal and plant health standards (the Sanitary and Phytosanitary (SPS) Measures Agreement) sets out the basic rules. It allows countries to set their own standards but also says regulations must be based on science. They should be applied only to the extent necessary to protect human, animal or plant life or health. And they should not arbitrarily or unjustifiably discriminate between countries where identical or similar conditions prevail. The relevant standard setting organisation for the SPS agreement for plant health is the FAO's secretariat on the IPPC.

The European Commission (EC)[9] is the European Union's (EU) executive body. It represents and upholds the interests of Europe as a whole and drafts proposals for new European laws. The protection of human health and consumer's rights is the main function of the Directorate-General for Health and Consumer (DG SANCO). To fulfil that function soundly based policies, laws and programmes are developed and maintained. Amongst its other food safety responsibilities, DG SANCO has responsibility for plant health. The EU plant health legislation regulates the trade of plants and plant products within the EU as well as imports from the rest of the world in accordance with international plant health standards and obligations

The European and Mediterranean Plant Protection Organisation (EPPO) [10] is an intergovernmental organization responsible for European cooperation in plant health. Under the IPPC (article IX of the text revised in 1997) the Regional Plant Protection Organizations function as coordinating bodies in the different continents to further the objectives of the Convention, and to gather and disseminate information. Each RPPO has its own independent statutes and conducts its own regional cooperation programme. Founded in 1951, EPPO now has 50 members, covering almost all countries of the European and Mediterranean region. The technical work of the Organization is done by the Panels of experts, under the supervision of the Working Parties. Experts are nominated by their National Plant Protection Organizations. EPPO objectives are to protect plants, to develop international strategies against the introduction and spread of dangerous pests and to promote safe and effective control methods. As a Regional Plant Protection Organization, EPPO also participates in global discussions on plant health organized by FAO and the IPPC Secretariat. Finally, EPPO has produced a large number of standards and publications on plant pests, phytosanitary regulations, and plant protection products.

The European Food Safety Authority (EFSA)[11] is the keystone of European Union (EU) risk assessment regarding food and feed safety. In close collaboration with national authorities and in open consultation with its stakeholders, EFSA provides independent scientific advice and clear communication on existing and emerging risks. It was set up in January 2002,

[9] http://ec.europa.eu
[10] http:// www.eppo.org/
[11] http://www.efsa.europa.eu/

following a series of food crises in the late 1990s, as an independent source of scientific advice and communication on risks associated with the food chain. Risk assessment is a specialised field of applied science that involves reviewing scientific data and studies in order to evaluate risks associated with certain hazards. Accordingly, EFSA's advice frequently supports the risk assessment and policy-making processes.

The National Plant Protections Services perform the practical implementation of phytosanitary measures and controls.

1.2 Regulatory framework in Plant Health

To prevent the introduction of new pests and to control already introduced pests, common phytosanitary regulations and procedures are developed and applied worldwide by almost all countries.

International Standards for Phytosanitary Measures (ISPMs)[12] are the standards, guidelines and recommendations recognized as the basis for phytosanitary measures applied by Members of the World Trade Organization under the Agreement on the Application of Sanitary and Phytosanitary Measures (the SPS Agreement). They are edited by the IPPC and the CPM and include standards for:

- Procedures and references;
- Pest surveillance, survey and monitoring;
- Import regulations and pest risk analysis;
- Compliance procedures and phytosanitary inspection methodologies;
- Pest management;
- Post entry quarantine;
- Exotic pest emergency response, control and eradication; and
- Export certification.

Non-contracting parties to the IPPC are encouraged to observe these standards.

The Council Directive 2000/29/EC of 8 May 2000 on protective measures against the introduction into the Community of organisms harmful to plants or plant products and against their spread within the Community is in place in the EU. The annexes I to V list the particularly dangerous harmful organisms whose introduction into the Community alone or associated with specific plants or plant products must be prohibited, as well as certain plants and plant products the introduction of which is prohibited in all member states. This is amended by special requirements and by lists of plants which must be subject of a plant health inspection before being permitted to enter the community. It contains for example specifications on plant health certificates, on special requirements for transport of certain plants and plant products within the Community.

EPPO standards[13] are a result of the work done by the different technical bodies of the organization and present recommendations to the National Plant Protection Organizations.

[12] https://www.ippc.int/index.php?id=13399&L=0
[13] http://www.eppo.org/STANDARDS/standards.htm

They are considered as Regional Standards in the sense of the IPPC. In order to ensure an international acceptance, the draft standards go through a rather complex approval procedure. Standards include:

- Efficacy evaluation of plant protection products
- Good plant protection practice
- Environmental risk assessment of plant protection products
- General phytosanitary measures
- Pest-specific phytosanitary requirements
- Phytosanitary procedures
- Production of healthy planting material
- Pest Risk Analysis (PRA)
- Safe use of biological control
- Diagnostic protocols for regulated pests
- Commodity-specific phytosanitary measures
- National regulatory control systems

On national levels guidelines and ordinances for certain pests determine the handling if this pests are introduced into the countries. They contain for instance the assignment of security zones, treatments of infested plants, and obligations to inform the plant protection service. Next to these organizational specifications, directives or guidelines exist that cover diagnostic matters, like detection and identification tests.

Third countries have their own phytosanitary regulations which are relevant for exports of plants and plant products from the EU.

2. Management and control of organisms of phytosanitary concern

The phytosanitary systems feature some methodical modules to combat the introduction and spread of quarantine and new plant pests and diseases. These modules aim either at the prevention of introduction, the assessment of posed risks, the identification or the eradication of already introduced pests and invasive alien plants.

2.1 Risk Assessment of new plant pests

Pest risk analysis (PRA), comprising pest risk assessment and pest risk management, is the central element of plant health. Article 5 (1) of the Sanitary and Phytosanitary Agreement by the World Trade Organisation states that “Members shall ensure that their sanitary or phytosanitary measures are based on an assessment, as appropriate to the circumstances, of the risks to human, animal or plant life or health, taking into account risk assessment techniques developed by the relevant international organizations.” PRA is defined as “The process of evaluating biological or other scientific and economic evidence to determine whether an organism is a pest, whether it should be regulated, and the strength of any phytosanitary measures to be taken against it” by the IPPC.

Pest Risk Analysis are the basis for decisions on phytosanitary measures. The first assessment to be made is therefore, whether the organism fulfils the characteristics of a pest of plants, and if so, whether regulation is necessary, i.e. whether the pest fulfils the characteristics of a quarantine pest. Though EU legislation on plant health does not use the terms pest and quarantine pest, the principles behind this IPPC framework are the same. According to the IPPC, phytosanitary measures have to be technically justified ("Contracting parties shall not, under their phytosanitary legislation, take any of the measures specified in paragraph 1 of this Article unless such measures are made necessary by phytosanitary considerations and are technically justified." Article VII 2a, IPPC 1997). The definition given in the IPPC for "technically justified" is as follows: "justified on the basis of conclusions reached by using an appropriate pest risk analysis or, where applicable, another comparable examination and evaluation of available scientific information."

PRA deals with the likelihood and magnitude of risks and impacts posed by entry, establishment and spread of pests and the economic impacts including those on the environment they may cause. A PRA needs a sound scientific knowledge concerning epidemiology, biology and ecology of the pests as well as on possible pathways, climatic facts, mechanisms and pathways of spread and economic consequences. Especially for new emerging pests data are often missing e.g. on biology and epidemiology. Background information on trade, pathways and economical consequences are often insufficient to estimate the risk. In addition, currently applied PRA methodology may lead to uncertain and inconsistent PRAs. The process of PRA is time consuming. Often risk assessments cannot be completed – at least not immediately, when a certain pest is detected for the first time. To improve current difficulties concerning PRA methodology an EU-funded research project named PRATIQUE[14] started work in 2008.

2.2 Inspection

The IPPC permits the importing countries to inspect imported commodities at borders, airports and ports whether they contain new or quarantine pests. If they are affected, the importation can be refused and the commodities will be re-exported or destroyed. At national levels phytosanitary measures comprise regular monitoring of cultivated areas as well as the control of the production and trade of plants.

Detection and identification of plant pests are therefore essential procedures for national plant protection organisations (NPPOs) to identify possible risks and take further action. They both form the basis of diagnosis. Based on diagnosis by the NPPOs the day-today decisions on treatment of consignments and management of outbreaks are taken. Detection and identification of the pest may depend on several factors e.g. the biology and the surrounding area of the pest.

Methods for detection depend on the pests and are variable, e. g. trapping, extracting, recovering and collecting. Detection methods must often be applicable to a range of substrates and matrices, (e.g. plant material, soil, water etc.) and the surrounding.

[14] https://secure.fera.defra.gov.uk/pratique/index.cfm

Furthermore they need to be sensitive and effective to detect even low levels of pests in large quantities of commodities or in difficult to access spots. The detection and identification of pests at the place of production is very important. Other very most important points for detection of new pests and diseases are points of entry into the EU, e.g. airports, ports or other borders. Commodities, quite often of a very large amount, have to be controlled. The decision on approval of the traded commodities has to be quick, thus time-consuming methods are disadvantageous. In addition some factors may hamper the detection of pests, e.g. the latency phases of pathogens and developmental stages of insects within the plants. But also large scale consignments or sites of production are difficult to inspect. Next to the problems described sampling methods often lack sensitivity to come up with reliable results. Pathogens can only be reliably detected at a certain minimum threshold level.

Identification of pests is one of the main fields of phytosanitary research. Detected pests have to be clearly identified to determine further proceedings. Methods for identification include morphological, serological and molecular methods. Some of these methods are labour intensive, time consuming and lengthy, especially those requiring culturing or use if plant bioassays. Other methods are not very specific or lack sensitivity. If new pests occur appropriate diagnostic methods are usually not available and need to be developed. Improvement and development of new methods for detection and identification is a rather complex process that needs time, innovation and scientific knowledge.

2.3 Eradication and control measures

When new plant pests or quarantine plant pests occur, immediate action needs to be taken to eradicate and/or to contain the pest. Effective and rapid eradication and containment campaigns at outbreaks are important to avoid further economical and ecological damage. The wider the pests are already distributed at the time of detection the higher are the costs to eradicate or contain it, and the lower the likelihood of success. Once a pest is established, eradication may not be possible anymore and control measures are then needed to reduce the impact of the pest. Some new or quarantine pests and diseases turn out to be very difficult to control. The reason might be the biology of life-cycle of the pest but also the availability of registered pesticides and their efficacy (e.g. in relation to any developed pesticide resistance) and other suitable methods to eradicate and contain the pest. Therefore phytosanitary measures mostly rely on preventing the entry of plant pests into the territory of the EU. The Glossary of Phytosanitary Terms defines phytosanitary measures as “any legislation, regulation or official procedure having the purpose to prevent the introduction and/or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests [FAO, 1995; revised IPPC, 1997; ISPM, 2002].

For commodities it is possible to apply special treatments, e.g. heat or cold treatments, controlled atmosphere, irradiation or chemical treatment. The treatments must be legally recognised as acceptable and effective. Some of these treatments might not be applicable for living plants, e.g. plants for planting and in some cases it might be more reasonable to destroy the infested batch.

Even more complicated might be the control or eradication of pests on places of production. If no chemical, biological or physical methods for control are available, which is often the

case, only strict regulations and growing restrictions remain. This might contain the destruction of all plants on the concerned field and an interdiction of a new planting. General hygiene and good management are factors that influence success of all eradication measures. This comprises the disinfection of all equipment and vehicles that had been in contact with the infested area, as well as weed control or the prevention of secondary growths. For some crops certificated seeds are available. The certification ensures that these seeds are completely free from relevant pests.

Different documents are necessary for import and export of plants inside the EU (including Switzerland) or into the EU from third countries. Plants or plant products that are listed in annex V of the EU directive 2000/29/EU need a plant passport if conveyed inside the EU. This plant passport certifies that these plants and plant products are free from quarantine organisms and that the specifications of the directive 2000/29/EC are maintained. The plant passport might consist of a tag and a data sheet or just a tag. Each concern conveying according plants or plant products has to be registered by the NPPO. Registered growers are monitored regularly by the NPPOs for their compliance with their plant passporting activities and obligations.

If permissible plants or plant products shall be imported from or exported to other countries outside the EU a Phytosanitary Certificate is needed for many plants or plant products. Export commodities (depending on the country or state) must meet certain standards or criteria outlined by the importing country or state. These plant health requirements may pertain to storage pests, plant pests and chemical treatments. The Phytosanitary Certificate certifies that the plants or plant products were inspected and conform to any phytosanitary entry requirements the importing country has set.

2.4 Surveillance

To collect dates and information on new or quarantine organisms regular monitoring is necessary. Monitoring provides information about the rate and extend of spread, as well as ways of introduction and possible establishment. According to the Glossary of Phytosanitary Terms[15] monitoring is “an official ongoing process to verify phytosanitary situations [CEPM, 1996]” and a survey is defined as an “ongoing survey to verify the characteristics of a pest population [FAO, 1995]”.

The IPPC standard on Determination of Pest Status in an Area [ISPM 08, 1998[16]] notes the definition “a pest record is documented evidence that indicates the presence or absence of a specific pest at a particular location and certain time, within an area, usually a country, under described circumstances”. Pest records are used in conjunction with other information for the determination of the status of the given pest in the area. Such information is relevant, e.g. for countries to conduct pest risk analysis, to establish pest management programmes or to

[15] International Standards for Phytosanitary Measures; ISPM No. 5, 2009; https://www.ippc.int/file_uploaded/1241701271714_ISPM05_2009_E.pdf

[16] https://www.ippc.int/index.php?id=13399&tx_publication_pi1[showUid]=13730&frompage=13399&type=publication&subtype=&L=0#item

establish pest free areas. The information on the status of a pest in the countries and regions may be used to establish the global distribution of a pest.

2.5 Scientific research

The success of eradication, containment and control measures relies on many factors. One of them is the knowledge on the biology of the pest and influence of the new environment e.g. on timeframe of pest development. Phytosanitary research projects deal with regulated quarantine pests, emerging pests with the potential to become quarantine pests and regulated non–quarantine pests in particular countries.

Research includes basic and applied research and experimental development as defined by the Organisation for Economic Co-operation and Development OECD (OECD Frascati Manual 2002[17]). Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge or the underlying foundation of phenomena and observable facts, without any particular application or use in view. Applied research is also original investigation undertaken in order to acquire new knowledge but directed primarily towards a specific practical aim or objective. Experimental development is systematic work. Drawing on existing knowledge gained from research and/or practical experience, which is directed to producing new materials, products or devices, to installing new processes, systems and services or to improving substantially those already produced or installed.

Research can fill in gaps in PRAs, both in terms if risk assessment and risk management options, e.g. research on the biology and epidemiology can help to apply detection and control methods at the most appropriate time (e.g. pheromone traps for insect pests) and to adapt control measures. Phytosanitary measures for quarantine and regulated non-quarantine plant pests must be based on scientific principles and can only be maintained with sufficient scientific evidence. Research related to diagnosis aims to provide appropriate methods for work of NPPOs. Therefore research is essential for underpinning all plant health activities, from regulation, inspection and surveillance, and action.

2.6 Phytosanitary and research infrastructure and expertise

The term “Research infrastructures” refers to facilities, resources or services that are needed by the research community to conduct research in all scientific and technological fields. This definition covers for example major equipment or sets of instruments used for research purposes, knowledge-based resources such as archives, structured information or systems related to data management, used in scientific research and any other entity of unique nature that is used for scientific research. Important parts of the research infrastructure on plant health are reference collections of quarantine pests and related taxa. Such collections need appropriate maintenance, indexing and updating as well as expertise for preparation and conservation. Free availability for NPPOs would be desirable. Another aspect is phytosanitary expertise, which relies mostly on the knowledge and experiences of scientists

[17] http://www.oecd.org/document/6/0,2340,en_2649_34451_33828550_1_1_1_1,00.html

or laboratory assistants. Training and education of staff and students is an important to maintaining the expertise.

3. Relevant impact factors on introduction and spread of new and quarantine organisms

Some conditions of modern global life including e.g., global trade, private behaviour of people, and climate change have relevant impact on the introduction and spread of new pests and diseases.

3.1 Global trade

Global trade has increased significantly in the recent years in terms of both diversity, volume and the number of new pathways. From 1999 to 2007 world-wide import of commodities into the EU has approximately doubled in value of money (from 743.3 Million Euros to 1433.83 Million Euros). The proportion of agricultural import and export in the global trade has decreased slightly in the recent years in many countries world-wide. But with increased trade quantity in total, global trade of plants and plant products has increased in the last few decades. The value of agricultural export world-wide went up from 224.117 Million US$ in 1979-1981 to 604.329 Million US$ in 2004. Not only is the trade quantity increasing but also the diversity of different products. Traditional trade pathways changed and other regions all over the world become trading partners to EU. In the recent years especially trade with Asia has increased significantly including plants and plant products.

Unintentionally, plant pests are transported along with commodities such as plants for planting (including seeds), cut flowers, grains, food, wood, soil, and plant products like furniture and wood packaging. Phytosanitary measures aim to prevent the introduction and spread of serious new plant pests and may include import bans on certain organisms or plants and plant products or specific pre-export conditions. Consignments are controlled at points of entry but the increasing amount of imported goods is difficult to deal with. The amount of interceptions is increasing in the recent years but the estimated number of undetected cases is unknown.

The more commodities are being imported and the more pathways are used the higher is the risk of introduction of new plant pests. Often detection methods for new pests are not developed and the risk of pest introduction is high; increasingly, new pests may even be completely new to science when first detected (e.g. Phytophthora ramorum and Phytophthora kernoviae). When inspection tools are laborious and time consuming inspections are costly and result in delays in trade or decay of perishable consignments. The required resources for phytosanitary inspections are increasing with escalating global trade, but the resources for the phytosanitary sector are not. This increases the necessity for commercial growers and companies to take responsibility for the production processes and the phytosanitary risks involved (cost and responsibility sharing).

Phytosanitary issues are also relevant for exports from the EU to third countries and within EU. The value of all exported commodities from the EU was nearly doubled from 1999 to 2007 (from 683.08 Million Euros to 1241.42 Million Euros). Along with export of plants and plant products undetected pests native in Europe might be transported to third countries and become invasive.

Some phytosanitary regulations of third countries pose a serious trading barrier for European producers and traders. High quality production of plants and plant products for international trade becomes essential for trade with third countries. Especially when the plant production chains include several regions world-wide, this poses a challenge for best practise in plant production, plant protection and inspections. New pests that are introduced to Europe may have significant impacts on EU exports if such pests are of quarantine significance to trading partners.

3.2 Climate change

Climate is always changing but since at least 100 years substantial global warming can be observed all over the world. 11 years of the period 1995-2007 have been the warmest since the start of comprehensive climate observations (AR4, 2007, Intergovernmental Panel on Climate Change IPCC). Climate change is also relevant for Europe. Prognoses predict further global warming possibly becoming faster in the next decades.

Climate change may significantly influence plant pests. Plants and plant pests which were not able to live in a certain area due to limitations in temperature may now find more suitable conditions in these areas as a result of increasing temperatures. In addition, a rise in atmospheric CO_2 concentration and the likelihood of sudden frosts after periods of warm weather or extreme weather conditions have an influence on plants and plant pests. These factors, with temperature as the most important one, may induce changes in life-cycle duration (rate of development), voltinism (number of generations in a year), population density, size, genetic composition, extent of host plant use as well as local and geographical distribution linked to colonization and extinction. Subsequently, whole ecosystems could be destabilised or non-native plants could become invasive and the balance of existing complex interactions between plants and plant pests may be disturbed. Due to climate change many new plant pests may be able to establish and spread more easily once introduced in Europe. The impact of introductions on plants may be increased, however, the overall impact of different factors has to be considered since the system is complex, and the synchrony between plants and plant pests plays an important role. Pests may perform principally better with higher temperatures, but then the phenology of the host plant may no longer match with the life cycle of the pest.

3.3 Invasive species

Invasive species are defined as an alien (non-native) species whose introduction and/or spread threaten biological diversity (Convention on Biological Diversity). They might out-compete native species for resources such as nutrients, light, water or food and thus endanger biodiversity in the new environment. Examples for invasive pests in the EU are *Anoplophora glabripennis* (Asian longhorn beetles) or *Bursaphelenchus xylophilus (pinewood*

nematodes), which are considered as quarantine pests. Whereas invasive plant pests including fungi, bacteria, insects, and virus are quickly identified as quarantine pests due to the obvious damage on agricultural crops, invasive plants are sometimes overseen. By the time their potential impacts are identified, they have often established already and spread significantly.

An assessment of the impacts of invasive species (Kettunen et. al 2008[18]) specifies the yearly known costs in the EU induced by invasive species on 8988.23 million Euros. Terrestrial invasive plants alone account for 2302.67 million Euros per year in the EU. These costs result from control measures and from losses from agriculture and forestry, fishery and human health. But especially the costs caused by human health problems due to for example allergic reactions on invasive plants are difficult to define. For example in Germany, the increase in allergenic and asthmatic disease heightens the costs for medical maintenance extremely. An assessment of medical costs caused by *Ambrosia artemisiifolia* in Germany (Reinhardt et al. 2003[19]) accounts the yearly sum between 19.8 million Euros up to 49.9 million Euros.

Even more complicated is the estimation of costs due to ecologic damages induced by invasive plants. The environmental impact of invasive plants ranges from wholesale ecosystem changes to more subtle ecological changes and increased biological homogeneity. Main negative ecological impacts are for example, competition with other organisms, hybridisation with native species, possible disruption of pollination, the altering of energy and nutrient flow as well as the altering of composition and function of habitats and ecosystems.

3.4 Private behaviour

Over the last decade and more, there has been a change in travel behaviour of humans. More and more people travel round the word for business and touristic purposes. Air transportation of passengers has tripled from the mid 1970s to 2000 from about 200 Million to 600 Million passengers yearly in the EU for instance. Tourists tend to bring souvenirs home. Sometimes these exotic living plants or plant parts are accompanied unintended by plant pests. Other plants intended for planting are invasive non-native species. The pests and potentially invasive plant species are introduced in small numbers only, but the impact may be significant once they have established and spread.

On the internet hobby gardeners who collect plants are able to find commercial and private traders of new exotic plants. It has become very easy to contact traders from all-over the world. Small consignments of plants and plant parts can be posted without attracting attention of plant inspectors and customs authorities. Presumably only small numbers of consignments are detected. This pathway may have a considerable estimated number of

[18] Kettunen M, Genovesi P, Gollasch S, Pagad S, Starfinger U, ten Brink P, Shine C. 2008: Technical support to EU strategy on invasive species (IS) – Assessment of the impact of IS in Europe and the EU (Final module report fort he European Commission). Institute for European Environmental Policy (IEEP), Brussels, Belgium. 40 pp. + Annexes. May 2008 (DG ENV contract).

[19] Reinhardt F, Herle M, Bastiansen F, Streit B. 2003: Economic impact of the spread of alien species in Germany. Skriptenreihe des Bundesumweltamtes Berlin, Bd. 79. Project report 20186211. 2003, 229 pp

undetected cases. With increased internet use the number of trade interactions with small amounts of plants presumably has increased significantly the last years.

Part B: Phytosanitary situation and Plant Health related research in the EU

– A Status Quo –

The current phytosanitary situation in Europe is concerning and introduction and spread of new pests and diseases appears to be increasing. More than 100 quarantine pests (including diseases) are listed in Annex I of the EU plant health directive 2000/29/EC. This annex lists pests, which are relevant to the whole community and which introduction and spread within all member states or within certain protected zones shall be banned.

Annex II of the EU plant health directive (2000/29/EC) lists whose introduction and dissemination on certain plants or plant parts is prohibited. Furthermore, EPPO lists more than 300 pests (including diseases and invasive plants) in its A1 and A2 lists and, recommends these for regulation. In addition the EPPO alert lists contain pests which may pose a threat to certain countries and should be studied to handle the threat successfully. In 2008, nearly 13,000 interceptions were notified in European countries. Approximately 96 % of these notifications have been interceptions on consignments imported from third counties to Europe. In the last years about 26 to 30 % of the interceptions have been due to the detection of harmful organisms in the consignments.

To prepare pest risk analyses for new pests and to determine measures and guidelines requires knowledge and research.

1. Research situation in partner countries

In the course of EUPHRESCO workpackage 2.2 a mapping and analysis of European and national phytosanitary research projects in the partner countries has been compiled[20]. In October 2007, the '*Report on the Mapping and Analysis of National Phytosanitary (Quarantine/Regulated Plant Health) research programmes*' was published. The current phytosanitary research landscape is described and analysed in detail including national research projects of 17 partner countries.

Around 260 recent or current phytosanitary projects were recorded via questionnaires in the partner countries. More than half of the projects fell into the two major categories of 'diagnostics' and 'intervention strategies'. The other projects dealt with PRA, infrastructure issues like collections, databases and taxonomy, and miscellaneous themes e.g. biology, impact evaluation, or climate change. The majority of projects were on mycology and entomology subjects: of 135 organisms or genera studied around 39 were fungi and 38 insects; there were 22 different viruses and 17 nematodes studied and only 7 bacteria and 7 phytoplasms. Invasive plant species were rather under-represented with only 5 species being the subject of a project (see Fig. 2). These organisms that were the subject of research projects represents only a small part of total number of quarantine pests listed in EU council directive 2000/29/EC or on the EPPO A1, A2 and Alert lists.

[20] Report on the Mapping and Analysis of National Phytosanitary (Quarantine/Regulated Plant Health) Research Programmes. EU Sixth Framework ERA-NET Project EUPHRESCO. Deliverable 2.2. November 2007. http://www.euphresco.org/public/publications/index.cfm?id=28

Around 9 genera or species were most widely studied and were the subject of projects from different countries, e.g. *Phytophthora ramorum* (14 Projects from 8 different partners in 5 countries) and *Diabrotica virgifera virgifera* (8 projects from 5 different partners in 4 countries). Most research is done on organisms that have already been introduced in a country or pose an immediate threat. According to the differences in climate and geography and therefore in agriculture, horticulture and forestry in between the member states, there is a natural variation in research interests. Still, quite a lot of countries face similar phytosanitary problems or might face them in a few years time due to increased risks of introduction, establishment and spread, or due to climate change or a possible adaption on different conditions from the pests.

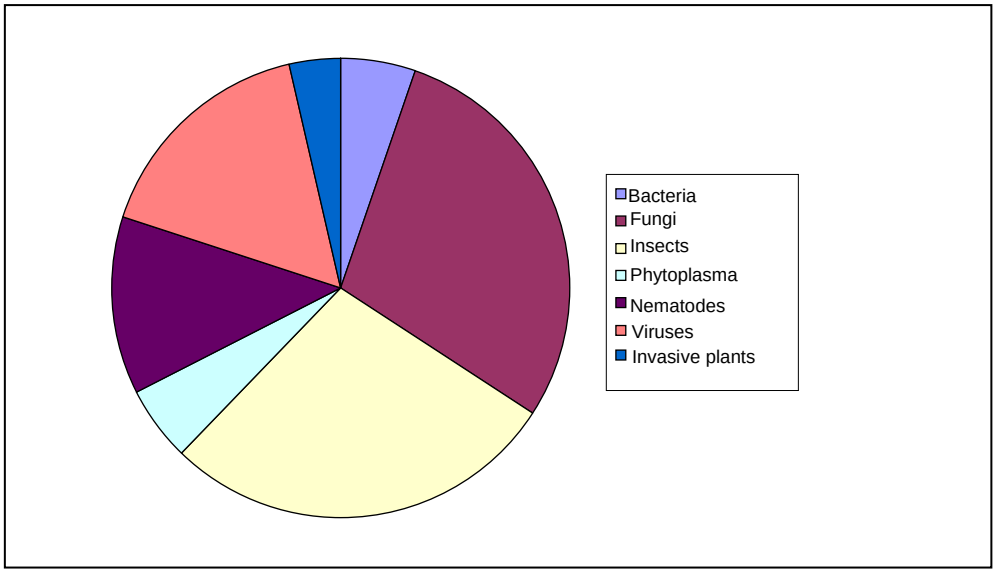

Figure 2: Averaged illustration of organisms studied in partner countries research projects

Funding is the basis of every research programme and monetary limitations restrict the volume of single projects as well as the extent of potential topics. The total amounts of annual funding in 2007 were around 15,720,480 million Euros in the EUPHRESCO partner countries. The budgets of individual national programmes range from € 40,000 to € 1,200,000 per year. Whilst some partners increased their budget in a three years period from 2006 – 2008, others decreased the amount of funding. For the national research programmes the annual budget range per project was very wide, varying from € 350 up to € 364,500 per year. The average budget for the projects was € 41,144 yearly.

To allow for shared research interests in different countries common EU-funded European projects have been done in recent years, primarily through the EU Framework Programme. As mapped and summarised in the EUPHRESCO '*Report on the Mapping and Analysis of National Phytosanitary (Quarantine/Regulated Plant Health) research programmes*', 11 European FP projects have been conducted during the last years or are still running. Subjects of EU-funded projects were for example epidemiological studies on *Clavibacter*

michiganensis ssp. *sepedonicus* (RINGROT), various risk analysis projects, e.g. for *Phytophthora ramorum* (RAPRA), Pepino mosaic virus (PEPEIRA), *Tilletia indica* (Karnal bunt risks) and pinewood nematode, or development of molecular diagnostics for EU quarantine pests (PORTCHECK) in the resent years. Currently running projects include the development of more efficient risk analysis techniques (PRATIQUE), the containment of Sharka virus in view of EU-expansion (SHARCO), DNA-barcoding for quarantine pests (QBOL) and a project of detection tools for inspection services (Q-DETECT). These last four projects are part of the ongoing framework programme FP 7. For the EU-funded phytosanitary projects in the range of EU Framework Programmes, a total of € 20,556,106 has been contributed from 1996 to 2007. The average contribution is about € 1,173,741 yearly.

2. EUPHRESCO ERA-NET project

EUPHRESCO is funded by the ERA-Net scheme of the 6th framework programme. Its aims are to coordinate phytosanitary research at the European level and especially facilitate trans-national research projects[21]. The abbreviation EUPHRESCO stands for EUropean PHytosanitary REsearch COordination. So far EUPHRESCO combines 24 partners from 17 countries: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Slovenia, Spain, Switzerland, Turkey and the UK. Partners are mainly governmental organisations involved in phytosanitary research funding or research programme management. There are six more European countries involved as observers as they do not maintain any current phytosanitary research programmes. The expert advisory group of EUPHRESCO includes representatives from the EC's Directorate General for Health and Consumer Protection (DG SANCO), the European and Mediterranean Plant Protection Organisation (EPPO), and the European Food Safety Authority's (EFSA) Plant Health Panel.

EUPHRESCO aims to enable a better coordination and structuring of phytosanitary research in Europe. The main over-arching goals consist of the development of phytosanitary research policy at EU-wide level, optimization of research provision and support of European phytosanitary policy, operations and science capability. Research on plant health issues and implementation of necessary measures needs sound funding. As budgets are restricted, EUPHRESCO aims to optimise the use of available financial and personnel resources by increasing collaboration, information exchange and coordination of research projects. EUPHRESCO also aims to coordinate its trans-national funding activities with EU-funded plant health research, ensuring complementarities. The Common Strategic Phytosanitary Research Agenda will help achieve these goals providing an agreed common vision for phytosanitary research themes and networking of funders within the next 10 years.

EUPHRESCO aims to coordinate its trans-national activities with EU-funded programmes to ensure overlaps are avoided and optimal research is commissioned. The EUPHRESCO Network Management Group (NMG) and the wider group of partners has a formal mandate

[21] http://www.euphresco.org

from the EU Council Working Party of Chief Officers of Plant Health Services (COPHS) to advice on plant health research priorities in the EU's Framework Programme 7 (FP7). Based on knowledge on national phytosanitary research activities in the partner countries, appropriate topics that are complementary to national and transnational research projects are proposed for EU-funding. In general, EU-funding is suited more to larger and/or more strategic projects of wide EU relevance. Conversely, EUPHRESCO trans-national funding is better suited to smaller, applied projects often with a narrower regional relevance and where quick research answers are needed to urgent problems.

Within EUPHRESCO, transnational research projects have been initiated in order to test and establish means of cooperation between the partner countries. An important tool of trans-national collaboration is the selection of research topics. This process of topic identification was tested via the EUPHRESCO pilot projects. The pilot projects were funded with national budgets of the partner countries. Formats for all administrative procedures related to transnational project management have been developed and summarized in a toolbook. EUPHRESCO has tested three different funding mechanisms and their associated tools and processes through to pilot research projects. The pilot calls have been reviewed and analysed so that lessons can be learnt for the future on each of the potential funding mechanisms. All pilot projects started in 2008 and ran for 12 – 18 months. Most of the projects ended in 2009 which enabled evaluation of the projects and refinement of the management tools within the EUPHRESCO project duration. All the transnational research projects commissioned directly support EUPHRESCO's aim to underpin EU plant health policy and build European phytosanitary science capability.

The three funding mechanisms tested are:

- **Non-competitive consortiums**
  A science/research problem or topic area is divided between research groups (preferred research suppliers), organised in a consortium, in different countries according to their expertise; each country pays/provides its own researchers to deliver work to the consortium according to its own contracting of commissioning mechanisms (which may be via additional funding or through existing funds); results are pooled together by mutual agreement. Such projects are non-competitive. There is no trans-national flow of funds.

- **Virtual common pot for a joint call**
  Each country pays only for the involvement of its own researchers in projects resulting from an open common call. This mechanism is competitive. Each country commits to providing funds to a virtual pot. There is competition between consortia; there may be competition between national research providers within individual countries, though some national funders may have restrictions that mean that they can fund only one specific research organisation. Once the best projects are chosen, the national funder simply meets the costs of its own researchers through its normal contracting procedures. But there is no competition between countries. There is no trans-national flow of funds.

- **Real common pot for a joint call**
  Each country provides funds into a real 'pot', e.g. in a single bank account; the best projects resulting from an open call are funded regardless of the national base of the

research organisations involved. There is competition between consortia and there is a trans-national flow of funds.

At the end of EUPHRESCO in 2010, a set of tested tools will be available for future collaboration between phytosanitary research funders.

At the end of EUPHRESCO a durable self-sustainable long term network of former EUPHRESCO partners will emerge. This network will comprise the same overall aims without direct EU funding. However, the network could be enlarged and activities deepened with additional EU funding.

3. Status Quo of phytosanitary structure in the EUPHRESCO partner countries

As part of EUPHRESCO's overall aim of increasing coordination and structuring of phytosanitary research in Europe, EUPHRESCO supports the development of more coherent European approaches and strategies for identifying plant health research needs and implementing actions to meet them.

In Europe, many countries face similar problems with quarantine plant pests, newly emerging pests and invasive species at the same time. In the phytosanitary sector the common regulatory framework provided by the EU for regulated pests and in particular new emerging pests and the risk of damages create quite similar research needs in many countries. However, there may be special regional interests in prioritising detailed research topics depending on agricultural, geographical, trading, and climate conditions. Despite this, there are many general and specific issues that are relevant to all European countries at the same time. In addition to the increasing threat through new and quarantine pests, a decline in some phytosanitary relevant topics and structures has been noticeable over recent years. This refers mainly to phytosanitary infrastructure and scientific expertise.

In the framework of EUPHRESCO, current needs on research and infrastructure were identified through workshops and discussions at national and European levels. The results were compiled and analysed. As could have been expected, there was a lot of similarity in the results. Roughly the demand on research and infrastructural elements was comparable in all partner countries and could be summarized into the relevant research priorities listed below.

- Development of modern detection and identification methods

  Currently detection and identification methods exist for many pests but quite often are laborious and cost intensive. Diagnostic confirmations can take many days or even weeks or months, depending on the methods. During that time, commodities have either to be stored somewhere, allowed to be imported or destroyed without final confirmation. In addition on-site methods for easy application at places of entry, e.g. ports or airports are lacking.

- Support for pest risk analysis (PRA)

  At the moment it often lacks in comprehensive knowledge of the pests concerned as well as in relevant environmental conditions, impact of climate change or other factors influencing the dissemination of pests.

- Support for phytosanitary research infrastructure and expertise

  As funding has been scarce on projects concerning fundamental taxonomic research or the maintenance and accessibility of collections and archives, expertise in these areas is declining. The lack of money results in loss of knowledge and expertise because retiring scientists were not replaced. Relevant collections cannot be managed optimally and maintained properly and are often not available for other scientists. The number, availability, and quality of existing collections are insufficient to support phytosanitary research sufficiently. Taxonomy and classification are the foundation of regulation.

- Basic phytosanitary research

  Before EUPHRESCO, research relating to phytosanitary issues was mainly done at national level, even though policy is mainly determined at the EU level via DG SANCO's Standing Committee on Plant Health. Results were only partly published broadly. The approach of trans-national research is an important step. Still many aspects of necessary basic research can't be executed by EUPRHESCO alone. For PRA's a broad knowledge on different aspects is needed, that has to be aspired by different institutions, e.g. universities or research institutes. These aspects might include climatic conditions, geographical aspects, biological information or the effect of certain treatments. Furthermore bio molecular methods that might offer relevant information about genetic aspects, virulence or even resistance are often under developed. The co-operation between scientists and research institutes from different fields is not optimally utilised.

- Investigation of climate change impact

  As climate change might have a big impact on the dissemination and especially the acclimatisation of different pests, information in this field of research is extremely relevant. It ranges from the direct effect of different climate change scenarios on specific pests to the changes in the environment that might have an influence on the pests. So far it lacks essential information for a broad range of pests. This includes the potential possibilities for adaption for new pests as well. As the development of climate change is currently only to be guessed, different models on temperature development etc. are needed.

- Development of eradication, containment and management methods (intervention strategies)

  Currently most existing strategies rely initially on regulation (legal restrictions for import and export of plants and plant products). When introduction do occur however, then methods for eradication, containment and management are required. Partly, eradication measures for certain pests or commodities are often lacking. Commercial

growers and companies are not adequately involved into the risk minimisation processes. The implementation of management strategies is often a time-intensive procedure and often very expensive. In addition the transformation of results into legal frameworks takes a very long time. The plant health system needs occasional evaluation to ensure that processes for ensuring compliance are still adequate.

In addition to these roughly classified research themes, partners expressed the desire for better national and international cooperation and the optimisation of research funds. Both aspects are considered important aims of EUPHRESCO itself and are therefore components of all EUPHRESCO activities.

The transformation of these overarching and generic research areas that have been identified into more specific implementation of projects is an important part of this Common Strategic Phytosanitary Research Agenda. It includes the definition of an aspired phytosanitary future as well as the formulation of reasonable aims that might be obtained in a nearer future. The enhancement of the research priorities listed above will play a decisive role in the next years.

In conclusion: Research is needed to underpin all aspects of the phytosanitary system, from regulation (supported by pest risk analysis) to surveillance (supported by tools for detection and diagnosis) to action (supported by tools for eradicating, containing or managing regulated/quarantine pests). Trans-national research also especially plays a significant role in maintaining and developing European phytosanitary scientific capability through collaborative projects.

Part C: Future strategic approach

– From current status to a future vision? –

The number of quarantine plant pests, plant diseases and invasive plant species arriving and establishing in Europe has increased in recent years and is predicted to increase over the next years as global trade in plants and plant products continues to expand and as new trade pathways develop.

This may be exacerbated by climate change, by continued EU expansion and by the decline in resources and expertise in the phytosanitary area (EPPO State of Emergency in Plant Health, 2004). A sustainable and efficiently structured phytosanitary system is essential to meet these challenges - nowadays and in the future. From the research needs defined by the EUPHRESCO partners during the national workshops held in 2008 and 2009 a vision for how research might fit into a future phytosanitary framework could be derived.

1. A vision for Plant Health in the future

The ideal phytosanitary system would not allow any quarantine, regulated non-quarantine or new emerging pest to be introduced into any European country where it is not distributed already. Phytosanitary inspections would ideally discover any such pest already prior to introduction and eradication measures would be a hundred percent effective. Growers and traders would source materials sensibly and control and treat their commodities thoroughly to prevent spread of these pests. Private people would refrain from bringing flowers, fruits and vegetables along from travels or importing plants or plant products via different ways if not certified as being free of pests.

This list could be continued, but such ideals are of course unrealistic. Next to the aspects not being controllable by humans as climate change effects or active dispersion of invasive species, the behaviour of people being growers, breeders, traders or just private persons on travels is unpredictable and only to a certain extend controllable. In addition new pests not known so far might be impossible to detect.

Nevertheless, even if not perfect, the goal should be to come as close to that ideal as possible. It will need a combination of different components and activities to reach that goal and most of all the participation of as much partners as possible.

The common strategic phytosanitary research agenda is one component of the approach to an improved phytosanitary system. It aims to include research needs and phytosanitary infrastructural requirements of the partners for the next years and will be revised regularly to stay up-to-date. It is based on the national research agendas and depends on the activity of all partners providing the necessary information. Partners will have national priorities that might often be similar to each other, though naturally priorities may differ. It will be a major aim of the common research agenda to combine national priorities and to define common goals within a European-level context, e.g. supporting EU policy and EU-level initiatives that emerge from the COPHS or via the commission and member states (e.g. increased collaboration between diagnostic laboratories). To decide which priorities are appropriate for common activities will demand an active participation from all partners again. EUPHRESCO aims to support trans-national research cooperation at a range of scales. This can be: at the EU-wide scale, either through trans-national projects relevant to all partners or trough coordinating trans-national research and EU-funded research; at the regional (zonal) scale,

where countries in a region share common problems as a result of their similar climate and crop types; at the bilateral level, where even just two countries share a common research need or interest. As such, the common strategic phytosanitary research agenda could be considered a helpful tool to identify important research areas, to summarise national research and structural requirements and to offer a strategic approach to solve emerging problems with the overarching goals to:

- Assure imports to, transit within and exports from Europe of plants and plant products based on harmonized and technically justified phytosanitary measures
- Protect plant health (agriculture, horticulture, forestry and the environment) from quarantine and emerging pests through appropriate and science-based phytosanitary measures

The necessary improvements and strategic approaches to reach these goals will be defined in the following chapters.

2. National needs and common research areas

Research and science are an essential part of the phytosanitary system and they directly underpin plant health legislation and the operations that implements policy. The EUPHRESCO Network of national or regional (sub-national) funders and managers of plant health research programmes aims to more effectively coordinate the research that is one of the key pillars of a phytosanitary system. Part of this process is the identification of plant health research needs and the implementation of actions to meet them.

In Europe, many countries face similar problems with quarantine plant pests, newly emerging pests and invasive species at the same time. In the phytosanitary sector the common regulatory framework provided by the EU and the risk of damages create quite similar research needs in many countries. However, there may be special regional interests in prioritising detailed research topics depending on agricultural, geographical, trading, and climate conditions. Despite this, there are many general and specific issues that are relevant to all European countries at the same time.

In the framework of EUPHRESCO, current research needs and priorities can be assigned into some general research areas with equal relevance, as identified through workshops and discussions at national and European levels. The main research topics relevant for the next years will presumably fall into these broad research areas. From the strategic point of view, EUPHRESCO partners will need to consider what research is most appropriate for national funding, for trans-national funding and for EU funding.

Naturally not all points required might be achieved in the next years. Nevertheless, the ideas and requests of the EUPHRESCO partners on the progression of phytosanitary research, deduced from the national workshops, are listed below and give an overview of what should be approached over the next years.

Detection and identification methods (laboratory and on-site methods)

Tools for the detection and identification of regulated and emerging pests are indispensable for official plant health services as well as for commercial growers and companies. Therefore, a main area for common research will be the further development of fast and reliable diagnostic methods that meet the needs of the NPPOs in many different situations e.g. monitoring in infested or pest free areas, tests of imported and exported consignments, delimitation of zones, confirmation of eradication efforts, etc. The further enhancement of molecular techniques will complement conventional diagnostic methods and will provide sound and sensitive identification of pests. Modern diagnostic methods should therefore fulfil the following requirements:

- ✓ Be fast to avoid delays in trade
- ✓ Be specific, sensitive, and reliable in order to provide the NPPOs and customers with the required confidence in the results
- ✓ Be user-friendly and suitable for routine detecting and potentially identifying pests, not labour intensive, and enable high throughput
- ✓ Be practicable and robust for use in different circumstances, including on-site locations
- ✓ Be cost-effective

Diagnostic approaches include detection and identification of the pest. Modern methods for detection should be able to reliably find the pests in an area, in plants and plant products e.g. at place of production or in consignments. This includes e.g. trapping methods, methods to detect pests in latently-infected plants where no symptoms are visible, and preferably using non-destructive methods.

Also, national reference laboratories and collaborations between countries may benefit from diagnostic knowledge and methods adapted to their specific needs. Methods included in diagnostic protocols developed at the EPPO or IPPC level may be evaluated and ring tested in the EUPHRESCO framework and thereby provide a more reliable basis for the harmonised application of methods by the NPPOs ensuring comparable results of the tests in different countries, as well as contribute to increasing broader scientific capability across European countries. The compliance with special quality standards for diagnostic activities of laboratories as described in the EPPO standard PM 7/98[22] aiming for the accreditation according to ISO/IEC Standard 17025[23] will ensure transparency, comparable results and a high standard for laboratories.

If formulated as concrete aims, the phytosanitary future in the research area of detection and identification methods should include:

[22] EPPO (2009): Specific requirements for laboratories preparing accreditation for a plant pest diagnostic activity. EPPO standard on phytosanitary measures PM 7/98
http://www.eppo.org/index.htm
[23] ISO/ IEC Standard 17025: General requirements for the competence of testing and calibration laboratories

- ⇒ The development of adequate methods, that fulfil the above mentioned specification for the most important quarantine and regulated non-quarantine pests
- ⇒ Adequate validation and evaluation of methods described in the diagnostic protocols
- ⇒ Establishment of reference laboratories in the partner countries
- ⇒ Enhancement of the molecular techniques available for detection and diagnosis
- ⇒ Increased development and use of on-site detection tools by inspection services

To reach these aims it will be necessary to determine the most important quarantine, regulated non-quarantine and even possible new pests for the partner countries. Available methods should be compared and disadvantages of single methods should be noted. Laboratories have to be equipped in an adequate form and personal has to be trained. Ringtests on mandatory methods should be executed regularly.

Phytosanitary research as the basis for PRA'S

Phytosanitary research should provide a sound basis for quarantine or regulated pest related tasks. Knowledge on pests, their natural environment and their adaption potential are relevant for developing PRAs and for filling in gaps in pest-specific or commodity-specific PRAs. Molecular technologies can provide a link to biological and epidemiological characteristics and can produce knowledge on resistance of plants or virulence of certain pests.

As relevant pathways relate to the question of dissemination of pests, it is important to identify early whether there is any chance that the pest could enter the PRA area. Pathways could be for example plants or plant products from certain countries or areas, any means of conveyance, tourists or anything else that is able to carry or harbour viable plant pests. It is also important to know the volume of pathways (e.g. certain plants for planting, wood packaging material, cut flowers) and frequency of movement of risk commodities along pathways.

With regard to the biology and the ecological aspects of the pest, the basic requirements concerning climatic and other abiotic factors conditions, the host plants needed, the life cycle and reproduction rate are important factors to be considered for the assessment whether the pest would be able to establish and spread. Origin and distribution of the pest give indications about some of these factors and thereby about the potential of the pest to establish and spread in the PRA area, but often, essential information about the organism is missing and can only be obtained by experiments or field observations. Especially for newly emerging pests, research needs are high and urgent. Broad research background is essential to provide the adequate range of information, to allow for correct and needed PRAs as well as for phytosanitary justification.

If formulated as concrete aims, the phytosanitary future in the research area of basic phytosanitary research should include:

- ⇒ Knowledge of relevant pathways for quarantine, regulated non-quarantine and new pests to enter the PRA area - in this framework – the European Union

- ⇒ Knowledge of the biology and ecological requirements of quarantine, regulated non-quarantine and new pests
- ⇒ Knowledge about production methods and other factors related to early detection of quarantine, regulated non-quarantine and new pests
- ⇒ Knowledge of potential impacts caused by quarantine, regulated non-quarantine and new pests
- ⇒ Knowledge about the PRA area itself
- ⇒ Information regarding eradication, containment and control measures

To reach these aims a huge amount of research will be necessary. It will be unlikely that research on all relevant pests can be accomplished. Therefore, next to the definition of the most important pests where this kind of research is needed, cooperation with different institutions of research like universities or different research institutes should be aspired. This refers not only to institutions on EU level but worldwide as important information on relevant pests might be gained from countries of origin of these pests.

Pest risk analysis

Pest risk analysis (PRA), comprising pest risk assessment and pest risk management, is a central element of plant health. The more details about climatic conditions and other abiotic factors, presence or absence of host plants, vectors, suitable habitats etc. are known, the more substantiated a PRA would be.

The decision on phytosanitary measures e.g. legal action and eradication and control measures depends on sound information on the pest concerned. Therefore a pest risk analysis needs to fulfil defined terms. The ISPM 11[24] contains specifications and regulations for PRA's, in addition a regional standard consistent with ISPM 11 has been developed (EPPO Decision support scheme[25]) which was the basis for the preparation of the EFSA publication 'Guidance on a harmonised framework for pest risk assessment and the identification and evaluation of pest risk management options by EFSA'[26]. Data about concrete economic, environmental and social impacts where the pest is already present have to be collected and to be extrapolated to the situation and conditions in the EU – the amount and value of host plants/crops that could be affected by the pest, the ecological functions and ecosystems that may be unbalanced, and the social conditions that might be deteriorated by the introduction of the pest. The EU-funded project PRATIQUE is currently collecting these data as far as they are available. Identified gaps will present future fields of research and exploration.

[24] ISPM 11: Pest risk analysis for quarantine pests including analysis of environmental risks and living modified organisms https://www.ippc.int/index.php?id=1110798&tx_publication_pi1[showUid]=34163&frompage=13399&type=publication&subtype=&L=0#item

[25] PM 5/3 (4): Decision-support scheme for quarantine pests http://archives.eppo.org/EPPOStandards/pra.htm

[26] EFSA (2010): Guidance on a harmonised framework for pest risk assessment and the identification and evaluation of pest risk management options by EFSA. EFSA Journal 8 (2), 1495

Uncertainty is an inherent part of PRA and its degree and possible consequences with regard to the estimation of risk need to be recognized and made transparent – with high uncertainty, technical justification of phytosanitary measures is difficult or even impossible, and trade restrictions based on such highly uncertain PRAs may be challenged as unjustified barriers to trade. However, if the potential risk is very high but quite uncertain, it may be dangerous not to implement phytosanitary measures. Therefore, the more the degree of uncertainty can be reduced, the more reliable the result of the PRA. A first step for this reduction is the documentation of uncertainty, as it will identify and prioritize research needs.

In case a phytosanitary risk has been identified, management options need to be explored and assessed that would reduce the risk to an acceptable level in relation to cost-benefit analysis. Especially with regard to new emerging pests, lack of information regarding control and eradication measures may hamper the process of the PRA and the consequences being drawn from its results.

If formulated as concrete aims, the phytosanitary future in the research area of PRA should include:

- ⇒ Gathering of necessary information on specific pests
- ⇒ Correlation of PRA with climate change effects
- ⇒ Regular cost-benefit calculations
- ⇒ Availability on concrete data about economic, environmental and social impacts
- ⇒ Meaningful communication of risk and uncertainty

To reach these aims it will be necessary to insert a lot of input into the subject of PRA's. The current project PRATIQUE will offer some solutions and answers to current problems as well as the EFSA project ('Pest risk assessment for the European Community plant health: a comparative approach with case studies'). The complex process of PRA requires a lot of expertise that needs to be provided jointly by all partner countries.

Management and intervention strategies

The introduction of new pests needs immediate action on eradication, containment and control measures to be taken. Chemical eradication is increasingly difficult due to withdrawal of pesticides and increasing resistance to those available for use. This highlights the need to prevent introductions in the first place. On many new pests sufficient information for establishing effective strategies is still missing.

Phytosanitary research should provide a sound basis for development and further improvement of eradication, containment and control measures. The control and management measures need to be effective, not harmful to the environment, sustainable, and cost-effective.

If formulated as concrete aims, the phytosanitary future in the research area of management and intervention strategies should include:

- ⇒ More effective strategies to prevent introduction and spread of quarantine, regulated non-quarantine and new plant pests
- ⇒ Emergency and contingency plans
- ⇒ Effective alternatives to chemical control e.g. integrated pest management, biological control methods
- ⇒ Strategies to fill gaps related to effective measures
- ⇒ Efficient treatment techniques for infested plants and contaminated plant products
- ⇒ Efficient treatment techniques for waste contaminated with quarantine pests
- ⇒ Development of effective and feasible containment measures
- ⇒ Cost-benefit analysis of management options
- ⇒ Knowledge about production procedures and chains to detect critical points for measures

To reach these aims it will be necessary to include the most innovative knowledge including experience and results from related disciplines. Much research will be necessary to come to the aspired strategies and methods. Treatment techniques have to be soundly tested for different pests.

Phytosanitary research infrastructure and expertise

A high quality research infrastructure is one of the prerequisites for preventive and reliable research on quarantine and new emerging pests and comprises comprehensive reference collections of relevant organisms as well as the related scientific expertise. Existing national reference collections of pests have to be preserved and enlarged and made more accessible. Establishment of new collections for not yet existing pests should be supported. In the context of molecular diagnostics databases are of main concern. For greatest benefit the collections and databases should be made open for researchers from partner countries. Information management about the collections and databases needs to be completed and communicated to relevant diagnostic and research institutions.

On the one hand, research infrastructure is needed for phytosanitary research. On the other hand, scientific knowledge and expertise is essential to keep infrastructure modern, well useable and effective, e.g. knowledge on storage methods for organisms and impact of long-term storage on the organisms. Modern collections, achieves and databases must also be cost effective.

Expertise in different fields is essential for maintenance of the phytosanitary system, especially research and diagnosis of pests. To provide expertise and to counteract critical erosion of expertise an improvement of academic education is needed. Plant health aspects can be integrated into corresponding study courses, classical taxonomy in education should be supported and expertise in taxonomy must be maintained for instance by sustainable research projects. Prioritisation of research topics must consider improvement of expertise as one of the selection criteria. Another point will be the transnational training on detection and identification methods. In this respect, uptake of on-site methods more consistently across member states' inspection services should be a goal.

Publishing and collecting of results and experiences will help to maintain knowledge and expertise. On this note regular update of already existing databases (e. g. EPPO database) should be supported by network partner countries and a knowledge exchange with third countries will be aspired. Joint efforts could help optimise the scientific background of modern and innovative infrastructure in Europe. Inclusion of results from other relevant disciplines is essential to secure innovation in research and best management of collection and databases. A project proposal for FP 7 on phytosanitary infrastructure was developed and submitted, supported by EUPHRESCO. It was not successful and the identified infrastructure needs remain unaddressed.

If formulated as concrete aims, the phytosanitary future in the research area of phytosanitary research infrastructure and expertise should include:

- ⇒ Molecular diagnostic databases
- ⇒ Well preserved and maintained reference collections
- ⇒ Easy access to such collections for scientists and inspectors of NPPO's
- ⇒ Support and preservation of expertise
- ⇒ Enhanced education on phytosanitary issues
- ⇒ Inclusion of phytosanitary topics in university courses
- ⇒ Adequate trainings for scientists, university teachers and personnel of NPPO'S

To reach these aims it will be necessary to gather information about existing collections and their status. If necessary, different collections might be combined to ensure completion and easier maintenance. Databases should be registered and completed by all partners. If hosted on universities or other research institutes, arrangements might be necessary to secure the most benefit for all sides involved. The enhancement of education and training on phytosanitary subjects might need assistance from governmental organisations in the partner countries. As a sound research infrastructure and comprehensive expertise is the key to innovative high quality research these aspects are considered important. To ensure a good infrastructure is mainly a part of national policies but should be amended by transnational arrangements.

Climate change

Climate change has an impact on many aspects of the whole phytosanitary system. In Pest Risk Analysis consequences of climate change need to be considered. Climate change can have an impact on the detection of pests e.g. via trapping because of changed timeframes of development. And management and intervention strategies may be influenced by different climate.

Climate change can have a direct effect on the development and growth of plants. Not only with regard to increased temperatures, but also with regard to the concentration of atmospheric CO_2 which has increased significantly in the last decades. Climate change may also have effects on pests, for example, if higher temperatures increase the number of individuals and accelerate development, resulting in earlier infestation of host plants, higher infestation rates, and increased number of generations. On the other hand, climate change

may have negative effects on pests from temperate climates. Though individuals may develop faster at higher temperature and survival may even be enhanced, they may consequently have lower adult weight and fecundity. But there are not only direct effects on plants and pests, but also indirect ones. For example, to successfully complete life-cycle, host specific pests require close synchrony with the phenology of their host. This synchrony could be disturbed, with negative consequences on entire ecosystems. This represents a large area for research.

If formulated as concrete aims, the phytosanitary future in the research area of emerging challenges should include:

- ⇒ Identification of suitable indicators for the influence of climate change on plant health
- ⇒ Development of a monitoring network to generate relevant data for the prediction of future spread of harmful organisms
- ⇒ Development and establishment of suitable, widely accessible databases for the generated data
- ⇒ Models of climate change in different scenarios
- ⇒ Knowledge about the impact of different climate change scenarios
- ⇒ Development of risk management options for phytosanitary pests under changed climatic conditions

To reach these aims a broad basis of research will be necessary. This area displays a good option for cooperation with different disciplines as most information might be obtained from institutions not specialised in plant health but maybe geography, meteorology or ecology.

Aspects of all research areas cannot be considered on their own but will overlap in wide range. Research in a specific area will affect other areas and results might have influence on different areas as well.

3. Common strategic aims for trans-national research cooperation

Resulting from the previous chapters some summarising common strategic aims were defined. The common strategic aims are an important component of cooperation and will facilitate future course of action. They have to be rated as a rough guide on future phytosanitary research and cooperation.

1. To develop effective and unburreaucratic processes and tools for facilitating trans-national research coordination, cooperation and collaboration framework

2. To develop reliable tools for information exchange and information management in order to better support regulatory policy and early-warning systems (i.e. research responsiveness to emerging threats)

3. To develop modern methods for prediction, monitoring, and managing of regulated and emerging plant pests, including:

    - Reliable, cost effective and approved methods for the detection and identification of quarantine and new pests
    - Effective methods for the eradication, containment and management of quarantine and regulated plant pests

4. To optimise phytosanitary research infrastructure and a sound scientific base of expertise, including:

    - Development and maintenance of national reference collections of plant quarantine organisms and their availability and accessibility for research hand diagnostic purposes
    - Related education, training and building of expertise

5. To further explore the impact of climate change on pests of phytosanitary concern and development of appropriate methods to adapt the phytosanitary systems if necessary

6. To further recommend phytosanitary topics for inclusion in future framework programmes of the EC and to ensure coordination between EU-funded and trans-national research to ensure value for money

7. To support a strong and innovative phytosanitary research landscape in Europe, sufficient connected to related disciplines, e.g. plant protection and with the integration of important stakeholders

8. To improve integration of commercial stakeholders in reducing introduction and spread of new pests

9. To enhance public relation strategies to raise public awareness for phytosanitary problems

10. To develop strategies for a quick and effective commissioning of trans-national research in response to urgent emergency policy and operational needs

4. Pooling of resources through cooperation

Considering the chapters above it can be summarized that research funders in Europe, at both national and EU levels, should provide sufficient resources to ensure that research is commissioned against the key research areas so as to maintain and improve the whole phytosanitary system. It is recognised by partners that we cannot change the future challenges for plant health e.g. amount of global trade, increasing travelling activities and climate change. But we can optimise reactions towards increasing threats by close

cooperation and coordination. Team work is known to provide best solutions to difficult situations.

Plant health regulations contribute to reducing potential risk from exotic pests. Policy is responsible for decision making on appropriate phytosanitary measures that can only be identified and imposed when based on sound scientific knowledge. The policy-driven decision process needs to be supported by science and research. EUPHRESCO aims to intertwine national programmes of phytosanitary research at the national level and to promote increased cooperation, thereby contributing to the preservation of one of Europe's most important economic and natural resources, the plants.

The co-operation will provide a number of benefits. It will help funding agencies to decide on competing research themes based on a comprehensive, sound and coordinated strategy. The work will also foster expertise in this challenging field and thus improve Europe's scientific capabilities and competitive position. Furthermore in times of tightening resources, it is indispensable that funders use their research budgets as effective as possible, preventing duplication and pooling resources where appropriate to achieve common goals. Research results should provide a maximum of short-term usability and at the same time provide innovation in the long run. National research funds need to be optimised by trans-national coordination and cooperation. Research cooperation will enable partners to efficiently use national or EU-based budgets for the best obtainable achievement.

In general, phytosanitary challenges do often affect most European countries in a similar way at the same time. Common solutions are therefore needed. Phytosanitary research has a Europe-wide interest and needs transnational priority setting. Only then can Europe maintain and develop its critical mass of phytosanitary expertise to meet current and future plant health challenges. Such co-operation reduces duplication and can achieve more through the pooling of resources than can be achieved through small national programmes alone. In particular, it is important that EU plant health policy is supported by EU-level research.

5. Networking for Plant Health future

The research areas described above will be of main concern for the next decade and the EUPHRESCO partner countries are willing to take this challenge for the future. To achieve these ambitious goals three important basics have to be provided to guarantee adequate phytosanitary research:

- Sufficient funding at national level
- Trans-national cooperation and collaboration
- Continuing EU funding support for larger and for more strategic R&D projects

A sustainable network of funders supports better research financing policy and assists in optimising the design of national programmes by information exchange. On this note EUPHRESCO aims at the implementation of a durable, self-sustainable long-term network of national and regional funders, as defined in the existing contract in the description of work package 5.2 (Annex III). Such a network allows for an appropriate involvement of

stakeholders' views and needs and provides for conformation and coordination of research policies in Europe. This network shall allow for continuation of current EUPHRESCO aims and activities. As advancement compared to existing EUPHRESCO structures requirements on the network comprise additional partners and additional activities. Though, during the project meetings partners expressed the need of an administratively light network which requires only a small level of national resources but provides all benefits of transnational cooperation. The development of such a network structure is an agile process needing the contribution of all partners to fulfil the following requirements:

- ✓ Allow for strong cooperation and critical mass of the involved partners
- ✓ Permit the flexible cooperation between partners at a range of levels and scales (EU-wide, regional, bilateral) and with third parties
- ✓ Enable quick reactions to recent or new problems
- ✓ Comprise larger projects on important subjects
- ✓ Ensure communication and contact with EC, EPPO, EFSA and other important organisations as well as with other countries
- ✓ Provide information about projects and research results
- ✓ Offer connection with other ERA-Nets or networks
- ✓ Fortify the collaboration with other areas (e.g. IPM; social sciences etc.)
- ✓ Can be administered without huge additional costs and efforts
- ✓ Identifies and addresses barriers to cooperation

The three over-arching strategic aims for the network can be summarised as followed:

- ❖ Develop phytosanitary research policy at the European level
- ❖ Optimise the research provision that underpins EU quarantine plant health policy development and policy implementation, in an era of increasing bio security threats from alien plant pests, diseases and invasive species
- ❖ Increase the capacity of European phytosanitary science and research in order to prevent the disappearance of EU expertise in this field and maintain Europe's competitiveness in the global market

One of the main activities of the network therefore is the initiation, funding and evaluation of transnational phytosanitary research projects. Research topics will be identified trough regular communication and discussions. The network will establish phytosanitary research agendas, and evaluates impact of research on plant health policy. Knowledge gaps and research needs in plant health will be identified. The range of initiated projects aims to close the gap between national and EU financed activities. By that financial resources and research infrastructures could be used effectively together at a transnational basis.

Further objectives comprise:

- Close cooperation with the COPHS and maintenance of the COPHS mandate to advise the EC on plant health topics suitable for EU funding
- Communication of phytosanitary issues and activities in order to achieve an appropriate level of coordination with other research funders
- Improved interaction with stakeholders at national and at EU level
- Enlargement in order to enhance the positive effects of cooperation.
- Alliance with new partners from countries in the European and Mediterranean region and enhance cooperation with other countries more internationally, e.g. non-European countries with similar plant health problems, or 3rd countries that are the source of pest problems for the EU
- Increase of public awareness to phytosanitary problems

The network activities will require active participation of the partners and regular contributions. The main benefits for network partners will be the synergistic effects and sharing of results as well as information exchange e.g. about national and transnational research projects and activities and research infrastructure in partner countries.

6. Network of Plant Health research funders

The network basis is formed by European partners who are research funders or at least research programme managers. Partners (including potential new partners) have to come from countries within the EPPO region. The countries should possess phytosanitary research programmes for taking an active part in the network. The envisaged network will consist of its partners including a network coordinator, network secretariat and network management group (NMG) (Fig. 2). Stakeholders may be involved in the network as associated partners. The network especially considers advice from the networks advisory groups: EPPO, COPHS; DG SANCO and its Standing Committee an Plant health, DG Research and EFSA. Relevant information about network activities is distributed to the advisory group, associated partners and is made public according to the networks dissemination plan.

The detailed network structures and management conditions will be described separately in a *modus operandi* (see EUPHRESCO deliverable DL5.1). A concrete action plan will cover the network activities and responsibilities within periods of two years and therewith complement the common research agenda. To initiate transnational research projects priorities of research topics will be assessed each year in alignment with the strategic considerations of the research agenda.

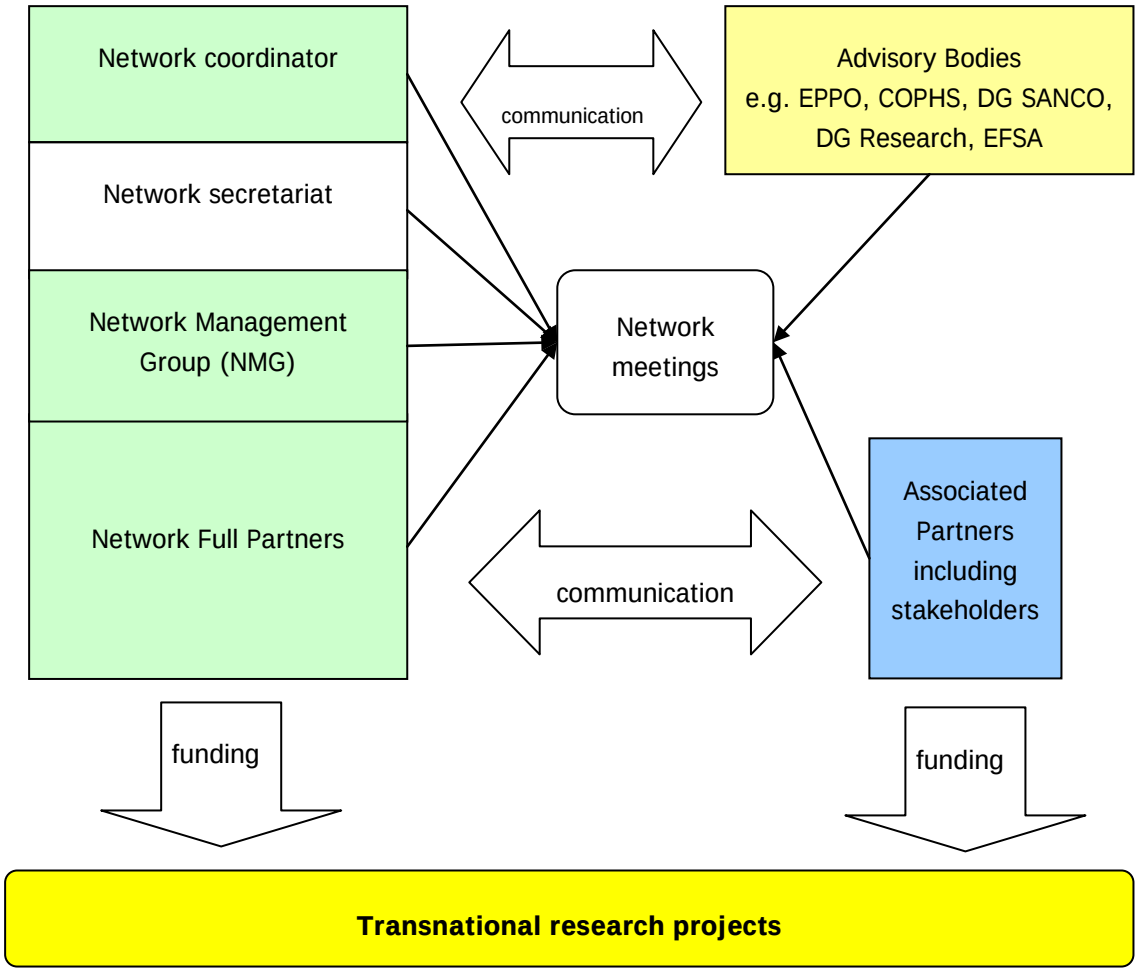

Figure 2: Key structure of the network of phytosanitary research funder

6.1 Initiation and management of trans-national projects

The planning, funding and realisation of trans-national projects will be the main task of the network. Initiation and management processes of this procedure are therefore extremely important. The administrative procedures for transnational project funding have been developed, tested and refined in the current EUPHRESCO project. An operational handbook has been developed that provides all formats required for the administrative steps involved (see EUPHRESCO deliverable DL4.2). The tools have been developed taking into account that administration should be as light as possible. Jointly funded transnational research projects should be developed and initiated fast. They will focus on main phytosanitary needs as defined in the research agenda. Transnational research projects are funded with national budgets of the participating countries. Interested partners need to allocate appropriate budgets for the research projects, regardless of which funding mechanism is chosen for the project. The future of the envisaged network will largely depend on the availability of resources for joint projects.

Topic identification and selection

Topic identification might take place any time. The topic selection should take place at certain times, at least once a year e.g. during the network meeting for the year to come. After the initiation of only long-time projects when the budgets are exhausted the selection process might be discontinued till the close end of the projects. The network coordinator is responsible for moderation of the topic selection process and assures that advice for topic selection from the advisory group is included in the topic selection process and complementary with EU framework programmes is guaranteed. Topic selection is a process of discussion and majority selection. Still transnational research projects do not always have to have a Europe-wide interest. Local and regional particularities can be taken into account when research topics are selected and discussed. Transnational projects may have a regional focus e.g. on certain crops or growing conditions. In case of emergency, partners could initiate transnational research projects in between. Selected topics should meet the following criteria:

- ✓ National priorities of the participating countries
- ✓ Collective interest of at least two countries in one particular topic
- ✓ Transnational relevance or European added value e.g. counteract eroding expertise at the European level, topic can serve as a model, meets the challenge of global trade, helps achieving financial critical mass
- ✓ Synchronisation with / strengthening of other EU-level plant health agendas and activities, e.g. complementary and not overlapping with EU-funded themes, in line with COPHS and EPPO initiatives and research priorities, support of EU policy need for a given pest

The ongoing topic discussion process in compliance with the identified strategies of the research agendas will ensure up-to-date priorities and that phytosanitary research tackles the main plant health problems and seeks for solutions of outstanding problems. Information exchange on research needs and common topic selection for joint research projects supports the coordination of research activities in the partner countries.

For each topic a topic coordinator should be appointed who is responsible for the main coordination of the topic, preferably a volunteer with expertise in the topic. The topic coordinator supported by the network secretariat is responsible for coordinating further activities of the funding consortium. Topic proposal process should start shortly after topic selection. Involved partners should develop a short topic description giving information about the topic but no methods for solutions. Topic proposals will be aligned and refined jointly by the involved partners.

The network developed mechanisms and instruments which are suitable and adaptable for larger and smaller projects. Partners are flexible in their use and can initiate new projects fast, dependent on the partners involved and the topic. Dependent on the topic content, the focused time and complexity the same three different funding mechanisms as during EUPHRESCO are available so far. The non-competitive (NC) mechanism does not need a call and a call management respectively a proposal selection process. The VP and the RP do need these processes.

Call management

If the topic will be funded via competitive mechanisms such as a real common pot (RP) or virtual common pot (VP) a call is necessary. The operational handbook developed in the frame of EUPHRESCO provides tested and refined tools and mechanisms for project management with all tested funding mechanism including general roadmap for call management. Adequate tools might be chosen by the topic coordinator and the partners including peer reviewing etc.

Administration of joint calls might be done by the network secretariat. But funding partners can do administration of transnational projects including call management on their own. The decision on how to organise the transnational activity is up to the funding consortium. If a call secretariat is needed the involved partners have to arrange this matter on their own including financing of the secretariat. It should be thought about possibly spending some part of the projects budget for administrative activities like a call secretariat. These matters have to be discussed further. The duties of a call secretariat might comprise the following:

- Call administration including call announcement, call proposal, call management, technical support, assistance of the national funding bodies during call implementation and follow-up phase
- Administrative support of funding consortia including proposal evaluation
- Administration of peer reviewing process including collection of nominations for peer reviewers and facilitation of contact with peer reviewers
- Administrative support of report evaluation

Projects execution

After the call respectively for projects with NC funding after finishing of topic proposal the project might start. All cooperation varieties in different projects should be regulated by contracts e.g. project duration, funding modalities and division of work. Each funder involved in transnational projects is responsible for national contracts. Details are described in the agreed roadmap of the certain funding consortium.

Supervision of projects usually takes place at the national level as well. If appropriate, depending on project duration and volume, progress reports might be prescribed after defined periods, e.g. after each year or at half of the project duration.

After the end of the project a written report has to be provided by the project coordinator. The form of the report depends on the funding mechanism respectively might be adjusted to the requirements of the funders and will be defined in contracts at project start. Report formats might be provided in the tool book. A quintessence of the research results should be published on the networks website respectively a database together with information on project duration and involved institutions, researchers etc. Funders can determine if project reports have to be peer reviewed. If necessary a project evaluation might be accomplished through questionnaires or similar.

6.2 Information exchange and common database

Information exchange will be extremely important in this network and comprises great benefits for all participants. It is part of the development of a sound phytosanitary infrastructure in Europe and therefore a relevant task. Information should be accessible to all network partners and advisors in each case and to concerned observers, stakeholders or others if adequate.

A common database on national, transnational and EU phytosanitary research projects will provide a platform for exchanging information, e. g. on current projects and participating partners, transnational project results, future research topics, and existing knowledge and experience. All network partners should have access to the database. It will be updated by network partners regularly and maintained jointly by the network. This way it will support prevention of duplication of research.

Another important aspect is information about relevant plant health subjects as new introduced pests and diseases. The network will partly depend on quick reactions on these occurrences and therefore has to rely on frankness of all partners. Concerned partners might get some value from the cooperation on introduced pathogens in return. Information on future activities of the EC or other important advisors will be significant as well. The respective NMG member respectively the network coordinator will be responsible for the contact to advisors and therefore has to inform the network partners on relevant plans, actions or programmes.

6.3 Involvement of stakeholders

The network of phytosanitary research funders enables common research activities in a coordinated and strategic way. In addition, complementarities with EU-funded projects are aspired. All network activities are developed to support the whole phytosanitary system and its actors. Phytosanitary research is predominantly applied research. Therefore the views and activities of stakeholders at national and Europe-wide level are considered important for prioritisation of research topics and design of the research strategy.

Organisations that have an interest in plant health research because they can affect or be affected by the networks' actions, objectives, and policies are regarded as stakeholders. It can be commercial firms, private organisations, or federal funding bodies that are not network partners. Likewise an important part will be the improved inclusion of affected parties like farmers or importers. Therefore stakeholders have an interest in the phytosanitary research projects and the results are relevant for their work. Stakeholders can be regarded as clients of phytosanitary research as they normally get profit out of the results.

Firstly, the network aims at information of stakeholders about network activities. The network works on a clear communication and dissemination plan that details activities towards stakeholders acting on the assumption of a two-way communication with stakeholders. The network aims at faithful contacts on a sustained basis. Stakeholders are invited to include their views and needs on research strategies and concrete activities of the network. Secondly, the network gives stakeholders the opportunity to participate in joint funding of

activities, preferably in their field of interest. The network encourages stakeholders to participation in funding consortia.

In addition EUPRHESCO tries to encourage private stakeholders, e.g. commercial grower associations, to take responsibility for their share on plant health problems. This refers mainly to the import and export of plant and plant products. Private stakeholders should be actively involved in the processes necessary to prevent introduction and spread of quarantine and regulated non-quarantine pests.

6.4 Commending important Plant Health topics

In all European countries, the phytosanitary sector dealing with issues related to regulated quarantine and non-quarantine pests and new emerging pests is in competition with many other sectors regarding the allocation of budgets. This also affects phytosanitary research which is essential for appropriate regulations, inspections, monitoring and other measures to protect economy and environment from harmful plant pests as outlined in this agenda. Politicians and general research funders may not always be fully aware about the significant role of the phytosanitary sector in our economy and environment. In order to ensure an appropriate research budget for the phytosanitary sector and to prevent from further significant reductions of phytosanitary research budgets a clear representation of phytosanitary research benefits and priorities is required. Within the Chief Plant Health Officers (COPHs) meeting on 12 June 2007, the importance of including and maintaining phytosanitary research within the EU Framework Programmes was agreed. The future network will be the special interest group in Europe to explain the importance of the phytosanitary area in general with its special research needs and should aim at keeping the current status to support the aspired development of research policy in Europe. As before that will contain:

- Taking responsibility for identifying research topics for which EU funding is appropriate and needed
- To advise on important plant health topics suitable for EU-funding in particular
- To initiate and perform the appropriate activities to propose the identified relevant topics in the EU Framework Programmes and to engage appropriately with DG Research, DG SANCO and member states
- Reporting to COPHS on the work progress and the topics identified and the related activities and to seek active support from the COPHS if needed

The approval of the COPHS and the EC should be obtained, to confer this task to the network as before to EUPRHESCO.

An additional task of the network will be calling public attention to phytosanitary problems. Dissemination activities of the network include suitable and professional public information.

6.5 Competitive phytosanitary research landscape in Europe

The aim of all ERA-Nets is to improve competitiveness of the European research area by coordination and joint activities. In order to improve competitiveness on plant health sector

several factors are considered important for the network activities. One of the factors is assurance of innovation in phytosanitary research. This can for instance be realised by linking phytosanitary research to related research disciplines. These related disciplines have been identified in EUPHRESCO and links have been established so far. Especially in the research area of plant health which can be considered mainly applied research, input from more basic disciplines like molecular biology, informatics, or chemistry is significant for the further development of research (Annex I).

6.6 Creating a global perspective through cooperation with other countries

In the context of global trade phytosanitary research has a global aspect too. Phytosanitary regulations affect import and export of plants and plant products word-wide. World-wide countries deal with the same range of harmful organisms, on the one hand as native plant pests and on the other hand as non-native, new pests. Ideally, research related to phytosanitary regulations may benefit from co-operation at the world-wide level or at least with relevant linkages. Therefore, the network aims at improving information exchange and collaboration with research funders from relevant countries world-wide. This includes acquiring more network partners from within Europe and the Mediterranean region. The contacts to EPPO and EFSA might help to get in touch with member states of this organisations not yet member of EUPRHESCO. Regulations should be made to enable different countries to participate in the network. Countries without any phytosanitary research programmes will have difficulties to actively take part in financing projects but might get a status as observer and could be included in meetings and discussions on relevant topics.

In addition the network will aim to deepen the contacts and the cooperation with countries not from Europe or the Mediterranean region, e.g. the QUAD of USA, Canada, Australia, NZ, Russia, Asian countries, and African countries. These contacts are very important:

- To gain more knowledge on introduced pests
- To align research already done with own projects (specially with USA)
- To cooperate with countries of origin of some pests for finding possibilities to stop sending them, or to provide opportunities to do research in situ in countries where they occur

Joint projects should be possible with different countries to add more value to the network activities. If necessary partners from such countries can participate in meetings and discussions on topics. To intensify these contacts regular international workshops on network activities and plant health issues might be held. Financing of these workshops has to be discussed further.

7. Strategic approach

The previous chapters summarised roughly the research needs EUPHRESCO partners expressed in their national workshops held in 2008/2009 and the phytosanitary future as envisaged by the partners. EUPHRESCO partners aim to build a self sustainable long-term network of research funders and managers as described above with the aim to increase

cooperation and coordination of national phytosanitary research and thereby supporting the needs of EU phytosanitary science and policy. From strategic point of view, EUPHRESCO partners will need to consider what research is most appropriate for national funding, for trans-national funding and for EU funding and ensure coordination between them. National fund might usually be spent on projects with particular interest and conditions on the national level. Coordinated transnational funding could support projects with transnational interest in the topic and thereby allow for more effective use of resources spend. EU funded projects should comprise topics of major concern for many European countries dealing with them in a comprehensive approach, and generally be larger and/or more strategic projects.

To make the decision on appropriate topics for common research respectively national or EU funding, the research needs have to be defined more precisely. In addition it has to be differentiated between urgent topics and research areas that have to be solved in the next years if possible and the ones that could be approached in a longer term. Of course some phytosanitary needs might be difficult to address and will remain as aspirations only.

The description of research needs covers the most important themes and research areas for EUPHRESCO partner countries for the time being. Still there is a big gap between the definition of needs and requirements and the practical transformation into projects or other activities. It is the task of the EUPREHSCO partners to define specific priorities and to decide on the appropriate funding degree. In co-ordination with all EUPREHSCO partners, the most important themes suitable for trans-national funding will be defined in detail and proposed as project topic. The EUPHRESCO partners will decide on the actual topics selected for funding and settle on a topic manager as described for the project initiation process above. Topics more suitable for EU- funding might be proposed to the Commission (and relevant Programme Committees of Framework Programme domains) for consideration.

8. Implementation of the research agenda

The implementation of the Common Strategic Research Agenda is a process consisting of different components operating corporately to weave a stable net.

Identification of research priorities and requirements

This is a continuous process, relying on the active participation of all partners. Research needs have to be identified and prioritised on a regular basis, e.g. via questionnaires, common Google spread sheets, national or international workshops and discussions. The identified topics and ideas will be included in future research agendas and action plans.

Joint projects

Within the framework of EUPHRESCO a second set of joint projects will start in 2010 to supplement the pilot calls in 2008 and to broaden the experiences with trans-national research. Further joint projects will follow after the evaluation of the pilot calls and will be continuously initiated over the next years. In the future, EUPHRESCO will seek to enlarge and deepen the cooperation.

Modus operandi

Structures and guidelines for the future network will be substantiating in a modus operandi. This paper will include rules of procedure, collaboration agreements and letters of intent from the partners. Exact arrangement of tasks to certain posts and legal issues and inevitable regulations of the network will be defined in this document.

Annexes

Annex I: Short review on key areas/disciplines linked to Plant Health

[Identifying expertise, existing work, opportunities & recommendations for increased inter-disciplinary R&D & collaboration]

Plant health is closely related to a number of different scientific disciplines. It has of course a close connection to biology and basic research, as information about the biology of different pests is essential for PRA and the definition of control measures. Similar is the connection to integrated pest management or climate research. During the ERA-Net EUPHRESCO national and international workshops had been held where amongst others the topic of relevant areas had been discussed. The most important key areas are summarised beneath:

Integrated pest management

Pest management is closely related to plant health. Often quarantine pests belong to the same genus as pests' nature to the concerned area. Behaviour of pest organisms as well as eradication and control measures for them might be similar.

- A contact has been established between EUPHRESCO and ENDURE. ENDURE is a Network of Excellence (NoE) comprising more than 300 scientists in different fields from 10 European countries. The network aims to build a lasting crop protection community of researchers and to develop a holistic approach to sustainable pest management. A EUPHRESCO representative is supposed to participate as lecturer in the ENDURE summer school.
- Additional expertise with regard to alternative pest control strategies, less based on the use of synthetic pesticiedes could be derived from the international Organisation of Biological and Integrated Control of Noxoius Animals and Plants [27]
- Furthermore collaboration and links of activities could be envisaged in common areas of interest with the ERA-NET CORE-ORGANIC

Climate research

Climate change will have a great impact on plant health issues as the dissemination and establishment of pests can be influenced by changes of various abiotic and biotic factors. Especially for PRA but also for modelling of pests dissemination scenarios it is important to consider the possible climate changes.

The importance of climate change for plant health is reflected in this agenda as it has been identified as one of the principal research areas for the next years. Connections to scientists from relevant disciplines as meteorology or plant sciences should be established. Information

[27] http://www.iobc-wprs.org

exchange between EUPHRESCO and other important institution might help to gather information already summarised by others.

- Some information exchange has been established with the United States Department of Agriculture (USDA) especially with the Animal and Plant Health Inspection Service (APHIS). EUPHRESCO provided a summary on research projects on climate change connected to plant health issues to APHIS.

General biological resources

Collections of viruses, microorganisms, nematodes, insects and mites harmful for plants or plant products are very important for plant health. They may serve as reference material and may provide valuable information about the relevant pests.

The importance of national reference collections is also reflected in this agenda as a subject of future concern for the next years. EUPHRESCO partners should summarise national collections in their own countries and get in contact with responsible institutions.

- Some contact exists, e.g. to the Global Biological Resources Centre Network (GBRCN) which aims to build a network of biological resources centres managed by a common secretariat with the aim to enhance the efficiency in collections of laboratory held, living biological material.

Biological research

Basic biological research is needed to get sufficient information on quarantine, regulated non-quarantine or new pests. These information might be gathered from plant health organisations but might originate as well from other institutions, e.g. from the countries of origin from certain pests.

- A contact exists to the Commonwealth Agricultural Bureaux Internationale (CABI), which is a non-profit science based development and information organisation to solve problems in agriculture and the environment, e.g. improving yields, safeguarding the environment and improving access to agricultural and environmental scientific knowledge. A representative from EUPHRESCO attended the CABI workshop 'Towards sustainable management of *Ambrosia artemisiifolia* in Europe' in Delémont, Switzerland in December 2009. CABI provide a link to developing countries and potential opportunities for research on EC listed pests.

- Numerous contacts to Universities dealing with basic biological topics are established

Mathematics, statistics and computer sciences, esp. modelling

To develop sound models for dissemination scenarios a basic knowledge of mathematics and computer sciences is essential. To utilise new IT technologies to support plant health inspection services is similar important.

Social sciences

Human behaviour has some impact on the introduction of quarantine and new pests. To collect ideas and possibilities to raise the awareness of people for the risks connected to plant souvenirs or internet ordering.

Economics

The integration of cost-benefit analysis for PRA is necessary to assess the risks posed by introduced quarantine, regulated non-quarantine or new pests. Of the same importance is the use of cost-benefit analysis for the decision on control or eradication measures, as they have to be economically justifiable.

Annex II –List of references

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Annex III - Description of WP 5

Workpackage number	5	**Start date or starting event:**	Month 18
Activity Type[11]**:** Coordination Activities			
Workpackage title: Develop trans-national agendas, programmes and a long-term, sustainable Coordination Network and external linkages to other disciplines			
Workpackage Leader: Germany-JKI (15)		**WP Deputy:** Netherlands-LNV (19)	

Participant ID	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	
Person-months per participant	4.5	1	1	2	1	1	1	1	1	1	1	1	
Participant ID	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**Total**
Person-months per participant	3	2	18	1	1	1	2	6	1	2	1	1	55.5

Objectives

To develop a common strategic research agenda based on shared priorities resulting in a proposed programme for trans-national funding at the end of the ERA-Net; to establish the infrastructure to sustain a long-term network of research funders to coordinate & develop trans-national phytosanitary research beyond the end of the ERA-Net; to develop further links with industry and with other national and international organizations; to explore linkages with other priority disciplines relevant to plant health needs that could be integrated into future trans-national programmes.

Description of work

This Workpackage is the key component of building the Network into a coherent structure of national phytosanitary research funders capable of cross-programme collaboration that will better serve the research needs of the European phytosanitary field. It draws upon all the previous workpackages. It will establish a common agenda for European phytosanitary research and a concrete action plan for collaboration and joint trans-national research activities at the end of the ERA-Net. To facilitate such a programme, a long term Network of National Programme Managers will be established. This will have a coherent management framework set out through a Collaboration Agreement detailing the Network's vision and *modus operandi* beyond the end of the ERA-Net.

5.1 Establish a common research agenda and Action Plan based on shared priorities, at the EU-wide

[11] For Coordination Actions each work package must relate to one (and only one) of the following three possible Activity Types: Coordination activities, Training activities, Management activities.

and potentially zonal levels:

- Produce draft common agendas (Partners 15 and 19/20; plus All), based on a 5-year and 10-year forward look, on which programmes of work can be based for trans-national funding at the end of the ERA-Net. These will be based on the analysis done in WP2.
- The draft agendas will then go out for consultation, e.g. to the Expert Advisory Group (DG SANCO; EPPO; EFSA; COPA-COGECA), and to organisations such as the European Commission's COPHS Working Party, as appropriate.
- The final proposed Programme and Action Plan, plus formalised instruments, will be submitted to the Governing Board for final agreement. The final documents will then be sent to other relevant groups for information, e.g. the Chief Officers of Plant Health Services (COPHS), DG SANCO, DG Research, EPPO, EFSA and COPA-COGECA, plus Non-EU bodies identified during the Project (e.g. key RPPOs and key non-EU NPPOs). This will include dissemination plans for results obtained from trans-national projects.
- The agenda's and instruments will then be presented (WP leaders/deputies), at the Final Project Dissemination Conference involving research funders, research providers, policy makers and other interested parties; the Conference will consolidate trans-national research partnerships and linkages.

5.2 Establish long-term network and infrastructure for developing and maintaining trans-national coordination and collaboration:

- A network of Phytosanitary research funders in European NPPOs will be established (Partners 15 and 19/20; plus All), at the end of project as a forum for on-going development of trans-national agendas/programmes and determining annual trans-national Phytosanitary research projects. The Network will seek to expand beyond the inclusion of just the Project Partners, and potentially to non-EU countries. It will function under a *Collaboration Agreement* (Partners 15 and 19/20; plus All), which will formalise issues of: membership and leadership; governance and decision making frameworks; mechanisms for joint programme identification and management; ownership of IPR, dissemination, exploitation and technological implementation arrangements; duration and review procedures; finance; long-term maintenance of the Network website and database to enable continuing collation and analysis of national programmes to inform trans-national activities and programmes. The Network will also aim to develop further links with industry and with other national and international organizations.
- The Network will have a defined remit/terms of reference and staff time allocated for its operation. It will submit reports to the COPHS and also interact with other trans-national organisations such as the EC Commission (e.g. DG SANCO, DG Research (including SCAR), DG Environment), EPPO, EFSA, COPA-COGECA.

5.3 Linkages to other disciplines that are related to, and need to feed into, the Plant Health area:

- Identify priority disciplines that need to feed into the phytosanitary area. The areas will be identified from the analysis in WP2 and from other exercises, e.g. EC Presidency notes, EPPO statements, COPHS statements, Plant Health themes in FP7. Examples of possible areas would include: economics; environmental impact analysis; modelling; taxonomy.
- For the areas considered of greatest priority and relevance to Plant Health, a review by a core group of Partners (partners 1, 4, 13, 15, 19, 20, 22) will be done identifying expertise, existing work related to Quarantine Plant Health, and opportunities/recommendations for increased collaboration and interdisciplinary research.

Deliverables

DL 5.1 A common strategic phytosanitary research agenda based on shared priorities and an Action Plan for joint trans-national programmes submitted to the Governing Board (Month 48)

DL 5.2. A defined and sustainable Network of Phytosanitary research funders/managers established for trans-national collaboration and co-ordination; *modus operandi* and Collaboration Agreement formalised (Month 48)

DL 5.3 Review on key areas/disciplines linked to Plant Health identifying expertise, existing work, opportunities & recommendations for increased inter-disciplinary R&D & collaboration (Month 48)

Milestones and expected result

MS 5.1 Workshops (national, zonal, Europe-wide) held to develop European-wide and zonal agendas (Month 24)

MS 5.2 Draft agendas and Action Plans drafted and sent out for consultation (Month 36)

MS 5.3 Submit recommendations to Governing Board for endorsement of the proposed common research agenda and Action Plan for joint trans-national activities, plus final instruments and processes that will facilitate trans-national funding (Month 47)

MS 5.4 Establish Network of phytosanitary research funders with terms of reference/*modus operandi* and a Collaboration Agreement agreed by The Governing Board (Month 48)

MS 5.5. Complete draft review of linkages with other disciplines relevant to Plant Health Science (Month 47)