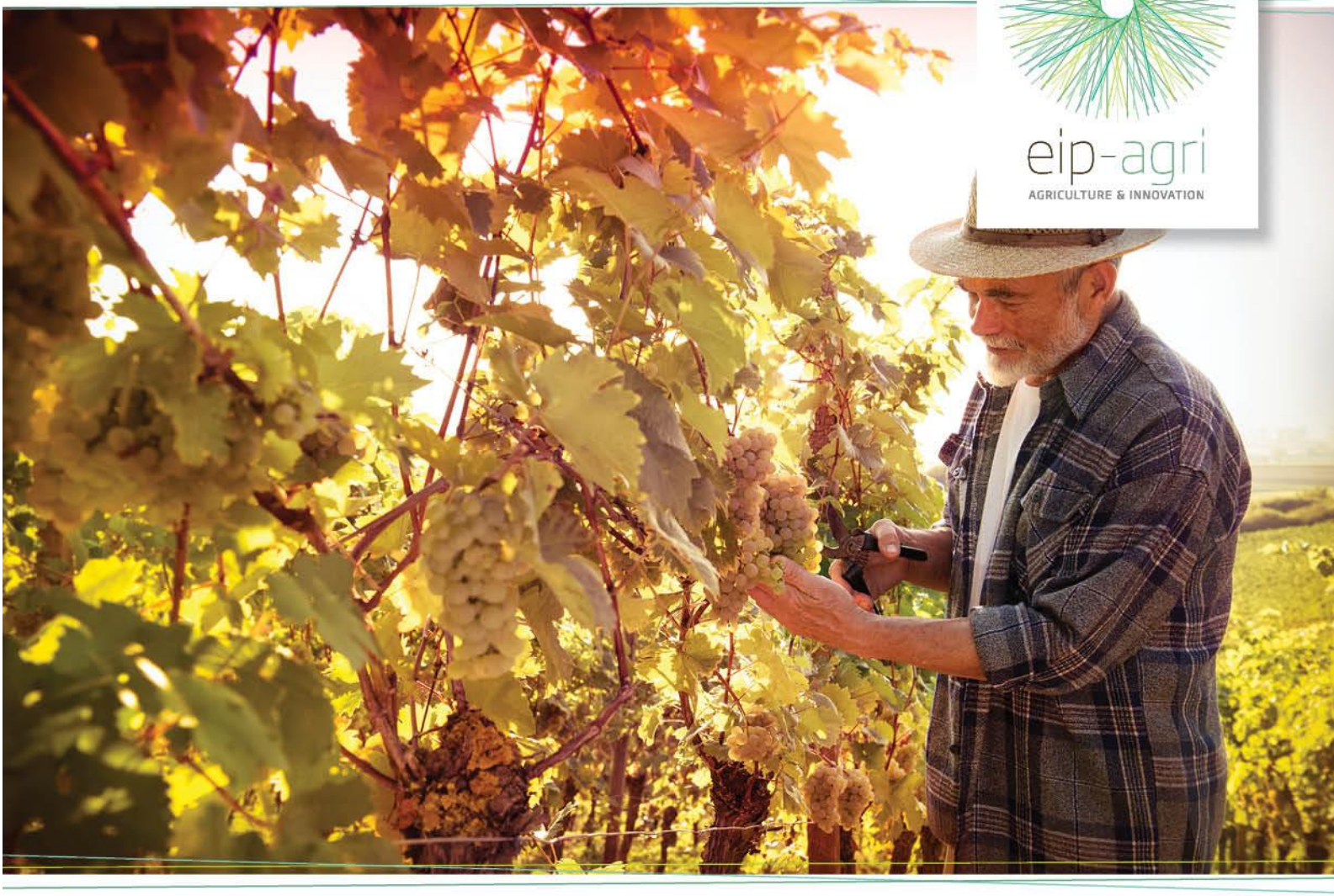

EIP-AGRI Focus Group

Diseases and pests in viticulture

FINAL REPORT
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1. Summary

`How can we increase the resilience of grapevines to pests and diseases and support the productivity of the sector in sustainable ways?` Nineteen Focus Group experts from different wine-growing regions in the EU discussed this question. They made an inventory of the main pests and diseases affecting grapevines, including their geographical distribution, and looked into Integrated Pest Management (IPM) strategies to combat them. The experts specifically considered how promoting functional biodiversity can help to create a more resilient vineyard system, as it can help to both prevent and fight pests and diseases. They also shared their ideas on how expected climatic changes will impact the distribution and occurrence of pests and diseases.

Viticulture is a relevant sector of EU agriculture in terms of economic revenues and job creation. It has also shaped the landscape, and is associated with regional culture and identity of wine growing regions. Wine is the main export item of the EU within the food sector. All the wine growing areas in the EU are characterised by specific varieties, climate, soil composition, and management practices. In each area, pests and/or diseases affect grape production and require specific management. Pests and diseases reduce grape quantity or quality and they may also threaten the longevity of vineyards. In conventional wine growing, an intensive pesticide schedule is usually required to meet qualitative and quantitative production standards. This is costly, and the environmental and health impacts of pesticides also need to be considered. The growing demand for more sustainable vineyard management is one of the reasons for the fast growth of organic wine production in all European wine regions and for the enacting of the European Directive on Sustainable use of Pesticides (Directive 2009/128/EC)1 that promotes Integrated Pest Management (IPM).

The Focus Group identified needs from the sector and possible gaps in knowledge on particular issues concerning the management of pests and diseases in grape production, which may be solved by further research, including, but not limited to:

- Selection and breeding of locally adapted grape varieties
- Developing ways to improve planting material health, including research on rootstocks and nursery management
- Adapting IPM and precision viticulture for small-sized and scattered vineyards
- Management strategies to control powdery mildew
- Methods to manage soil organic matter, soil fertility and the soil microbiome to improve plant health and reduce the impact of pest and diseases
- Effects of climate change on vine pests and diseases
- Develop strategies to manage Grapevine Trunk Diseases

They also proposed priorities for relevant innovative actions/ projects including practical ideas for EIP-AGRI Operational Groups, such as:

- Identify and test appropriate IPM and precision viticulture practices, with locally adapted strategies and specific regional implementation requirements
- Test and select locally adapted varieties and planting materials for local conditions and market demands.
- Develop local strategies for a proper use of cover-crops.
- Test ways to enhance both functional and vine biodiversity in vineyards to increase vineyard resilience
- Define strategies, based on local conditions and requirements, to increase vineyard resilience, to cope with climate change effects on pest and disease pressure

Other recommendations included:

- Knowledge exchange on plant, pests and diseases physiology and their interaction
- A "learning from failure - Platform" and an e-learning system with scientific validation, where farmers can upload a picture of an infection and get advice.

1 http://ec.europa.eu/food/plant/pesticides/sustainable_use_pesticides/index_en.htm

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2. Introduction

The Focus Group (FG) on diseases and pests in viticulture was launched by the European Commission in 2016 as a part of activities carried out under the European Innovation Partnership 'Agricultural Productivity and Sustainability' (EIP-AGRI).

The main question for the Focus group was: "How can we increase the resilience of grapevines to pests and diseases and support the productivity of the sector in sustainable ways?".

The Focus Group brought together 19 experts from all over the EU (see annex B for the list of members) with the purpose to:

- **Make an inventory of the main pests and diseases** affecting grapevines, including their distribution and economic impacts. Where possible, **summarise** how expected climatic changes will impact the distribution and occurrence of pests and diseases.
- **Get an overview of current practices** in early detection, diagnostics, and monitoring.
- **Get an overview of current methods for control**. Particular care should be taken to highlight both existing problems and opportunities in pest/disease management.
- **Make an inventory of IPM (Integrated Pest Management) strategies** (including biological control) to control pests and diseases in grapevine. **Compare** these different management practices and strategies, having also practicability and costs in mind.
- In particular, **explore potential solutions to manage pests/diseases** based on agro-ecological principles such as biodiversity. The role of disease management in supporting the resilience of grapevines to biotic stresses should deserve special attention.
- **Compile examples of 'good practices'**, i.e. a number of case studies, from farm level in particular, across different regions in Europe.
- **Identify needs from practice (farming sector) and possible gaps in knowledge** on particular issues concerning the management of pests and diseases in grape production which may be solved by further research.
- **Propose priorities for relevant innovative actions/ projects** including practical ideas for EIP-AGRI Operational Groups.

According to the 2018 statistics from OIV[2] , referring to 2017 data, the vineyards in the EU-28 covered 3,312 thousand ha, representing about half of the vineyard plantings in the world (7,564 thousand ha). European vineyards include grapes for wine production (by far the majority) but also grapes for fresh consumption and dried grapes. The most relevant countries for EU wine production are Italy, France, and Spain (see table 1).

2 http://www.oiv.int/public/medias/5958/oiv-state-of-the-vitiviniculture-world-market-april-2018.pdf

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Country	x 1000 ha	
	2016	**2017**
Spain	975	967
France	786	787
Italy	690	695
Portugal	195	194
Romania	191	191
Greece	105	106
Germany	102	102
Hungary	68	68
Bulgaria	64	64
Austria	46	46
Switzerland	15	15
Other European countries	683	681
Total Continenal Europe	**4007**	**4001**
Total EU-28	**3317**	**3312**

Tab.1 Number of hectares of vineyard per country in the EU (data from OIV refer to 2016 - 2017).

Within the EU, and also within each EU wine-growing region, there is wide variety in the size of wine estates and vineyards, vineyard management techniques, wine types and their values. Nevertheless, for all the countries and regions with a strong viticulture tradition, wine production is an economically important agricultural activity.

In addition to the economic importance of wine production, the value of viticultural landscapes and the link to traditional knowledge and skills increase the social relevance of viticulture in Europe. At the same time, the intensification of viticultural practices has led to a loss of biodiversity (with intensive use of few International varieties and declining use of local varieties), the degradation of soils, and an overall decrease of the resilience of viticulture systems.

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3. Brief description of the process

The Focus group met twice. Their first meeting was held in Porto, Portugal on 25-26 October 2016 (Porto, Portugal). The `starting paper` served to catalyse the discussion. This starting paper had been prepared beforehand by the coordinating expert and took into account inputs from the 19 experts concerning the most relevant pests and diseases within the different areas.

At this first meeting, the group identified three core topics, which were further discussed in subgroups per topic.

- Prevention, early detection, diagnosis, monitoring, and control tools
- Good practices, traditional or innovative, or a combination of both
- The role of biodiversity in viticulture protection

The second meeting took place on 4-5 April 2017 in Cluj-Napoca, Romania. At this meeting, the participants:

- identified bottlenecks in the practical implementation of Integrated Pest Management in viticulture;
- gave recommendations and practical hints on how to overcome the bottlenecks;
- identified risks linked to climate change;
- gave recommendations for further research and innovation activities to be proposed at European, National, and Regional level.

The Focus Group produced five mini-papers. (complete list in **Annex B**).

Inspiring farm visits

Besides the meetings the experts visited local farms to see and discuss pest and disease management in practice. In Porto the group visited Quinta do Seixo farm in the Douro valley that applies several functional biodiversity measures with the support of ADVID (Association for the Development of Viticulture in the Douro Region). The farm is managed under specific Integrated Production rules since more than 10 years and still serves as a trial ground for research studies and innovative practices. The group discussed the following topics related to functional biodiversity:

- Ecological infrastructure and its role in pests and diseases prevention (example of inter-row management).
- the Project BIODIVINE (LIFE+) with the evaluation of biodiversity in vineyard landscape management, meaning flowering strips, an area with wild shrubs and trees within the vineyard etc., and the evaluation of the impact of biodiversity in decreasing pest pressure.
- The relevance of genetic material preservation (as a basis for innovation) and use of local varieties (Muscat à petits grains, Aragonêz, Touriga Nacional, Tinta Francisca).
- The impact of climate change on viticulture in the Douro valley area.
- Local automatic weather stations with data available online (part of a private network of 20 stations in vineyards).

An optional field visit was offered during the second Focus Group meeting to visit the Jidvei vineyards and cellar in Tarvavas valley, Transylvania (A very large farm with high technical level management) and to discuss the specific strategies implemented to combat pests and diseases in this area.

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4. State of play: pests and diseases in viticulture, and management recommendations

All viticultural areas are characterised by specific varieties, climate, soil composition, and management practices. In each area, pests and/or diseases affect grape production and require specific management. Pests and diseases reduce grape quantity or quality and they may also threaten the longevity of vineyards. Fungal diseases can cause significant economic losses in traditional grape varieties, either by reducing production or through increased costs of antifungal treatments. It has for instance been calculated that in Piedmont, the annual costs for controlling downy mildew (the most critical disease in this area) in all conventional vineyards ranges from 8 to 16 million Euros, (including costs for work, equipment and fungicides[3]). In France, under medium downy mildew pressure, 12 treatments per season are necessary for traditional varieties grown under conventional management[4].

Besides the costs, the environmental and health impacts of pesticides have to be considered. The growing demand for more sustainable vineyard management is one of the reasons for the fast growth of organic wine production in all European wine regions and for the enacting of the European Directive on Sustainable use of Pesticides (Directive 2009/128/EC)[5] that promotes Integrated Pest Management (IPM).

The Focus Group experts discussed which pests and diseases are currently most relevant in EU viticulture, and which would be the most sustainable management approaches to counter the effects of these pests and diseases. They considered that for almost all of these pests and diseases, an integrated pest management approach would be required.

4.1 Integrated Pest Management (IPM)

The FAO defines IPM as the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimise risks to human health and environment. IPM emphasises the growth of healthy crops with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms. The Focus group experts considered this the most appropriate definition of IPM.

The Directive 2009/128/EC on sustainable use of pesticides also provides a definition of IPM which includes elements of the FAO definition. Integrated pest management is a broad-based approach.

A pest is any organism that damages or interferes with the crop plants. It can be a weed, an invertebrate (insects, mites, slugs, nematodes), a bird, rodent or other mammal, or a pathogenic microorganism (fungi, bacteria, phytoplasmas, viruses). NB In this report, a distinction has been made between pests and diseases, with the latter caused by fungi, bacteria, phytoplasmas and viruses.

IPM is based on accurate pest identification. It typically includes regular observation, crop monitoring and applying economic damage thresholds to determine if, when and what treatments are needed for effective control. Emphasis is given to preventive measures (for instance cultural practices, the use of pest-free and pathogen-free planting material, the use of resistant varieties, supporting functional biodiversity) to suppress or prevent pests. They should be exploited to the fullest extent to reduce the need for direct control measures.

Direct control measures should only be taken if they are economically justified. Preference is given to non-chemical control measures such as physical interference (nets or traps, mechanical weed control) and biological control (the use of natural enemies – predators, parasites, pathogens, and competitors – and pheromones to control pests and their damage) if they provide satisfactory pest control. Chemical control is only used when

3 Salinari, F., Giosue, S., Tubiello, F.N., Rettori, A., Rossi, V., Spanna, F., Rosenweig, C., Gullino, M.L., 2006. Downy mildew (*Plasmopara viticola*) epidemics on grapevine under climate change. Glob. Change Biol. 12, 1299–1307, http://dx.doi.org/10.1111/j.1365-2486.2006.01175.x.

4 Rousseau, J., Chanfreau, S., Bontemps, É., 2013. Les Cépages Résistants and Maladies Cryptogamiques. Groupe ICV, Bordeaux, pp. 228

5 http://ec.europa.eu/food/plant/pesticides/sustainable_use_pesticides/index_en.htm

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needed. Pesticides should be selected and applied in a way that minimises their possible harm to people and to the environment. Resistance management strategies are applied to prevent the development of resistance in pests, pathogens or weeds. The general principles of integrated pest management as formulated by the European Union can be found in Annex III of the Directive 2009/128/EC.

The Focus group experts considered that for the main pests and diseases, an IPM approach should be put into place in order to obtain a reliable level of plant protection. These IPM approaches include:

- **prevention practices**
- **early detection and monitoring**
- **direct control and management**

The experts identified the following tools and practices that could be useful for vineyard management, as well as factors that may limit their use.

Prevention practices

- Creating an **ecological infrastructure**, both at farm and at larger scale, with the aim of improving micro-climatic conditions, increasing biodiversity and timely presence and activity of beneficial insects, spiders, mites, microorganisms and pest predators. In the vineyard this infrastructure is characterised by flowering strips, alternate mowing between rows, creation of hedges and wood-lots and other elements of agro-forestry systems;
- Choice of **varieties and rootstocks** adapted to the local conditions. Among "traditional/international" varieties there is the possibility to select more tolerant ones and better-adapted clones. Several farmers run on-farm mass-selection programmes or multiply their own ecotypes to increase adaptation. In addition, efforts to breed new tolerant varieties of grapevine during the last 10 years have led to several quality varieties and rootstocks that have a high potential to reduce pesticide use. In France it was estimated that tolerant varieties could reduce production costs by half[6]. Nevertheless, and in particular in traditional wine production areas, the concern for maintaining wine quality and wine characteristics is slowing down the acceptance of tolerant varieties.
- **Crop management strategies** that prevent, suppress or at least mitigate the development/impact of pests and diseases. For instance, soil management that facilitates drainage, balanced nitrogen fertilisation to limit excess vigour of the plants leading to a reduced susceptibility to downy and powdery mildew, training and pruning systems to facilitate air circulation in the canopy or leaf removal to improve ventilation around the bunches of grapes and so reduce Botrytis risk, adoption of pruning techniques and trellising systems that reduce the trunk diseases` impact;
- **Sanitation measures** to prevent the spread of diseases. For example, care for healthy nursery materials and removal of diseased plants in the vineyard to reduce the inoculum of pathogens and sources of infected materials, which may cause vectors to spread diseases.

Factors currently limiting the use of IPM prevention strategies, and elements that could help vineyard managers to take up these strategies:

- generally the vineyard is not viewed or managed as a whole, integrated system. The move towards a systems approach in vineyard management requires time, training, and good examples;
- there is a need to create a resilient agro-ecosystem from the beginning, when the vines are first planted; these resilient agroecosystems generally avoid mono-cultures and prefer a complex system including flowering inter-rows, hedges, trees, and other ecological elements in the vineyard;
- pruning and canopy management should favour plant health, reducing disease outbreaks, and managing plant vigour;

6 Galbrun, C., 2008. Étude INRA: Comment Réduire ses Coûts de Production de 50%. Réussir Vigne, France (Online:) http://vigne.reussir.fr/actualites/etude-inra-comment-reduire-ses-couts-de-production-de-50:6ZKTI5TA.html

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- soil is a key element. Proper management strategies are essential and a pause/rest before re-planting is needed to reduce problems during the life of the vineyard. The use of cover and catch crops to increase diversity and soil activity is very beneficial;
- the use of mycorrhiza and in general microorganisms can be beneficial but it requires proper management, with deep knowledge of species and mechanisms;
- mainly due to climate change, there is a need for different varieties, more adapted to local conditions (even within the same vineyard), including tolerant varieties. Concerning the latter, for some regions, there is still need for further breeding, while in some Member States, or for certain production areas, tolerant varieties are already available;
- healthy planting materials, which are free of pests and diseases are very important, and there is a need to cooperate with nurseries to set up best practice guidelines and quality control procedures;
- a good canopy structure improves air circulation, supporting the establishment of a positive microflora/microclimate. Cultural practices, such as fertilisation, trellising and pruning are the first tool for preventing diseases, but operations such as drastic or invasive pruning may also spread diseases, and should be avoided;
- region-wide weather forecasting tools and information about growing conditions (i.e. vegetation indexes) are needed to generate sufficient and appropriate local data for precision viticulture.

Early detection/diagnostics/monitoring tools

- **Monitoring/scouting** of pests and diseases but also of beneficial insects and other organisms, including pollinators and natural enemies of pests and diseases, is essential to Integrated Pest Management. Good knowledge of physiology and morphology (of the plant, the pest/disease and of beneficial organisms) is a basic requirement to plan and implement an efficient monitoring system. Monitoring can be done with simple visual inspections, for example to identify and count juvenile forms of *Scaphoideus titanus*. Traps that catch insects, mites or spores may also be used, for example, traps baited with pheromones for vine moths. There are also more advanced systems that capture air samples to monitor spores. There are even fluorescence-based methods to detect molecules in plant tissues which are produced when the plant is affected by a downy mildew infection;
- **Forecasting systems** are developed to identify the risk level linked to the attack of a pest or a disease and to decide if and when to start plant protection. Forecasting systems exist for different diseases, especially for downy and powdery mildew, and for several pests, such as vine moths and *Scaphoideus titanus*. In the last decades the availability of Information Technology (IT) tools, of wireless sensors (to constantly monitor climatic data and vegetation), of precise algorithms (to forecast pest and disease development cycles) has increased constantly. This has helped to advance the implementation of IPM and precision plant protection techniques in many regions and farms. IT tools, such as connected meteo stations or climatic sensors inside the canopy, are available in several EU regions and are used directly by the farmers or, more often, by the advisory services, that disseminate early alerts based on the results of these tools. Recent technology allows for very specific, timely and place-related forecasting;
- **Decision Support Systems** (DSS) to guide practitioners in the efficient implementation of plant protection schemes (whether to spray, when to spray and what to spray). IT and Internet of Things (IoT) technologies have allowed the development of several tools: apps, web-based services etc. can be used directly by farmers and advisers - with no need for intermediate steps/actors. These tools rely on forecasting systems and constant monitoring, allowing high efficiency and savings for the farmers.

Factors currently limiting the use of early detection and monitoring tools, and elements that could help vineyard managers to take up these tools:

- logistics for monitoring tools need to be developed (weather stations at farm or area level, where to situate them, how to read the data) as several small details influence the final efficacy;
- epidemiological models need to be site-specific in order to be reliable (i.e. validated) and able to provide useful information for decision-making about cropping techniques and/or interventions (i.e. treatment applications). More models should be put together to work simultaneously in order to provide better information about crop management to growers;

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- in some cases, there is too much reliance on monitoring traps (i.e. moth pheromone traps) and the check of efficacy is missing. It is important to also verify post-treatment efficacy (i.e. yellow strips to verify leaf moisture);
- drones are still underused for monitoring;
- the most promising monitoring tools rely on:
    - Recovery panels
    - Electrolysed nozzles
    - Sensors (of different types)
    - Efficiency assessment
    - Risk mapping
    - Geographic Positioning System (GPS)
    - Decision Support Systems (DSS)

The group also discussed whether farmers are using these available tools in practice and if not (or not enough) why:

- vine-growers need to know how to use these diagnostic and monitoring tools, and be convinced that they will prove useful and economically viable before they will decide to implement them fully. Peer-to-peer knowledge exchange is needed as vine-growers tend to trust their colleagues. Researchers should be part of the learning process - or better, the knowledge creation and circulation process (no top down approaches). Demonstration farms/plots where the innovative approach is demonstrated in its complete implementation (no single practice) could speed up the adoption process;
- the traditional "calendar" approach is still preferred in certain areas because it has been used for decades and does not require specific observations or knowledge.

Methods and tools for direct control/management

These include:

- **mechanical control systems**, ranging from simple mass trapping (for example of chafers) or flame weeding (instead of chemical or mechanical weeding) to more technologically advanced vibrational mating disruption (experimentally applied to *Scaphoideus titanus*);
- **biological control methods, including for example**
    - mating disruption using pheromone dispensers applied to several *Lepidoptera* species and to *Planococcus ficus*,
    - the use of microorganism based products, such as *Bacillus thuringiensis* to control moths
    - *Ampelomyces quisqualis* to reduce formation of overwintering structures of powdery mildew
    - *Bacillus subtilis* to counteract Botrytis infections or other living organisms able to compete with (for space or for food)
    - to parasitise pests and pathogens. There are successful examples against insects, mites, fungi, and bacteria;
- **use of direct control, including pesticides.** This should be considered a last resource and should be applied under guidance of monitoring and forecasting systems. Pesticides include natural products, like botanicals, products of mineral origin (i.e. clays, some sulphur formulates), biocontrol agents (BCAs), pheromones, resistance inducers (often based on natural molecules or combination of molecules), low risk products (i.e. food-grade products like carbonates or plant oils or lecithin or weed extracts) and, as a very last resource, synthetic pesticides. Pesticides can act by contact or be systemic or cytotropic and their application mode changes accordingly. For example with contact pesticides the leaves should be permanently covered, while with systemic pesticides the active substance circulates inside the plant tissues and there is no need to repeat the treatment after rain;

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- Machinery and sprayers used to apply treatments in the vineyard should be selected according to the "sustainable" principles: for instance, **sprayers** using reduced volumes of water or able to recycle the part of treatment not reaching the canopy. In addition, regular control and fine-tuning of sprayers and other treatment machinery is strategic (and compulsory according to the Sustainable Pesticide use directive) for a more efficient and safer use.

4.2 Functional biodiversity

The Focus Group experts specifically considered **functional biodiversity** and its role in vineyards.. Functional biodiversity is the diversity on microorganisms, insects, plants etc that live in the vineyard and can develop or not depending on the management of the vineyard, including pesticide use, soil management etc. Promoting functional biodiversity can help to create a more resilient vineyard system, as it can help to both prevent and fight pests and diseases. Healthy soils will for instance also contain beneficial microorganisms which limit the growth of pathogens and promote plant health in different ways. Functional biodiversity also includes pollinators, and predators of plant pests, such as spiders, ladybirds which eat plant lice, and insect-eating birds. The experts noted that there is often a lack of understanding of how functional biodiversity works. Action could be taken to improve on the following points/issues:

- a better understanding of the plant-pathogen interaction;
- a better understanding of how functional biodiversity works in general, and specifically considering the effects of climate change;
- more knowledge of agronomic practices contributing to resilience and good biodiversity.

Furthermore, the group identified some initial steps needed to trigger the adoption of **functional biodiversity**:

- to promote the advantages of a balance between the vineyard and the agro-ecosystem around it;
- to disseminate and promote the benefits of choosing local varieties as a tool to preserve biodiversity and an essential pool of characteristics that increase sustainability and resilience. Especially in the "newly developed" viticulture areas there is the need to increase the awareness on preservation and the use of local varieties;
- to map pests and diseases across Europe to monitor their spread and better understand their cycles and factors affecting their development;
- to create a good balance in the farm/area between the vineyards, other crops, and the ecological areas.

4.3 Main pests and diseases and corresponding IPM recommendations

The experts agreed that the following lists include the main pests and diseases currently affecting vineyards in Europe. They indicated their relevance in the different wine areas, and recommended practices to be integrated in an IPM approach, that can help to reduce their impact.
The experts emphasised that an Integrated Pest Management strategy is essential. It should consider:

- the whole life cycle of the vineyard;
- all the pests and diseases that may affect the vineyard;
- the combined use of different means and tools, starting from preventive measures (like soil fertility management to enhance plant health) up to the rational and smart use of pesticides, which should always be considered the last possible solution.

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Diseases

Concerning diseases, the following list summarises opinions and experiences of the experts, including the recommended corresponding elements of IPM strategy.

Overview symbols

- Regions/countries where it is reported as problematic
- Climatic conditions that lead to higher impact
- Soil and location conditions that lead to higher impact
- Viticulture management practices that lead to higher impact/risk:
- General information
- Focus Group recommendations for Integrated Pest Management

Downy mildew *Plasmopara viticola*

All countries

High humidity conditions, Temperatures above 12ºC. More impact in rainy and mild spring-summer periods

Compacted and wet soils

Wrong vineyard orientation, training system, low ventilation, inappropriate fertilisation and inappropriate disease prevention

It is caused by *Plasmopara viticola,* may cause devastating effects in climates with relatively warm and humid summers. It attacks all European varieties, to different degrees and may cause large losses of production. Common symptoms include necrosis of the stem or shoot, discolouration including brown spotting and yellowish-green tips of the leaves;

- the use of tolerant varieties and clones or at least of less sensitive varieties in areas with a high pressure of the pathogen;
- balanced fertilisation with reduced nitrogen to avoid excessive vigour and canopy development, and management practices to increase soil organic matter through appropriate fertilisation and cover cropping
- canopy management with removal of water-sprouts and lateral shoots, control of shoot length and partial leaf removal to facilitate air circulation in the canopy;
- proper soil management to enhance microbial activity, including the use of cover crops to reduce survival and sporangiospores dispersal via rain splashes and care for soil structure and reducing machine impact;
- the use of natural products to decrease pathogen pressure and to dry tissues surface (i.e. acid clays, proteins etc.);
- the use of elicitors to enhance plant self-defence;
- preventive application of control measures;.
- the use of Decision Support Systems to rationalise pesticide use.

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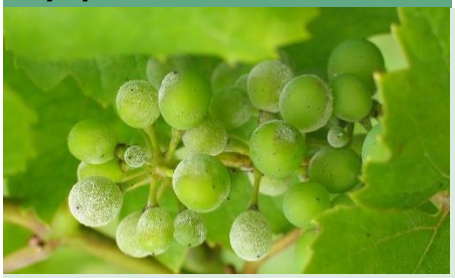
Powdery mildew
Erysiphe necator



All countries

Dry and cold springtime, hilly, windy areas, dry summer if humidity is high and temperatures favourable – on this point, the experts had NO COMMON POSITION

Compacted soils

High N availability and abundant new growth on the vines resulting in low ventilation in the vineyard

It is caused by *Erysiphe necator*, all European varieties are more or less susceptible. It infects all green tissues on the grapevine, including leaves and young berries and can cause serious crop loss. Warmer and drier climates favour the attack. Main symptoms are easily identifiable: gray-white, dusty formation that is more evident on the upper side of the leaves; it can also infect buds, flowers, young fruit, and young stems;

- balanced fertilisation with reduced nitrogen availability. Soil organic matter management is especially important;
- structure of the canopy that allows ventilation;
- early symptoms scouting on lower leaves to monitor primary infections;
- removal of young infected shoots (flag shoots);
- choice of tolerant varieties, clones or heterogeneous materials;
- Decision Support Systems (DSS) use if available in the area;
- the use of low toxicity products such as Orange oil or $KHCO_3$;
- the use of preventive applications of control measures (i.e. chemical or proper BCAs (biological control agents) such as *Ampelomyces quisqualis* against the formation or to reduce vitality of the overwintering structures (*chasmothecia*) of the fungus;
- the use of elicitors to enhance plant self-defence.

Grey mould / Botrytis
Botrytis cinerea

All countries

Rainy season, in particular around flowering and during maturation

Compacted soils

High plant vigour, N fertilisation, heel or other damage to the grapes, including grape moth attacks

It is caused by *Botrytis cinerea*. Its relevance strongly depends on climatic conditions and canopy density, as air circulation prevents the pathogen development. Its impact, compared to downy and powdery mildew, is more related to specific yearly climatic conditions and to the level of damage caused by other pests and diseases.

- the use of tolerant varieties and clones or, at least, less susceptible ones in areas with high pathogen pressure;
- balanced fertilisation to control vigour;
- canopy management: removal of water-sprouts and lateral shoots, controlling shoots length and partial leaf removal to facilitate air circulation;
- defoliation of the cluster area;
- ventilation after flowering to blow out infected debris;
- removal of major source of inoculum;
- management of inter-row vegetation in order to facilitate air circulation;
- the use of biological control agents, dryers (such as clay), elicitors and skin hardener products;
- early and preventive application of control measures to properly protect bunches at flowering and avoid latent infections.;
- control of pests that increase the risk of Grey mould;
- the use of Decision Support Systems to rationalise pesticide use.

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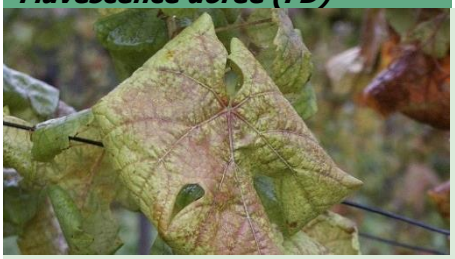
Flavescence dorée of grapevine
Flavescence dorée (FD)



Almost all countries, but not all regions; in Spain the vector is present, but the disease is not reported

Optimal temperature for the vectors.

no clear link

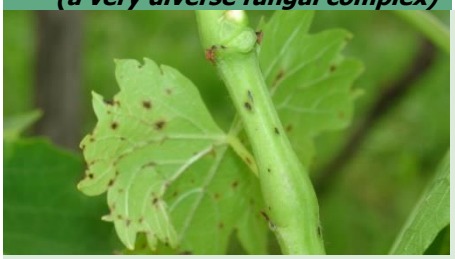
Uncontrolled vineyards; lack of protection against *Scaphoideus titanus*; infected vines

It is caused by a phytoplasma transmitted by the vector *Scaphoideus titanus*, it develops in the phloem vessels of the host plants. FD arrived in Europe in the 80s, starting from France and rapidly spreading to Italy and it is now moving Eastwards. FD and Grapevine Trunk Diseases are the core topics of the recently concluded Thematic Network Winetwork.[1]

- implementation of a territorial strategy: uprooting of unmanaged vineyards, large scale monitoring, monitoring of symptomatic plants, timing direct control etc.;
- use of controlled/certified planting material;
- precise monitoring and control of the vector (see *Scaphoideus titanus*);
- thermotherapy in nursery (no unanimous opinion on efficacy).

[1] www.winetwork.eu

Grapevine trunk diseases (GTDs)
--- (a very diverse fungal complex)



All countries

Depends, for instance rainy spring/early summer may favour esca complex; and for other GTDs not always clear.

Compacted soils, Cool and wet areas

Stress caused by different factors, infected material

GTDs include Eutypa, Esca and Botryospaeria (Black Dead Arm) dieback. Each can be caused by different species of one fungus belonging to one genus or different genera. They may cause the plants to die (more or less rapidly), are only partly related to climatic conditions and mainly to variety sensitivity. GTDs are present in many European wine regions but the symptoms may not always be visible. FD and GTDs are the core topic of the recently concluded Thematic Network Winetwork[1].

- balanced fertilisation and careful soil management to enhance plant health and correlated capacity to keep GTDs under control;
- pruning during dry weather to avoid inoculum dispersal;
- pruning wounds protection, soon after pruning, with *Trichoderma* spp. or other registered biological control agents or with chemical+physical barriers;
- use of high-quality vines in new plantations;
- removal of symptomatic plants;
- use of *Trichoderma* spp. and mycorrhizae or other biological control agents to support rooting during planting and other phases;
- specific attention to pruning management and techniques, especially in first years, avoiding pruning in wet conditions;
- removing/composting pruning debris if affected (or at risk of infection);
- trunk renewal of affected plants.

[1] www.winetwork.eu

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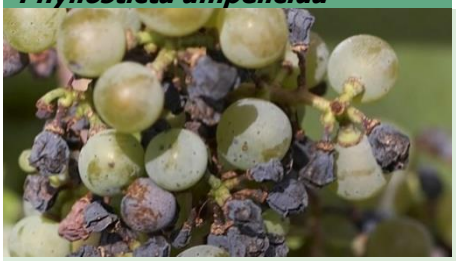
Black rot
Guignardia bidwellii (syn. Phyllosticta ampelicida



Italy, Spain, Hungary, Romania,

Rainfall in spring, mild temperatures, rainy summer (rainy flowering)

No clear link

High plant vigour, high fertility in soils, low ventilation exposition

It is caused by *Guignardia bidwellii also known as Phyllosticta ampelicida,* and it can affect both European varieties and American hybrids. Main symptoms are pale brown spots surrounded by a darker boundary on the leaves, and berries heavily shrivel and mummify on bunches. On both types of organs a few days after the appearance of symptoms black pycnidia (fruiting bodies of the fungus) are formed, allowing a clear identification of the disease.

- balanced fertilisation to enhance plant health;
- canopy management to improve ventilation;
- removal and burning of affected bunches and shoots from the previous year, mummies removal to decrease inoculum;
- use of Decision Support Systems for a rational use of pesticides;
- removal of abandoned vineyards.

Crown gall
Agrobacterium vitis

Bulgaria, Hungary and Romania

Low temperatures during the dormant period (below -18°C)

no clear link

Low quality planting material, wrong pruning, missing protection against frost

It is caused by *Agrobacterium vitis* which causes typical tumour formation on the aerial plant parts and root necrosis. Because *A. vitis* persists systemically in symptomless grapevine plants, it can be efficiently disseminated to distant geographical areas via international trade in propagation material. In the vineyard it can be easily spread by mechanical and physical damage caused by vineyard management practices.

- correct pruning;
- sterilisation of pruning devices;
- removal of infected vines;
- use of clean/healthy propagating material;
- avoid/protect from mechanical and physical damages.

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Pests

Concerning **Pests** the following list summarises opinions and experiences of the experts, including the recommended corresponding elements of IPM strategy.

Grape(vine) moths/ vine moth *Lobesia botrana, Eupoecilia ambiguella*

All countries

Mild winters; high temperatures and high atmospheric humidity during the vegetation period

No clear link

Variety sensitivity (bunch compactness) high N input, no weed control, compacted soils

European grape (vine) moth (*Lobesia botrana*) and Cochilis grape moth (*Eupoecilia ambiguella*), two *lepidoptera* of *Tortricidae* family that cause direct damage to the bunch as they feed on the grape content, and indirect damage as their feeding opens wounds that consequently offer opportunities for diseases such as the one caused by *Botrytis*. They are common in Mediterranean climate;

- appropriate variety choice for low sensitivity;
- balanced fertilisation with reduced nitrogen input;
- careful soil management to avoid compaction;
- removal of pruning debris;
- monitoring by pheromone traps and use of forecasting models (FM);
- application of mating disruption strategy;
- use of *Bacillus thuringiensis*;
- use of selective insecticides that do not harm beneficial insects, including pest predators.

Mites

Spider mites, leaf blister mite, grape leaf rust mite, grapeleaf bud mite, grapevine yellow mite, grape gall mite, red spider

Hungary, Spain, Bulgaria and Romania

Cold springs and hot summers, while for red mite, yellow and bud mite warm and wet Springs are favourable

Not clear

N abundance, high moisture in soil, compacted soil, use of pesticides that reduce beneficials, grafting with material from infested vineyards. Inappropriate management of pruning material

Different species (such as *Calepitrimerus vitis, Eriophyes vitis, Eotetranychus pruni, Panonychus ulmi),* more common in mild climates they attack leaves and shoots, decreasing the photosynthetic activity of the plant;

- avoid excessive use of pesticides that will harm beneficial insects and natural enemies of pests, and increase pest damage;
- balanced fertilisation with reduced nitrogen input;
- proper soil management to avoid compaction;
- avoid grafting with material from infested vineyards;
- management of pruning debris (removal or composting);
- control overwintering population;
- preservation of high biodiversity within the vineyard to enhance the presence of natural enemies;
- predatory mites release;
- visual monitoring to decide if there is the need to spray and when.

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Smaller green leafhopper
Empoasca vitis

Spain, Hungary, Greece

High temperatures in June

/

High vigour

A phloem-feeding leafhopper causing veinal browning, as well as marginal rolling and burning;

- balanced fertilisation with reduced nitrogen input;
- balanced management of the canopy;
- shoots removal;
- use of chromatic traps;
- use of selective insecticides that do not harm beneficial insects.

Grape mealybug / Med. Mealy bug
Planococcus ficus

Italy and Greece, and northern Spain

Higher temperatures, humid summer

Vigour of the plant

N availability, compacted soils

An unarmoured scale insect of the *Pseudococcidae* family that damages grapes by contaminating clusters with cottony egg sacs, larvae, adults, and honeydew and can transmit grape viruses

- balanced fertilisation with reduced nitrogen input;
- accurate soil management to avoid compaction;
- use of pheromones traps;
- use of mineral oils;
- control of overwintering population;
- release of natural enemies (*Anagyrus vladimiri* and *Cryptolaemus montrouzieri*);
- visual monitoring to decide if there is the need to spray and when;
- use of selective insecticides to preserve beneficials.

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Thrips
Thrips Tabaci/ Frankliniella sp.

Italy and Greece

No specific

Wild areas nearby

Avoid wild areas, facilitate ventilation in the canopy, weed control, reduce irrigation

A very small yellowish thrips that sucks the sap. The sucking leaves silver wounds on the vines, so reducing the photosynthetic surface and increasing loss of water. It may also transmit viruses.

- care in case of wild vegetation (hosting thrips but also beneficials) close to the vineyard;
- facilitate ventilation in the canopy;
- reduced irrigation;
- use of chromotropic traps;
- accurate weed management;
- use of selective insecticides that do not harm beneficials.

Phylloxera - Leaf form of phylloxera, grape phylloxera
Phylloxera vastatrix

Italy and Bulgaria

Hot and wet springtime

Unmanaged vineyards

Non grafted vines

It is an old and well-known pest that caused huge damage to European viticulture when it arrived in the mid 1800s from North America. It completely changed the European vineyard, making practically impossible to avoid grafting on American root-stocks. In last years it appeared on grafted vines, showing symptoms on leaves.

the symptoms on leaves are still rare but emerging as a problem, probably due to climate change. Still under observation. The control in nursery is recommended.

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American grapevine leafhopper
Scaphoideus titanus ball

Italy, Hungary but all countries as FD

Mediterranean climate

No impact

Wild/unmanaged vineyards

It is a leafhopper that feeds on *Vitaceae* plants, introduced in Europe from North America in the '70s.It has only a generation per year. It is the main vector of the phytoplasma inducing flavescence dorèe

- proper pruning and removing pruned materials from the vineyards ;
- monitoring with chromotropic traps;
- use of selective insecticides that do not harm beneficials;
- management at landscape scale (uprooting abandoned vineyards or wild areas as a reservoir of FD and leafhoppers);
- continuous monitoring of FD symptoms.

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4.4 The influence of climate change on vineyard pests and diseases

Premium wine grape production occurs within very narrow climate ranges. In Europe the impact of global warming on wine regions will be large[7]. Salinari et al.[8] estimated that in Piedmont climate change will increase the downy mildew incidence, requiring a higher number of treatments leading to a cost increase of 20 to 50%, and a higher risk of environmental impact.

Several simulations[9] tried to predict the evolution of the vineyard agro-eco-systems with the changing climate, including the development of pests and diseases.

Even if there are no clear figures, the overall forecast is

- an increase of incidence of pests and diseases on viticulture;
- a change of pest species causing problematic situations;
- a change in the biological cycles of pests and diseases, making them more difficult to control;
- an increased difficulty in forecasting due to extreme variation in climatic conditions and, consequently, in the vine growth and development of pests and diseases.

In any case, viticulture will face a more complex situation, which will include more frequent and rapid changes in both weather and pest and disease cycles. This situation requires a more resilient wine and grape production system, since direct control methods will be less effective and probably not sufficient.

The FG experts identified trends in pest and disease development and also identified those pests and diseases that are becoming more and more relevant due to climate change. The Focus Group experts considered the following the most important:

- The **Mediterranean vine mealybug**: both its prevalence and impact are increasing, with significant damage to wine and table grapes;
- several insect **cycles are changing**, making it more difficult to apply forecasting systems;
- in recent years diseases such as **downy mildew**, also became problematic in areas where they rarely appeared before, i.e. Sicily or Sardinia and, vice versa, pesticide-resistant strains of pathogens are appearing in areas with long term presence of the specific pathogen.
- **powdery mildew** has started to become problematic in more Northern areas where it wasn't usually an issue in the past.

Practical examples of temperature change effects are already visible:

- *Lobesia botrana* males appear in early spring, 30 day earlier compared to 30 years ago;
- *Eupoecilia ambiguella* is affected by higher winter temperatures, it appears 30 days earlier;
- also the grapevine starts its cycle earlier, about 13 days in 2011 compared to previous 30 years average in Spain and about 12 days earlier in France.
- Insects seem to be showing a kind of adaptation towards increasing CO_2 concentrations. However, it will only be possible to draw conclusions about this after several generations of insects with higher pupae weight and shorter larval development. This would probably lead to a change in plant-insect interactions, but it is not yet clear what this change will look like, nor what it will mean for vine cultivation in Europe.

7 Mozell, M.R, Thach, L., 2014. The impact of climate change on the global wine industry: Challenges & solutions. Wine Economics and Policy 3 (2014) 81–89

8 Salinari, F., Giosue, S., Tubiello, F.N., Rettori, A., Rossi, V., Spanna, F., Rosenweig, C., Gullino, M.L., 2006. Downy mildew (*Plasmopara viticola*) epidemics on grapevine under climate change. Glob. Change Biol. 12, 1299–1307, http://dx.doi.org/10.1111/j.1365-2486.2006.01175.x.

9 Fraga, H., Malheiro, C.C., Mountinho-Pereira, J., Santos, J.A., 2012. An overview of climate change impacts on European viticulture. Food Energy and Securyty 2012; 1(2). 94-110

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5. Recommendations

Taking into consideration the main challenges and bottlenecks in the protection of the vineyard, the experts listed a set of recommendations for:

- innovation projects, that can be implemented at local level, to make use of the knowledge and skills already available but often underexploited;
- research projects, on topics where the available knowledge is still missing

5.1 Ideas for local innovation projects, including EIP-AGRI Operational Groups (OGs)

The proposed topics and contents recommended by the experts for Operational Groups are:

- Working with owners and managers of small-scale and scattered vineyards to identify and test appropriate **IPM and precision viticulture practices**, with locally adapted strategies and specific regional implementation requirements. These may include for example: using local forecasting models, mating disruption systems (adapted to small scale or alternative methods), locally adapted varieties, the use of drones, etc.
- Involving local vineyard managers, owners, wine producers in the testing and selection of **locally adapted varieties and heterogeneous planting materials** fitting local conditions and market demands. The OG project could test and select locally adapted varieties/heterogeneous materials for their tolerance to pests and diseases, acceptability for the market and ease to grow in site-specific conditions, including small vineyards.
- Developing local strategies for a proper use of **cover-crops**. This will include vineyard managers identifying the best, locally adapted species (and mixtures), sowing time, mowing/terminating method and time for different cover-crops management.
- Testing ways **to enhance biodiversity in vineyards**, through the activation of local networks including gene banks, *in situ* conservation etc. to protect and enhance both functional biodiversity and vine biodiversity in vineyards. The project could list locally adapted good practices to maintain or increase biodiversity in vineyards.
- Impact of **climate change** on pests and diseases, incidence and definition of strategies, based on local conditions and requirements, to increase resilience. The project could work on specific local effects of climate change and locally adapted mitigation measures.
- Involving local vineyard owners and managers in testing site specific **GTDs management** through preventive and control strategies. These strategies should include monitoring of seasonal inoculum in order to guide management. Successful innovative practices should be shared widely.

5.2 Research needs from practice

Besides the ideas for local innovative projects (e. g. Operational Groups), the experts also identified topics where more research is needed and is recommended for consideration within a large framework, either national, transnational or European.

The list below summarises these recommendations:

- **Selection and breeding of grape varieties and heterogeneous planting materials** fitting local conditions and market demands. The research should include testing and selection of locally adapted varieties but also heterogeneous materials, tolerant to pests and diseases, but also acceptable for the market and easy to grow in site-specific conditions, including in small vineyards.
- To increase **health in planting materials** by improving nursery management. The research should focus on how to make viticulture more resilient, starting from planting materials and nursery methods. The aim

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is to produce healthy plants (and also the definition of healthy plant is still to be completed), including research on rootstocks and their influence on resilience.

- A set of measures to **downscale IPM and precision viticulture** in order to make them applicable in small-sized and scattered vineyards and farms, which form a relevant part of European viticulture. The measures should help to identify or adapt IPM practices and precision technologies which will be useful for such small-scale vineyards. These may include for example: adoption of local forecasting models, mating disruption systems (adapted to small scale or alternative methods), locally adapted varieties, drone use on small scale, etc.
- **IPM overall strategy on table grapes and related labelling**: need for research on **overall IPM strategy** to efficiently manage pests and diseases and to reduce pesticide use on table grapes - and at the same time - reduce resistance risks. The research activity should include practical implementation of the strategies, which should be locally adapted, and demonstration/pilot farms to increase trust and peer-to-peer knowledge exchange.
- Management strategies to control **powdery mildew**, including the reduction/control of overwintering structures, fitting within a global strategy that can be adapted to local specific conditions, availabilities and needs.
- The **role of organic matter and soil fertility on plant health**. Research on methods to manage soil organic matter, soil fertility and the soil microbiome that will improve plant health and reduce the impact of pest and diseases.
- Effects of **climate change on pests and diseases**. The research should include the identification of specific changes in pest and disease life cycles, their impact on grape production, and resistance of pest and diseases under climate change scenarios. Also the emergence of new pests and diseases should be forecast.
- Understanding the main factors of **vine decline**, in different European regions/conditions. Research should aim to understand the reasons behind the vine decline and should propose strategies to halt this decline. These strategies should be adapted for different regions and for different types and structures of vineyards.
- Research to develop strategies to manage **Grapevine Trunk Diseases** (GTDs), which can be incorporated in overall vineyard management strategies covering the entire lifecycle of the vineyard. To improve their efficacy, these strategies should include the role of biocontrol agents, understanding their mode of action.

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5.3 Other recommendations, including knowledge and training needs

The Focus group experts highlighted that knowledge sharing and training are essential to implement IPM measures and strategies successfully. They noted that there is much knowledge available on IPM strategies and on how to increase vineyard resilience, based on scientific activity and from advisory experience (**see Annex C**), but its practical implementation is extremely limited and slow, often due to a lack of trust from the growers` side. For this reason, the Focus Group considered that the most urgent needs are training and demonstration activities, supported by researchers, advisers and skilled farmers. As reported in **mini-papers 2 and 4** several efficient biocontrol methods are available but these are still not effectively used. Very often farm managers are aware that there are non-chemical alternatives to pesticides but they do not know their exact potential or how to practically insert them into an IPM strategy. The Focus Group experts also noted that the vine sector is quite traditional, with small size companies and a lot of regional rules and particularities. This means that it is difficult to establish a unique/general framework methodology for knowledge exchange (about viticulture topics) which is clear, efficient and useful for all the different regions or countries.
They therefore stressed the need to identify how the knowledge exchange chain works in each area in order to identify both the good points and the points for improvement.

Trentino-South Tyrol (Italy) hosts a good example of close cooperation between growers and research institutions, which allowed the establishment of IPM in the Region. Here the driving force for IPM implementation was the adoption, in the past 20 years, of pheromone mating disruption with an Area Wide approach against codling moth and leafrollers on apple crops and against the vine moths in the vineyards. Although the mountainous terrain of the area was not optimal for the efficacy of mating disruption, grower cooperatives and their field consultants were very influential in convincing growers to implement this technology. Public research institutions conducted extensive research and education, and provided credible assessments of various mating disruption technologies. Thus, the development and adoption of an area-wide mating disruption in Trentino-South Tyrol resulted from the merging of several favourable factors, which brought together researchers, advisors, cooperatives, growers, pheromone distributors, and related industries.

There are not many similar examples of large scale success but in Tuscany a pilot project on the implementation of mating disruption (to manage moths and mealy bugs; see mini-paper 4) demonstrates that IPM implementation can be taken up widely, when research scientists have an interest in and are encouraged to promote and adapt existing knowledge to practical implementation together with local winegrowers. Scientists must play a leading role in engaging all groups of stakeholders to work together with a common goal. This was probably the most important factor in the successes achieved in this project.

The specific needs can be summarised as follows:

- improved knowledge on **plant, pests and diseases physiology and their interaction**. A wide understanding of pest and disease development based on local historical data (forecasts, phenological stages etc.) and deep knowledge of physiological mechanisms are needed in order to make farmers confident and skilled in a systems approach.
- **The establishment of a European network of farms** where IPM strategies and practices are demonstrated in local environments. Links between similar initiatives in different wine regions would enhance the uptake. The topics in the demo farm network should include:
    - local genetic materials,
    - newly bred varieties with high tolerance and quality, fitting IPM and organic needs,
    - biodiversity management within the farm and at landscape level,
    - IPM strategies covering the whole vineyard production cycle from vineyard planting upto grape harvest. The demonstration network will increase trust and knowledge among practitioners as well as the interaction between farmers, researchers and advisors.

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- There is an urgent need for knowledge (practical and scientific) and systems that use all available knowledge from science and practice. The experts propose a **"learning from failure - Platform"** and an e-learning system with scientific validation, where farmers can upload a picture of an infection and get advice.

  It can include an alert system for the spread of pests or diseases.

Finally the experts proposed to set up a traceability system in nurseries to trace the plant materials` origins. This could help to increase the sustainability of European viticulture.

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Annex A: Members of the EIP-AGRI Focus Group

Name of the expert	Profession	Country
Ait Barka, Essaid	Scientist	France
Caffi, Tito	Scientist	Italy
Compant, Stéphane	Scientist	Austria
Csikós, Anett	Scientist	Hungary
Donkó, Ádám	Scientist	Hungary
Durán Pereira, Daniel	Farm advisor	Spain
Fabianek, Daniela	Farmer	Austria
Legas, Markos	Farmer	Greece
Lucchi, Andrea	Scientist	Italy
Majcenović, Irena	Farmer	Croatia
Mugnai, Laura	Scientist	Italy
Palacios Muruzábal, Julián	Farm advisor; Farmer	Spain
Popescu, Daniela	Scientist	Romania
Rapf, Klaus	Farmer	Austria
Rego, Cecilia	Scientist	Portugal
Santesteban, Luis Gonzaga	Farm advisor; Scientist	Spain
Zekri, Olivier	Expert from agricultural organisation, industry or manufacturing; Advisor; Scientist	France
Tsvetkov, Ivan	Scientist	Bulgaria
Vrbanek, Josip	Farm advisor; Farmer	Croatia

Facilitation team

Cristina Micheloni	Coordinating expert
Emilie Gaetje	Task manager
Sergiu Didicescu	Back-up Task manager

You can contact Focus Group members through the online EIP-AGRI Network.
Only registered users can access this area. If you already have an account, you can log in here
If you want to become part of the EIP-AGRI Network, please register to the website through this link

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Annex B. List of mini-papers

All mini-papers can be downloaded from the **'Diseases and pests in viticulture' Focus Group page** on the EIP-AGRI website.

	Title	Main author	Other authors
1	Practical ways to increase functional biodiversity to control pests and diseases, including soil pathogens	Luis Gonzaga Santesteban	Luis Gonzaga Santesteban*, Julián Palacios Muruzábal, Ivan Tsvetkov, Daniela Popescu, Ádám Donkó
2	How gain the interest and trust of vine growers: training, demonstration, capacity building & education.	Daniel Durán	Daniel Durán*, Ivan Tsvetkov, Daniela Fabianek, Josip Vrbanek, Irena Majcenović, Tito Caffi
3	How can winter pruning practices help to reduce the impact of Grapevine Trunk Diseases	Julián Palacios Muruzábal, Luis Gonzaga Santesteban	Julián Palacios Muruzábal*, Luis Gonzaga Santesteban*, Anett Csikós, Daniela Popescu, Stéphane Compant, Essaid Ait Barka, Cecilia Rego, Ivan Tsvetkov
4	SHARING NEEDS AND KNOWLEDGE PROMOTES IPM	Andrea Lucchi	
5	Strategies for a better use of copper-based fungicides in organic viticulture	Tito Caffi	

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Annex C: Relevant recent and on-going research projects

project name	main topic/characteristis	Frame work	web
BCA_GRAPE	New biocontrol agents for powdery mildew on grapevine	7FP	www.bca-grape.eu
CO-Free	Reducing copper as a pesticide	7FP	www.co-free.eu
Endure	Diversifying crop protection	7FP	www.endure-network.eu
INNOVINE	Vineyard agronomic management and breeding for improved grape quality to reinforce competitiveness of the winegrowing sector	7FP	www.innovine.eu
MODEM_IVM	A web-based system for real-time monitoring and decision making for integrated vineyard management	7FP	www.modem-ivm.eu
PLANT CT	Making plants healthier - development of monitoring tools	H2020 SMEs tool	
PROECOWINE	Development of bio-fungicides	7FP	www.proecowine.eu
PROLARIX	Botanicals for plant protection	7FP	www.prolarix.eu
PROMESSING	Promoting eco-system services in grapes	FACCEJPI ERANET	www.promessing.eu
PURE	Pesticide Use-and-risk Reduction in European farming systems with Integrated Pest Management	7FP	www.pure-ipm.eu
VINEMAN	Innovative cropping systems for organic viticulture.	Core Organic2 ERANET	www.vineman-org.eu
VINEROBOT	Tools for precision viticulture	7FP	www.vinerobot.eu
WINETWORK	Thematic Network on Grape Trunk Diseases and Flavesence Dorée	H2020	www.winetwork.eu
Cost action FA 858	Viticulture: Biotic and abiotic stress - Grapevine Defence Mechanism and Grape Development	Cost action	www.cost.eu/COST_Actions/fa/858 www.cost.eu
COST Action FA1303	Sustainable control of grapevine trunk diseases	Cost action	http://managtd.eu/en
BIODIVINE	Demonstrating functional biodiversity in viticulture landscape	LIFE	www.biodivine.eu
ADVICLIM	Adaptation of viticulture to climate change	LIFE	www.adviclim.eu
EVITICLIMATE	Climate change and European wine producers	LLLP	www.eviticlimate.eu
SUSVIT	Sustainable viticulture on farm	Grundtvig	
SUSVIT PLUS	Sustainable viticulture on farm	Grundtvig	
VISO	Viticulture and sustainable development of local resources in the wine industry	Interreg	http://viso.appliedgenomics.org/en
BACCHUS	Pest and disease in viticulture	Interreg	http://www.bacchus-science.eu/
WINETECH PLUS	Comunidad de Innovación y Nuevas Tecnologías en Viticultura y Elaboración de Vino	Interreg	http://www.winetechplus.eu/index.php?lang=es
WINETECH	Promote the Innovation engagement int the vine and wine sector	Interreg SUDOE	http://www.winetech-sudoe.eu
PAThOGEN	Training programme to improve grapevine virus knowledge and management	Erasmus+	http://www.pathogen-project.eu/ngcontent.cfm?a_id=13020
VALOVITIS	Identification of unknown and ancestral varieties and preservation plant material in vine	Interreg-POCTEFA	http://www.valovitis.eu/senalar-un-pie-de-vid/?lang=es
VITISOM	Viticulture Innovative Soil Organic Matter management	LIFE	http://en.lifevitisom.com/objectives
PLAID	Access to innovation through demonstration	H2020	http://www.plaid-h2020.eu/
INBIOSOIL	Control of subterranean crop pests of global economic importance	FP7	http://inbiosoil.uni-goettingen.de/
MYCORRAY	Solution to help prevent fungal trunk diseases for the vine grower	FP7	http://www.mycorray.eu/
VINTAGE	A user friendly Decision Support System for an integrated vineyard management, for addressing quality and quantity production variability optimising the use of resources	FP7	www.vintage-project.eu.
FITOVID	Reduction of phytosanitary use in viticulture	LIFE	http://www.fitovid.eu/?lang=es
TOPPS	Train operators to promote best management practices and sustainability	LIFE	http://www.topps-life.org/
VINOVERT	To guarantee the long-term competitiveness of companies in the wine sector in south-west Europe, adapting them to a new type of demand for wines considered to be more "clean" from the point of view of health and the environment	Interreg SUDOE	https://www.interreg-sudoe.eu/proyectos/los-proyectos-aprobados/161-vinos-competitividad-politicas-medioambientales-y-sanitarias-de-las-empresas-acompanamiento-

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project name	main topic/characteristis	Frame work	web
			hacia-la-puesta-en-marcha-de-metodologia
ATLANTIC VINEYARDS	Development & demonstration of a complete system to reduce the use of chemical products in the D.O. RIAS BAIXAS	LIFE	http://vinasatlanticas.depo.es/web/vinas-atlanticas/home
PRIORAT	Making compatible mountain viticulture development with European Landscape Convention objectives	LIFE	http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=2899
AWARE	Reducing pesticide-related water pollution by improving crop protection practices: The use of embedded ICT technologies	LIFE	http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=2860
LIFEAGROINTEGRA	DEMONSTRATION OF SUSTAINABLE ALTERNATIVES TO CHEMICAL PRODUCTS FOR EUROPEAN CROP PROTECTION (AGROINTEGRA)	LIFE	http://www.agrointegra.eu/en/
LIFE VinEcoS	Optimizing Ecosystem Services in Viniculture facing Climate Change	LIFE	http://www.life-vinecos.eu/en/news/index.html
LIFE+ SOIL4WINE	Innovative approach to soil management in viticultural landscapes	LIFE	http://dipartimenti.unicatt.it/diprove s-progetti-di-ricerca-life-soil4wine
CENIT-DEMÉTER	Adaptation to the Climate change	Spain-CDTI	www.cenitdemeter.es
GLOBALVITI	Adaptation to the Climate change	Spain-CDTI	http://www.hispatec.es/globalviti-id-vitivinicola-participamos/
AGRISENSACT	New generation of wireless sensors for integrated precise agriculture	FP7-SME	www.agrisensact.eu
BROWSE	Bystanders, Residents, Operators and WorkerS Exposure models for plant protection products	FP7	www.browseproject.eu
VITISENS	COST-EFFECTIVE HAND-HELD DEVICE FOR RAPID IN-FIELD DETECTION OF FLAVENSCENCE DOREE PHYTOPLASMA IN GRAPEVINES	FP7-SME	www.vitisens.eu
SAFEGRAPE	Biosensor-based instrumentations to be used in vineyards and wineries for fast and sensitive detection of Botrytis cinerea, grey rot, in grapes	FP7-SME	http://www.safegrape.eu
SUSTAVINO	Integrated Approaches for Sustainable European Wine Production	FP7-SME	http://cordis.europa.eu/result/rcn/60432_en.html
BIOBIO	Indicators for biodiversity in organic and low-input farming systems	FP7 KBBE	http://cordis.europa.eu/result/rcn/54220_en.html
VITICAST	VITICAST: innovative solutions for fungal diseases prediction in vines». Objective: to develop site-specific DSS (Decision Support System) for monitoring fungal diseases, taking into account the phenological stages as well as climate data, inoculum pressure information and weather forecast Members: 2 wineries, 2 winegrowers associations, 1 ITC company, 1 research group	National OG	no website http://www.campogalego.com/es/vina-es/galicia-consolida-su-papel-en-la-investigacion-nacional-del-sector-vitivinicola/
RETMAVID	Project that seeks to minimize the incidence of GTD's	Spanish Ministry (MINECO Funds)	no website + info: http://www.martincodax.com/blog/es/noticia/retmavid/
EVID	EVID: Innovative practices to fight the grapevine trunk diseases». Objective: to monitor innovative practices on GTD´s management, identified in WINETWORK project, by implementing protocols and field trials that allow to obtain information about the viability and efficacy of those practices. Members: 1 winery, 1 research group, 1 administrative body. Regional project	Regional OG	no website
SISTEMIO	Downy mildew and powdery mildew remote sensing system	Regional Funds	no website http://www.innovi.cat/es/innovi-coordina-prova-pilot-sistema-teledeteccio-gestio-tractaments-fitosanitaris-vinya/

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project name	main topic/characteristis	Frame work	web
VineDivers	Biodiversity-based ecosystem services in vineyards: analysing interlinkages between plants, pollinators, soil biota and soil erosion across Europe	FACCEJPI ERANET	http://www.vinedivers.eu/
ADER 521	Assessing the vulnerability of the viticultural ecosystem to the harmful impact of competing and antagonistic organisms	Romanian Ministry (ADER Funds)	http://www.madr.ro/cercetare-inovare/ader-2011-2014/ader-5-2011-2014/18-ader-5-2-1.html
ADER 116	Developing adapted wine technologies to mitigate the disruptive effect of climate change	Romanian Ministry (ADER Funds)	http://www.madr.ro/cercetare-inovare/ader-2011-2014/ader-1-2011-2014/57-ader-1-1-6.html
ADER 311	Technological system for the production of viticulture propagation material free from viruses in protected areas	Romanian Ministry (ADER Funds)	http://www.madr.ro/cercetare-inovare/ader-2011-2014/ader-2-2011-2014/15-ader-2-2-6.html
GTDfree	Management of grapevine trunk diseases	Hennessy/industrial chair ANR	https://www.plan-deperissement-vigne.fr/travaux-de-recherche/contributions-de-recherche/lancement-de-la-chaire-industrielle-gtdfree
Euréka	Management of grapevine trunk diseases	French Ministry	https://www.plan-deperissement-vigne.fr/travaux-de-recherche/programmes-de-recherche/eureka
CO-ACT	Flavescence dorée	French Ministry	https://www.plan-deperissement-vigne.fr/travaux-de-recherche/programmes-de-recherche/co-act
LONGVI	Vineyard sustainability	French Ministry	https://www.plan-deperissement-vigne.fr/travaux-de-recherche/programmes-de-recherche/longvi
ORIGINE	Vineyard sustainability	French Ministry	https://www.plan-deperissement-vigne.fr/travaux-de-recherche/programmes-de-recherche/origine
PHYSIOPATH	Vineyard sustainability	French Ministry	https://www.plan-deperissement-vigne.fr/travaux-de-recherche/programmes-de-recherche/physiopath
TOLEDE	Management of grapevine trunk diseases	French Ministry	https://www.plan-deperissement-vigne.fr/travaux-de-recherche/programmes-de-recherche/tolede
TRADEVI	Vineyard sustainability	French Ministry	https://www.plan-deperissement-vigne.fr/travaux-de-recherche/programmes-de-recherche/tradevi
VACCIVINE	Biocontrol of fanleaf virus	French Ministry	https://www.plan-deperissement-vigne.fr/travaux-de-recherche/programmes-de-recherche/vaccivine
VITIMAGE	Management of grapevine trunk diseases	French Ministry	https://www.plan-deperissement-vigne.fr/travaux-de-recherche/programmes-de-recherche/vitimage
Plant signaling and Phytoplasma Response	Plant signaling and Phytoplasma Response	Austrian Science Fundation	https://www.fwf.ac.at/en/
GYBase	Phytoplasma understanding	Austrian Science Fundation	https://www.fwf.ac.at/en/
Obsphytoplasmosen	Phytoplasma understanding	Austrian Ministry	
FFOQSI_DownyMildew	Downy Mildew	Austrian Ministry	
SOIL4WINE	Innovative approach to soil management in viticultural landscapes	LIFE+	http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=5780

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project name	main topic/characteristis	Frame work	web
ValorInVitis	Valorisation of biodiversity towards a more sustainable viticulture in "Colli Piacentini" environment	RDP 2014-2020 (Rural Devolpment Program, Emilia-Romagna Region IT)	
Nutrivigna	Innovation and new techniques of precision viticulture for vineyard nutrition	POR-FESR 2014-2020 (Rural Devolpment Program, Emilia-Romagna Region IT)	http://www.nutrivigna.it/nqcontent.cfm?a_id=13827
BIOCONVITO	"INTRODUCTION AND TESTING OF BIOLOGICAL CONTROL TECHNIQUES FOR EFFECTIVE AND SUSTAINABLE CONTROL OF INSECTS HARMFUL TO THE VINE IN TUSCANY"	EU programme of rural development f, funded by the regional government of tuscany	
RTA2010-00009-C03	Biology of pathogenic fungi causing wood diseases on grapevine and development of control methods.	Spanish Ministry (MINECO Funds)	http://p-rta2010-00009-c03-01.agripa.org/
RTA2015-00015- C02-01	Desarrollo de una tecnología para reforzar la resistencia de portainjertos y variedades a los patógenos fúngicos de la madera de la vid	Spanish Ministry (MINECO Funds)	
VIT-FOOT	Evaluation the impact of grafting methods on GTDs incidence	Regional Funds, Navarra region	no website
ViTHZ	Use of THz spectrometry to detect GTDs non-destructively	Regional Funds, Navarra region	no website
R-03-16	Characterization, epidemiology and control of fungal trunk pathogens of grapevine in La Rioja	Regional Funds, La Rioja region	no website
TROPICSAFE	Insect-borne prokaryote-associated diseases in tropical and subtropical perennial crops: facing, yellows in grapevines	H2020	http://www.tropicsafe.eu/
LIFE GREEN GRAPES	LIFE GREEN GRAPES - New approaches for protection in a modern sustainable viticulture: from nursery to harvesting	LIFE 2014-2020	http://www.lifegreengrapes.eu/

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eip-agri
AGRICULTURE & INNOVATION

The European Innovation Partnership 'Agricultural Productivity and Sustainability' (EIP-AGRI) is one of five EIPs launched by the European Commission to promote rapid modernisation by stepping up innovation efforts.

The **EIP-AGRI** aims to catalyse the innovation process in the **agricultural and forestry sectors** by bringing **research and practice closer together** – in research and innovation projects as well as through the EIP-AGRI network.

EIPs aim to streamline, simplify and better coordinate existing instruments and initiatives and complement them with actions where necessary. Two specific funding sources are particularly important for the EIP-AGRI:

- ✓ the EU Research and Innovation framework, Horizon 2020,
- ✓ the EU Rural Development Policy.

An EIP AGRI Focus Group* is one of several different building blocks of the EIP-AGRI network, which is funded under the EU Rural Development policy. Working on a narrowly defined issue, Focus Groups temporarily bring together around 20 experts (such as farmers, advisers, researchers, up- and downstream businesses and NGOs) to map and develop solutions within their field.

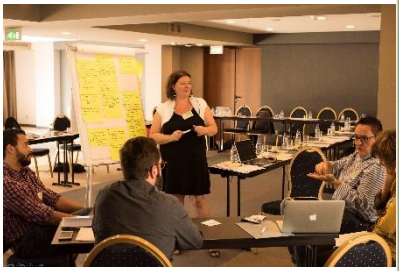
The concrete objectives of a Focus Group are:

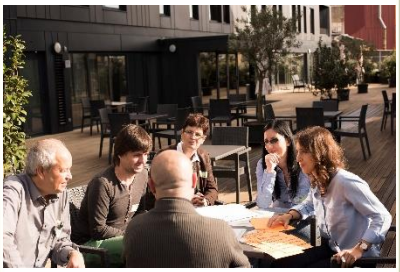
- ✓ to take stock of the state of play of practice and research in its field, listing problems and opportunities;
- ✓ to identify needs from practice and propose directions for further research;
- ✓ to propose priorities for innovative actions by suggesting potential projects for Operational Groups working under Rural Development or other project formats to test solutions and opportunities, including ways to disseminate the practical knowledge gathered.

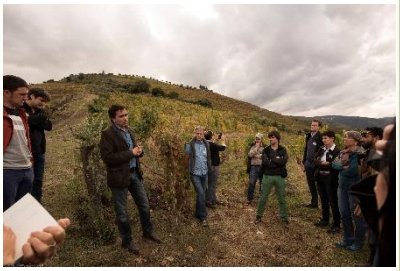
Results are normally published in a report within 12-18 months of the launch of a given Focus Group.

Experts are selected based on an open call for interest. Each expert is appointed based on his or her personal knowledge and experience in the particular field and therefore does not represent an organisation or a Member State.

*More details on EIP-AGRI Focus Group aims and process are given in its charter on:
http://ec.europa.eu/agriculture/eip/focus-groups/charter_en.pdf







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Join the EIP-AGRI network & register via www.eip-agri.eu

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