D1.1 Report on available technologies and their adoption

WP 1. Baseline definition and key drivers´ identification

Horta

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RENOVATE

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List of abbreviations

AI: artificial intelligence

AKTA: Advanced Knowledge Transfer Actions

BCA: Bio Control Agent

DSS: Decision Support System

EIP AGRI: Agricultural European Innovation Partnership

IoT: Internet of Things

IPM: Integrated Pest Management

OG: Operating Group

PPP: Plant Protection Products

SWOT analysis: Strengths, Weaknesses, Opportunities, Threats analysis

UAV: Unmanned Aerial Vehicle

Executive summary

This report presents the analysis of available technologies, developed for the agricultural activity in the frame of research project at National and European level. Seven main categories have been identified: i) Application technologies; ii) New products; iii) Soil management; iv) Physical techniques; v) Genetic resources; vi) Decision Support Systems and models; vii) Pest or symptoms detections. For each category, Strength, Weaknesses, Opportunities and Threats have been identified, as well as adoption rate and barrier to adoption.

1. RENOVATE project overview

The RENOVATE project 'Development of an easy-to-use interactive platform to renovate training experiences and networking for farmers in the field of sustainable crop management' will develop an attractive knowledge sharing platform that provides farmers, agro-foresters and advisors with unique access to both new and existing training tools and renovated educational programs. This platform is designed to increase the exchange of practical knowledge and enhance farmers' capacities to achieve sustainable crop management through the uptake of innovation.

Built on attractive and motivating technologies, such as serious games and gamified contents, the RENOVATE Platform will provide farmers, agro-foresters and advisors with a centralized access to new and existing training resources, legislative information applicable, best practices, practical and real data (including costs info) about the implementation of innovations in the field of Plant Protection optimisation. RENOVATE will feed the platform with resources developed by previous EU projects, including 14 EIP Agri Operational Groups. Moreover, RENOVATE will implement 15 Advanced Knowledge Transfer Actions (AKTAs) around Europe, which will generate knowledge ready for practice to be shared through the platform. RENOVATE will then be aligned with the Green Deal, the Farm to Fork Strategy and the new CAP, as well as the UN SDGs for 2030. The consortium involves 16 partners from 8 EU countries, that will work together for 48 months.

The RENOVATE platform, as a unique source for practical knowledge sharing and training material, is expected to become a reference for local and national administrations encouraging local farmers, agro-foresters and advisors to adopt innovation and new technologies for sustainable crop management.

2. Identification of new technologies

The importance of defining the baseline

Initially, the project aims to define the baseline to identify the farmers' and advisor's current status, needs and challenges regarding the available training options for Plant Protection Products (PPP) application optimisation. The feedback and information obtained in the baseline definition will inform the requirements specifications for the development of the architecture and digital base for the RENOVATE Community Platform in the form of an app adapted to farmers' and advisors' needs. Moreover, the collected information will serve as a base for the definition and then the compilation of training contents on PPP use optimisation and technology adoption for agricultural purposes (from existing sources) and on the development of new and attractive digital tools (games, simulations) to be integrated in the platform.

Methodology for information search

The aim of the initial information search was to identify technologies helping to reduce the use of Plant Protection products in field, which were developed in research projects. In this context, the term 'technology' also applies to techniques or best practices developed or tested from research projects, allowing farmers to decrease the need of sprays performed with chemical products.

The RENOVATE project activities are tailored to the European agricultural context, so the analysis was focused on the project partner countries and on the European Union as a whole. The research was performed by the partners involved in the task using the most relevant project databases available in each country, as well as those available at European level.

In order to identify the most relevant outcomes from EU funded research project, EU wide funding programmes targeting agriculture were identified in the EU Research and Innovation Framework Programme (Horizon Europe) and the CAP (Common Agricultural Policy). By mean of these programmes, the EU promotes an interactive and inclusive innovation model following three key principles: focus on actual needs of farmers, foresters and rural communities; bring together project partners with complementary knowledge; practice co-decision and co-creation. The interactive innovation model is implemented in the Horizon-funded multi-actor projects and the CAP-funded Operational Groups (OGs).

Common Agricultural Policy

EU's common agricultural policy (CAP) aims to support farmers and improve agricultural productivity, ensuring a stable supply of affordable food; safeguarding European Union farmers to make a reasonable living; help tackle climate change and the sustainable management of natural resources; maintaining rural areas and landscapes across the EU; keeping the rural economy alive by promoting jobs in farming, agri-food industries and associated sectors.

EU CAP network

The EU CAP Network is a forum where national CAP organisations, administrations, researchers, entrepreneurs and practitioners come together to share knowledge and information, research needs and practical solutions in agriculture, forestry and rural development. The network offers specific support for innovation, knowledge exchange as part of EIP-AGRI by providing networking activities, learning material and managing the EIP-AGRI project database with the support of the EIP-AGRI Support Facility.

Operating groups funded under the EU CAP network are accessible online at the following link: https://eu-cap-network.ec.europa.eu/projects/search_en?exposed_form_display=1

EU Research and Innovation Framework Programme

The current EU Research and Innovation Framework Programme is Horizon Europe, running for the period 2021-27. Its second pillar focuses on Global Challenges and European Industrial Competitiveness, supporting research and innovation activities that address societal challenges while enhancing technological and industrial capacities. Within this pillar, Cluster 6 focused on 'Food, Bioeconomy, Natural Resources, Agriculture and Environment', and offers funding opportunities for research and innovation in areas such as agriculture, forestry, rural areas, resource management, food systems, and environmental resilience.

Cluster 6

Under Horizon Europe's Cluster 6, collaborative research and innovation efforts focus on the agriculture, forestry, and rural sectors. The EU-funded projects encompass a broad spectrum of activities, such as developing innovative practices, technologies, products, and governance and business models. They help evaluate policy tools like the CAP and deepen understanding of socio-economic issues, including sector attractiveness and rural living conditions.

Many projects target climate change adaptation and mitigation, as well as agrobiodiversity, with a strong focus on sharing new knowledge and innovations with farmers, foresters, and rural stakeholders, while improving access for advisors.

Information on project funded under Horizon Europe, and the previous framework programmes (FP7 and Horizon 2020) are available in the Horizon Cordis platform: https://cordis.europa.eu/search.

Horizon Europe Mission 'A Soil Deal for Europe'

The EU Mission A Soil Deal for Europe (Mission Soil) is one of five missions funded by Horizon Europe. Its goal is to create 100 Living Labs and Lighthouses by 2030 to promote sustainable land and soil management by co-creating and testing practical, site-specific solutions for improving soil health, fertility and resilience to climate change. The Mission Soil empowers farmers, foresters and other landowners, land managers to increase productivity sustainably and reduce input costs, improving their competitiveness.

Information on project funded under the Soil Mission are available in the Horizon Cordis platform: https://cordis.europa.eu/search.

European partnerships

European Partnerships are strategic instruments, which enable long-term collaboration between the EU's various partners, bringing together the European Commission and private and/or public partners to address some of Europe's most pressing challenges through concerted research and innovation initiatives. This strategic alignment and pooling of resources makes them contribute significantly to achieving the EU's political priorities, such as the green and digital transitions. European Partnerships help to avoid duplication of investments and reduce the fragmentation of the research and innovation landscape in the EU.

Several European partnerships tackle the topics of Food, bioeconomy, natural resources, agriculture and environment, the most relevant to the RENOVATE project scope were identified in:

Circular Bio-based Europe, a partnership between the European Union and the Bio-based Industries Consortium (BIC) that funds projects advancing competitive circular bio-based industries. Information on funded project is available at: https://www.cbe.europa.eu/projects ;

Biodiversa+, the European Biodiversity Partnership that supports excellent research on biodiversity with an impact on policy and society. Information on funded project is available at: https://www.biodiversa.eu/research-funding/funded-projects/ ;

Water4All, the partnership aiming to tackle water challenges to face climate change, help to achieve the United Nations' Sustainable Development Goals and boost the EU's competitiveness and growth. Information on funded project is available at: https://www.water4all-partnership.eu/funded-projects ;

Agroecology partnership, accelerating farming systems transition through agroecology Living Labs and Research Infrastructures. Information on funded project is available at: https://www.agroecologypartnership.eu/en/projects ;

European Partnership for Research and Innovation in the Mediterranean Area (PRIMA), aiming to build research and innovation capacities and develop knowledge and common innovative solutions in the Mediterranean area in the thematic areas of water management, farming systems, food value chain. Information on funded project is available at: https://prima-med.org/projects-portfolio/.

Partnership constituted under the previous framework programme (Horizon 2020), and in line with the project search considered, for addressing the agricultural activity, and in particular vegetal productions, are:

Joint Programming Initiatives on Agriculture, Food Security and Climate Change (FACCE-JPI), building an integrated European Research Area addressing the interconnected challenges of sustainable agriculture, food security and impacts of climate change. Information on funded project is available at: https://www.faccejpi.net/en/faccejpi/actions.htm ;

European Joint Programme Cofund EJP soils, aiming to build a sustainable research community on agricultural soils and develop a roadmap on climate-smart sustainable agricultural soil management. Information on funded project is available at: https://ejpsoil.eu/ejp-soil-projects/;

Food systems and climate (FOSC) part of the ERA-net cofund instrument, aiming to achieve food and nutrition security and sustainable agriculture. Information on funded project is available at: https://foscera.net/projects ;

Suscrop, part of the ERA-net cofund instrument, aiming to strengthen the European Research Area in the field of sustainable crop production by better coordinating national and regional research programmes. Information on funded project is available at: https://www.suscrop.eu/call-information/1st-call;

Core Organic, focus on organic food, farming, and aquaculture. https://projects.au.dk/coreorganicpleiades/previous-core-organic .

LIFE programme

The LIFE Programme is the EU Programme for Environment and Climate Action, contributing to transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy, while protecting,

conserving and enhancing the EU's natural capital, and protect the health and well-being of citizens from environment and climate related risks and impacts. The LIFE Programme contributes to these priorities through its four sub-programmes: Nature and Biodiversity, Circular Economy and Quality of Life; Climate Change Mitigation and Adaptation; Clean Energy Transition.

Information on project funded under the LIFE Programme are available in the LIFE project databases:

https://webgate.ec.europa.eu/life/publicWebsite/search .

Interreg

Interreg is an initiative of the European Union that connects countries, regions and communities through a series of funding programmes promoting cross-border, transnational, interregional and outermost regions cooperation. Interreg supports projects that tackle shared challenges and deliver sustainable solutions, Interreg addresses regional inequalities while promoting economic, social and environmental development across Europe.

Information on project funded under the Interreg programmes are available: https://keep.eu/projects/ .

European wide and National databases were explored in order to retrieve information on newly developed technologies useful to reduce the use of plant protection product in tree crops, in line with the RENOVATE focus. The full list of websites and databases explored is reported in Annex 1. As the aim of the search is to identify recent technologies, the search was limited to projects started from 2016 onwards.

The search was performed using keywords such as ‘Plant Protection Product’; ‘pesticide’; ‘reduce use of plant protection product’; ‘reduction plant protection product’; ‘reduction pesticide’, and each partner was free to choose the most suitable ones for its search. Only projects dealing with tree crops were taken into consideration, in line with the target crops of the RENOVATE project.

A template for data collection was defined in excel, aiming to facilitate information gathering in a consistent way among partners. Horta was in charge of looking for international projects, while other partners were responsible to look for National project. This was done to facilitate the comprehension of the information available on the selected project, as usually for National or Regional ones information is only available in the National language.

For each project, relevant information only were collected: title, acronym, funding programme, specifications about the type of technology examined, and a link to the online database from which information were collected.

Search results

A total of 180 projects were identified as relevant to the RENOVATE scope, considering that the project mainly addresses the reduction of the use of Plant Protection products in tree crops. For each identified project, the publicly available material was checked, in order to verify the information as in line with the technologies for plant protection product reductions. A summary of the main project scope was reported in the excel file, and the main technologies or techniques tested were identified. A summary of the main information retrieved is presented in Annex 2 of the present document.

One third of the identified projects are funded under European wide grants and thus involve partners from different countries. The graph in Fig. 1 shows the relative abundance of projects funded from National Authorities in the various countries.

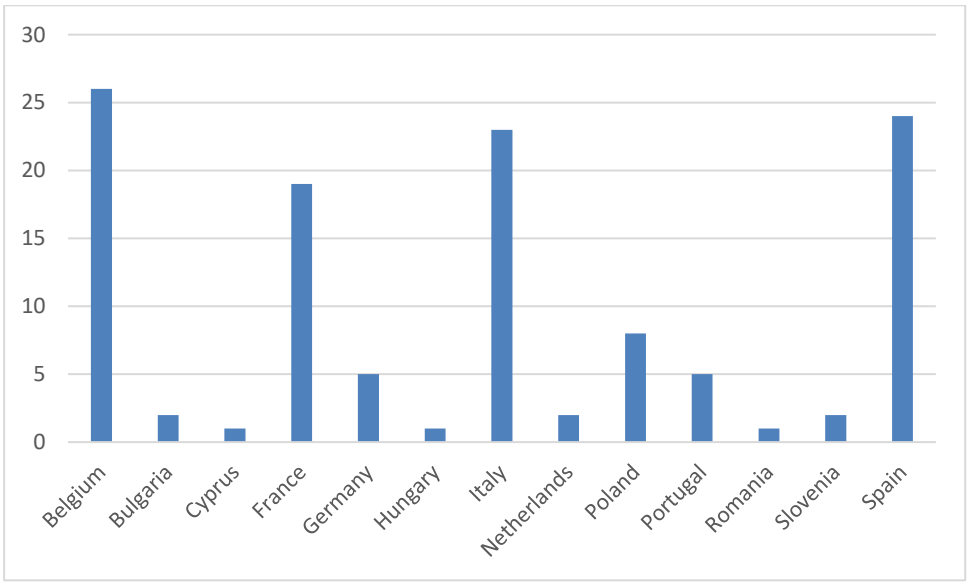

Fig. 1 Relative abundance of projects funded from National countries and identified as relevant to the RENOVATE scope.

Most of the project addressed more than one crop, with grapevine and pomefruits being the most investigated ones, followed by stonefruits, olive and citrus (Fig. 2).

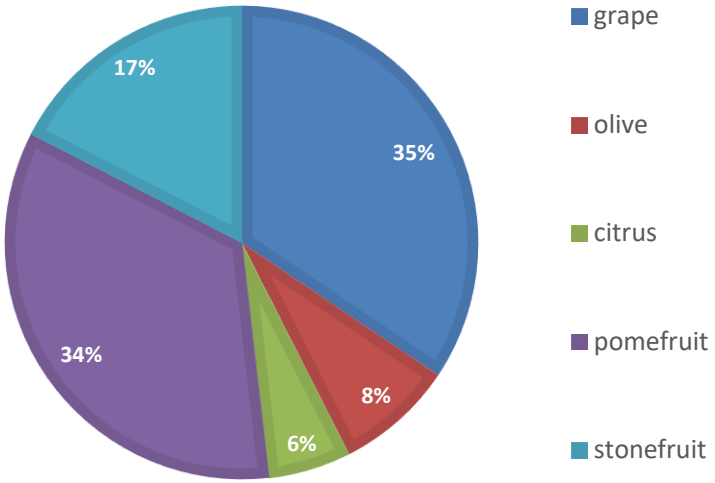

Fig. 2 Relative representation of crops addressed in the identified research projects.

The screening of the technologies addressed allowed to classify them in seven main categories:

- Application technologies, including all the technologies related to the spray application techniques, such as variable rate application, precision application, drift reduction, electric machinery.
- New products, including Bio Control Agents, alternative products such as organic formulations, resistance inducers, products from insect mass trapping.
- Soil management, including agroecology techniques and the promotion of functional biodiversity.
- Physical techniques, which can be applied to avoid the application of chemicals, such as insects mating disruption, net systems, traps, mechanical weeding.
- Genetic resources, including projects dealing with the development and testing of plant varieties resistant to pathogens.
- Decision Support Systems and models, which can support the decision on the need of a treatment or how to perform it.
- Pest or symptoms detections, which can be enhanced by newly developed algorithms for image analysis

Application technologies

A total of 87 projects were identified as relevant to this category, and the main research topics are related to the development and testing of new equipment, with particular emphasis on variable rate applications, improved PPP distribution, tools for drift reduction and spray volume adjustment. Unmanned

and electric machinery are also under study, as well as the application by mean of Unmanned Aerial Vehicles (UAV). Attention is also posed to training to the users, with several initiatives stressing the importance of performing spray operations correctly.

New products

A total of 115 projects were identified as relevant to this category. The solutions developed and tested in these projects mainly addressed the use of Bio Control Agents, testing organisms, formulation and application strategies. Moreover, resistance inducers and biostimulants were tested, aiming to enhance plant resistance to pest and diseases. Biopesticides were also tested, as well as those deriving from by-products, underlining the concept of circular economy. Pheromones and mating disruption methods were also object of study.

Soil management

A total of 52 projects were identified as relevant to this category. The solutions developed and tested in these projects mainly aim to develop and implement soil management techniques able to contribute to pest and disease control. In particular, new solutions aim to exploit ecology-based processes, more diversity and more biodiversity, which are expected to contribute to the control of the development and spreading of pest and diseases. The increase of biodiversity is mainly reached by the use of cover crops in the orchards, either on the row or in the interrow.

Physical techniques

A total of 32 projects were identified as relevant to this category. The solutions developed and tested in these projects mainly aim to physical methods which can contribute to the crop protection, such as net systems to avoid pests to enter the orchard, or UV technology to protect plants against fungal diseases. Mass trapping techniques for insects were also tested, as well as fungal disease inoculum removals.

Genetic resources

A total of 15 projects were identified as relevant to this category. The solutions developed and tested in these projects mainly aim to minimise fungicide use

and improve biodiversity in orchards, promoting the use and the correct management of plant varieties with disease resistance, well suited to local environment. The resistance to abiotic stress is also investigated, aiming to identify crop varieties more tolerant in order to reduce technical inputs usage in the cultivation.

Decision Support Systems

A total of 75 projects were identified as relevant to this category. The solutions developed and tested in these projects mainly addressed the application of efficient models of agronomic management. The development and test of models for crop, pest and disease was also addressed, as well as their use for decision support.

Pest/Symptoms detection

A total of 34 projects were identified as relevant to this category, addressing the identification of pest, diseases and weeds by image analysis. Tools for detection can analyse images deriving from sensors in the fields, UAVs or satellite. New and automated diagnostic tools are also investigated.

3. Analyses of the classes of technologies

In order to evaluate the identified classes of technologies, SWOT analyses were carried out. A SWOT analysis allows to evaluate Strengths (S), Weaknesses (W), Opportunities (O), and Threats (T) related to a particular project or situation. This analysis helps identifying both internal and external factors that could influence the success or failure of the subject under analysis.

Strengths are represented from internal attributes and resources that give and advantage over others and contribute to success and need to be leveraged. Weaknesses are internal factors that could hinder progress or prevent success. These are areas for improvement or limitations that need to be addressed. Opportunities are external factors or trends that could be advantageous or beneficial if leveraged. These represent potential areas for growth or success. Threats are external challenges or risks that could potentially harm or hinder the progress of the initiative. These are factors outside the control of the entity being analysed.

An analysis of the barriers preventing adoption of new technologies from farmers and advisors is also carried out. Adoption of new technologies goes beyond their purchase; it requires a change in the farm management. A successful adoption balances economic, environmental, and operational goals. The adoption of agricultural innovations has been studied, highlighting that the uptake of innovations depends on five main attributes: i) relative advantage; ii) compatibility with existing practices; iii) complexity of the innovation; iv) trialability; v) observability. In agriculture, adoption decisions are also strongly influenced by risk perception and farm-level constraints. Farmers operate in uncertain environments where pest pressure, weather conditions, and market prices fluctuate. Consequently, innovations that are perceived as risky or difficult to integrate into existing systems are less likely to be adopted.

Application technologies

The main plant protection product (PPP) application technologies are used to efficiently deliver pesticides, herbicides, fungicides, and other agricultural chemicals to crops. Different technologies are available, aiming to minimize waste, improve precision, and reduce environmental impact. Each technology has its advantages and limitations, and the choice of technology depends on factors like the crop being treated, the type of pest or disease, environmental conditions, and the scale of the operation. Precision and smart application technologies are gaining traction because they reduce waste, lower environmental impact, and increase efficacy.

Plant protection product application technology innovations are creating new avenues for improving agricultural productivity and sustainability. However, while they bring significant benefits, such as increased precision, reduced environmental impact, and cost savings, the challenges, including high initial costs, regulatory concerns, and infrastructure limitations, need to be addressed for broader adoption. The growing focus on sustainability and the demand for more efficient agricultural practices provides substantial opportunities, but the industry must remain cautious of potential resistance development and the risks associated with over-reliance on technology.

Strengths

- Increased precision and efficiency: technological innovations allow for precise application, reducing pesticide waste and improving target accuracy, which maximizes effectiveness.
- Reduced environmental impact: technologies such as smart nozzles minimize drift, ensuring that chemicals are applied only where needed, reducing environmental pollution and harm to non-target organisms.
- Cost savings: efficient use of resources (water, pesticides, labour) leads to cost savings for farmers in the long run.
- Automation and labour reduction: autonomous systems reduce the need for manual labour, improving operational efficiency and minimizing human errors.

Weaknesses

- High initial investment: the cost of adopting advanced technologies can be high, which might be a barrier for small-scale or resource-limited farmers.

- Complexity and learning curve: some technologies require a high level of technical knowledge to operate effectively. Farmers may face challenges in learning and managing new systems, especially those that integrate multiple technologies.
- Limited infrastructure: access to robust infrastructure, such as reliable internet and GPS systems, can be limited in rural or underdeveloped areas, hindering the implementation of advanced technologies.
- Regulatory and safety concerns: the introduction of new technologies often faces regulatory hurdles. There may be concerns over the safety of novel approaches like drone spray application, which could slow adoption.

Opportunities

- Growing demand for sustainable agriculture: there is increasing demand for more sustainable farming practices, driven by environmental concerns, consumer preferences, and regulatory pressure. This opens up opportunities for innovations that minimize pesticide use and environmental impact.
- Expanding markets for precision agriculture: with the increasing adoption of precision agriculture globally, the demand for advanced application technologies is expected to rise.
- Integration with emerging technologies: combining PPP application technologies with emerging fields such as blockchain for traceability, or data analytics for predictive modelling, could offer opportunities for innovation.
- Government and research support: governments and international organizations are investing in sustainable agricultural technologies. Incentives, subsidies, and research funding could accelerate the adoption of PPP application innovations.
- Better resource management: innovations in resource-efficient technologies (e.g., water and nutrient management) are key opportunities to optimize input use, boosting both profitability and environmental stewardship.

Threats

- Technological dependence: over-reliance on technological solutions may reduce farmers' ability to adapt or respond manually when technology fails or malfunctions, especially in remote or low-resource areas.

- Economic inequalities: the costs of new technologies might disproportionately benefit larger farms or those in developed regions, leaving smaller or less affluent farmers at a disadvantage and exacerbating the gap between different agricultural sectors.

Adoption and Barriers

Adoption rates of application technologies vary depending on farm characteristics, technology type, and geographic region, as well as farm size and production systems. Larger farms are more likely to invest in advanced spray technologies, as they can distribute the fixed costs over larger production areas. Similarly, high-value crops such as orchards and vineyards often show higher adoption rates because precision spraying can generate significant economic returns.

Main barrier in application technology adoption can be identified in:

- Economic barriers: they represent one of the most significant obstacles to adoption, as advanced spray systems often require substantial capital investments in specialized machinery, sensors, software, and data management tools. The initial investment can thus be a significant barrier especially for small and medium farms.
- Technical barriers: advanced spray technologies require the integration of multiple components, so that the technical complexity can be a major barrier to adoption. Farmers may encounter difficulties in getting familiar with the new technologies. New technologies can also be not compatible with old equipment that can be already present in the farm.
- Knowledge and training barriers: new skills are required for the adoption of new application technologies, related to digital technologies, data analysis, and equipment management. Specific training and advice is needed to effectively use these tools.
- Farm structural factors: farm size, farmer age, education level, and financial resources need to be taken into consideration for the decision to adopt new application technologies. Younger farmers and those with higher levels of education are generally more willing to adopt innovative technologies. Similarly, larger farms tend to adopt precision technologies earlier due to their greater financial capacity and operational scale.
- Institutional and regulatory barriers: the availability of policy incentives, subsidies, and the presence of rural infrastructure, such as broadband internet connectivity, have an impact on the diffusion of digital agricultural technologies. On the other hand, environmental regulations related to pesticide use and spray drift can encourage farmers to adopt improved spraying technologies.

Advisors have a role in the adoption of technology by the farmers. They can leverage on the agronomic performance of the technologies, which allow to an improved crop protection from pest and diseases, and is more compliant with the environmental and regulatory requirements. Advisors can also effectively support the farmers in the appropriate usage of the technology, helping them in the learning phase.

New products

In European orchards, resistance inducers, mass trapping, and biocontrol agents are increasingly being used as part of Integrated Pest Management (IPM) strategies to reduce the reliance on chemical pesticides and promote sustainable farming practices. Many orchards today use a combination of resistance inducers, mating disruption, and biocontrol agents as part of an integrated pest management (IPM) strategy. In European orchards, the use of resistance inducers, mass trapping, and biocontrol agents offers an eco-friendly alternative to traditional chemical pesticides. They help reduce pest damage, lower production costs, and protect both the environment and beneficial species. These practices are critical components of sustainable agricultural systems and are increasingly recognized as essential tools for maintaining healthy and productive orchards.

Strengths

- Environmentally friendly: techniques such as mating disruption and the use of biocontrol agents or resistance inducers are non-chemical methods minimizing environmental impact by reducing the need for chemical PPP, thus promoting sustainability and protecting non-target organisms.
- Targeted pest control: techniques such as mating disruption and the use of biocontrol agents or resistance inducers focuses on specific pests, reducing harm to beneficial insects (e.g., pollinators and natural predators) and maintaining ecological balance.
- Reduced resistance development: unlike chemical plant protection products, which can lead to the development of pest resistance over time, techniques such as mating disruption and the use of biocontrol agents or resistance inducers help manage pest populations without contributing to resistance.
- Simple to implement: mating disruption systems are often easy to install and can be used in various cropping systems without requiring significant technological expertise.
- Less impact on human health: since techniques such as mating disruption and the use of biocontrol agents or resistance inducers avoid

chemical PPP, it reduces the risk of residues on food and potential health risks for farmers and consumers, as well as for the farmer.

- Enhanced disease resistance: resistance inducers stimulate plants' natural defence mechanisms, leading to increased resistance against a variety of pathogens (fungal, bacterial, viral).
- Reduced dependency on chemical pesticides: they offer an environmentally friendly alternative to synthetic chemical pesticides, potentially reducing pesticide resistance in pests.

Weaknesses

- Dependence on environmental conditions: effectiveness can be affected by environmental factors such as temperature, humidity, and soil conditions, making them less reliable in certain climates.
- Effectiveness may vary: the effectiveness of resistance inducers can vary depending on the plant species, pathogen, and environmental conditions, making them less predictable than chemical PPP.
- Limited spectrum: techniques such as mating disruption and the use of biocontrol agents or resistance inducers may only be effective against certain types of pathogens or a limited range of diseases, requiring additional treatments for broader protection.
- Limited knowledge: There is still a gap in understanding the full potential and limitations of biocontrol agents, which can hinder adoption and effective application.

Opportunities

- Growing demand for sustainable farming: with increasing demand for organic and sustainable farming practices, techniques such as mating disruption and the use of biocontrol agents or resistance inducers offer a viable and eco-friendly alternative to chemical pesticide use.
- Technological advancements: advancements in trap design, pheromone formulations, and remote monitoring technologies can improve the effectiveness and efficiency of mating disruption systems.
- Integrated Pest Management (IPM): techniques such as mating disruption and the use of biocontrol agents or resistance inducers can be valuable tools within an integrated pest management strategy, combining with biological control and other methods for more effective pest control.
- Market for eco-friendly products: consumers are increasingly concerned about pesticide use in food production, and the adoption of techniques

such as mating disruption and the use of biocontrol agents or resistance inducers aligns with the market's shift toward pesticide-free or reduced-pesticide products.
- Research and development: ongoing research into more efficient, broad-spectrum, and cost-effective new techniques such as mating disruption and the use of biocontrol agents or resistance inducers presents opportunities to enhance their applicability and effectiveness.
- Organic farming growth: with the rise of organic farming practices, techniques such as mating disruption and the use of biocontrol agents or resistance inducers can play a vital role in supporting disease management without compromising organic certification.

Threats

- Lack of knowledge: the application of techniques such as mating disruption and the use of biocontrol agents or resistance inducers require knowledge or expertise, which may prevent widespread adoption, especially in developing countries.
- Unintended consequences: introducing biocontrol agents into new environments could potentially disrupt local ecosystems or have unintended side effects, such as non-target species being affected.
- Competition with chemical methods: chemical PPP are still widely used due to their effectiveness and ease of application, which can make the adoption of techniques such as mating disruption and the use of biocontrol agents or resistance inducers slower in conventional agriculture, particularly where pesticide regulations are lax or chemical options are more affordable.

Adoption and Barriers

Adoption rate of new product is sometimes limited, influenced not only by the technical performance of the products but also by economic, informational, institutional, and behavioural factors.

- Economic barriers: farmers evaluate innovations based on their expected profitability and cost-effectiveness, so the economic consideration is significant. The use of new products can lead to higher product costs compared with conventional pesticides, due for example to the need to purchase equipment (such as traps for insect mass trapping), or the need of repeated application, meaning additional labour or monitoring requirements.

- Technical and performance barriers: farmers can have concerns about the reliability and effectiveness of the new product. In particular, the efficacy under field condition may vary due to their sensitiveness to environmental condition, and they need to be entered in a compatible overall strategy of pest management practices.
- Knowledge and information barriers: new skills are needed to adopt innovative pest management solutions, so that limited access to information or training can therefore hinder adoption. Relevant barriers include limited awareness of available alternatives; insufficient technical knowledge on how to use them effectively; lack of extension services or advisory support; limited demonstration trials at the local level. Farmers are more likely to adopt innovations when they observe successful implementation by peers or receive guidance from trusted advisors.
- Institutional and regulatory barriers: institutional factors such as regulatory frameworks, certification systems, and supply chain structures can significantly influence adoption. Limited availability of approved new product can limit their adoption, as well as market structures favouring conventional pesticides. The presence of policies supporting integrated pest management or reducing pesticide use can facilitate adoption, but inconsistent regulatory environments may slow down the diffusion of alternative technologies.
- Behavioural and social barriers: farmers' attitudes, beliefs, and social contexts also play a crucial role in adoption decisions. Significant barriers can be the individual risk aversion, resistance to changing established practices, as well as the influence of peer networks.

Advisors can somehow experience similar barriers as farmers related to the adoption of new products, being a mix of knowledge gaps, economic risks, regulatory complexities, practical limitations, and behavioural factors. The availability of training for advisors and field demonstrations can help improving their knowledge and prove the efficacy of the new products. Clear economic incentives and evidence of efficacy, as well as regulatory simplification and better product support can also improve the adoption.

Soil Management

The adoption of cover crops can depend on the specific practices of the orchard and the types of crops grown. For example, in some high-value orchards, such as vineyards or tree-fruit orchards, farmers may use cover crops selectively, depending on the crop's needs and the balance between orchard maintenance and soil health. In general, the trend toward using cover crops has been growing, especially as European agriculture moves toward more sustainable practices, with policies promoting environmental conservation.

In general, in Southern Europe (e.g., Spain, Italy, Greece) cover crops are used in Mediterranean orchards (such as olive groves and citrus orchards) to improve soil fertility, reduce erosion, and manage water efficiently. In Central and Northern Europe (e.g., France, Germany, Netherlands), cover crops are commonly used in apple, pear, and stone fruit orchards. They are especially beneficial for controlling weeds and improving soil quality in regions with more rainfall and colder climates.

Strengths

- Soil health improvement: grassing in the interrow of tree crops, either with spontaneous vegetation or with sown cover crops, demonstrated to improve soil structure and prevent erosion, enriching the soil with organic matter and enhancing water retention. Moreover, it can improve soil fertility by fixing nitrogen (for leguminous cover crops), increasing microbial diversity, and reducing soil compaction. The right choice of species and the green manure techniques can also lead to a reduction of the need for external inputs t the crop (i.e. fertilisers).
- Weed control: the presence of grassing can suppress weed growth by outcompeting them for sunlight, nutrients, and space, reducing the need for herbicides.
- Pest management: the presence of cover crops enhances biodiversity in the orchard, attracting beneficial insects and decreasing pest and pathogen pressure exploiting functional biodiversity.
- Water conservation: the presence of grassing reduces surface runoff and increases water infiltration into the soil.

Weaknesses

- Increase of complexity in orchard management: more expertise is required to the grower for choosing the right cover crop species, sowing and termination timing. Especially in climates with short growing

seasons or in orchards where space is limited, cover crop management can be complex.
- Competition for resources: cover crops may compete with the main crop for water and nutrients, potentially impacting yield and quality if not managed properly.
- Costs for cover crop management: cost can increase for due to cover crop management (sowing and crop operation, which can require specific equipment).

Opportunities

- Climate Resilience: the presence of grassing in the interrow can help mitigate climate change impacts by improving soil health, which can lead to better drought tolerance and overall resilience to extreme weather conditions.
- Diversification: the implementation of sustainable farming practices can lead to new market opportunities for the farmer (i.e cover crops seed production) and may allow the request for dedicated subsidies. Consumers are increasingly demanding for product obtained using sustainable farming practices.
- Improved soil carbon sequestration: an improved soil management can enhance carbon sequestration, contributing to the mitigation of climate change, and potentially opening the carbon credit market for the farmer.

Threats

- Climate variability: in areas where climate conditions fluctuate dramatically (e.g., extended droughts or floods), cover crops may not perform consistently, potentially leading to failures.
- Farmers resistance: traditional growers may be reluctant to adopt cover cropping practices due to unfamiliarity with the concept or skepticism about its benefits, leading to slower adoption rates. Moreover, farmers can be reluctant to keep the adopted solution over time and to spend money specifically for it (i.e. buying machineries or paying for external service).
- Government regulations and support: lack of strong policy incentives or support for sustainable farming practices could limit the adoption of cover cropping in fruit production. If government regulations do not recognize or support these practices, growers may hesitate to invest in them.

Adoption and Barriers

The decision to adopt of new soil management strategies are linked to both individual farmer characteristics (attitudes, knowledge, risk perception) and external structural conditions (economic incentives, policy context, social networks). These factors shape farmers' perceived feasibility, profitability, and compatibility of agroecological soil practices. Supportive policies, training, financial incentives, and peer learning can have a positive effect on adoption rates.

- Economic and financial barriers: economic uncertainty, linked to initial investment costs (equipment for reduced tillage, seeds for cover crops); short-term yield reduction risks; delayed economic benefits.
- Knowledge and information barriers: successful implementation of agroecological soil management requires understanding complex ecological interactions, such as soil microbiology, crop–soil feedbacks, and biodiversity dynamics, and thus requires and enhance knowledge. Farmers may lack access to adequate training, extension services, or locally adapted knowledge.
- Risk and uncertainty: risk perception strongly influences farmer behaviour. Innovative soil management practices such as cover cropping or reduced tillage may introduce uncertainty regarding yield stability, weed and pest dynamics, soil moisture management.
- Social and cultural factors: farmers are often rely on local communities and informal knowledge exchange to evaluate new practices.
- Institutional and policy constraints: subsidy and incentives structure can have an impact on the adoption of new soil management, as well as the presence of local research and demonstration activities of the new practices.
- Structural and farm characteristics: farm size, labour availability, land tenure, and access to machinery influence adoption capacity.

Advisors experience related barrier in promoting the adoption of new soil management techniques. Advisors may lack sufficient training, as they may have been historically focused on input-intensive agriculture, emphasizing fertilizers, pesticides, and yield optimization. Advisors may feel less confident recommending agroecological practices, requiring them to tailor to the local specific context. Without strong evidence or demonstration sites, advisors may hesitate to recommend practices perceived as uncertain or experimental.

Physical techniques

In Europe, the use of physical methods for pest and disease control in orchards has been steadily increasing in recent years. Netting is one of the most widely used physical methods in European orchards, aiming to protect orchards from both insect pests. UV technologies primarily focus on controlling fungal diseases, thus contributing to reduce the need for fungicides. Mass trapping, which targets specific pest populations using pheromone or sticky traps, is increasingly used across Europe, particularly in integrated pest management (IPM) programs.

Strengths

- Targeted pest and disease control: netting offers a direct and precise way to prevent specific pests from reaching crops without affecting other organisms like pollinators. Mass trapping (pheromone or sticky traps) targets specific pests, reducing the risk of non-target species being harmed.
- Support for Integrated Pest Management (IPM) and organic farming: reducing the need for chemical plant protection products applications.
- Long-term investment: high initial setup costs are balanced by long-term cost savings, as netting, traps, and UV systems can be durable and reusable with proper maintenance.
- Reduced resistance development: unlike chemical PPP, which can lead to the development of pest resistance over time, physical techniques help manage pest populations without contributing to resistance.

Weaknesses

- Labour-intensive: setting up, maintaining, and monitoring traps and netting system requires continuous effort, which can be labour-intensive, especially in large-scale farming operations. For example, nets may need regular repairs, cleaning, or replacing. Traps need to be monitored, cleaned, and recharged (e.g., with new pheromones).
- Limited pest control: mass trapping generally controls pest populations only at the trapping sites. It may not be sufficient for widespread pest infestations, especially if the pest pressure is high.
- Initial setup costs: while maintenance costs may be low, the initial investment , such as purchasing nets, UV equipment, or mass trapping systems can be costly, particularly for large-scale operations.

- Limited coverage or effectiveness: netting and UV technology may not provide total protection in high pest-pressure situations or when pests have already established. UV systems might only be effective against certain fungal pathogens and may not cover all disease risks.
- Effectiveness can be weather-dependent: physical barriers like netting may not perform well in extreme weather conditions (e.g., heavy winds or storms). UV light systems might need to be used carefully, as overexposure could harm plants, and UV effectiveness is reduced in cloudy or rainy conditions.
- Aesthetic and Physical Space Issues: The use of large-scale netting can affect the appearance of orchards and may be seen as unappealing to consumers in some regions. In some orchards, installing and maintaining nets can be physically difficult, especially for larger areas or on sloped terrain.

Opportunities

- Growing demand for sustainable farming: with increasing demand for organic and sustainable farming practices, physical techniques for avoiding pest and diseases offer a viable and eco-friendly alternative to chemical pesticide use.
- Integrated Pest Management (IPM): physical techniques for avoiding pest and diseases can be a valuable tool within an integrated pest management strategy, combining with biological control and other methods for more effective pest control.
- Market for eco-friendly products: consumers are increasingly concerned about pesticide use in food production, and the adoption of mass trapping aligns with the market's shift toward pesticide-free or reduced-pesticide products.
- Expanding to new pests: Ongoing research into pest, diseases and pheromone identification may lead to the development of physical techniques for new pests, further expanding its potential in agriculture.
- Technological advances: advances in UV technology and automated systems for mass trapping (e.g., automated trap monitoring, smart traps) offer opportunities to increase the efficiency and cost-effectiveness of physical methods. New materials for netting and UV systems that are lighter, stronger, and more durable could reduce costs and improve adoption rates.
- Regulatory pressure on plant protection products use: stricter regulations on pesticide use encourage farmers to explore and adopt alternative pest and disease control methods. Growing concerns about the negative impact of chemical pesticides on biodiversity and health may lead to increased government support for physical solutions.

- Integration with other sustainable practices: physical methods can be combined with biological controls, crop rotation, and other sustainable farming practices to create a more holistic, resilient approach to pest and disease management.

Threats

- Dependence on specific pests: mass trapping is generally effective only for certain types of pests (e.g., those attracted to specific pheromones), making it unsuitable for controlling a wide range of pest species.
- Climate change and extreme weather: increasing weather extremes, such as storms, heavy rains, or droughts, can compromise the effectiveness of physical barriers like nets or UV systems. More unpredictable pest populations may emerge due to climate changes, making it harder to predict the most effective methods or system designs.
- Pest resistance and adaptation: although physical methods can reduce pesticide use, pests might still find ways to bypass barriers or adapt to trapping systems, especially if not properly managed or if populations grow too large.
- Cost pressure: high upfront costs and maintenance requirements may be prohibitive for smaller or less-capitalized orchards, especially in times of financial uncertainty or when commodity prices fluctuate. The increasing pressure on profitability may deter investment in physical methods, especially in conventional farming systems where chemical methods are still cheaper or more familiar.
- Public perception: some consumers may see netting or UV technology as an unnatural or overly industrial solution, potentially raising concerns about the aesthetics of farm operations and the "naturalness" of the produce. The effectiveness of physical methods is sometimes perceived as less immediate or less reliable than conventional chemical treatments.

Adoption and Barriers

The adoption of physical techniques as sustainable alternatives to chemical pesticides and herbicides face multiple adoption barriers. High costs, technical complexity, labor requirements, limited access to inputs, and social-cultural resistance hinder widespread adoption. Conceptualizing these barriers through a multifactorial framework provides a roadmap for designing targeted interventions, such as subsidized inputs, farmer training, community

demonstration plots, and policy incentives. Addressing these barriers holistically can improve adoption rates and promote environmentally sustainable farming practices.

- Economic barriers: high initial costs related to the equipment purchase; perceived cost-benefit imbalance, as farmers may perceive returns as insufficient relative to labour, installation, or maintenance costs.
- Knowledge and technical skills: many farmers lack awareness or training on how to use these techniques effectively. Moreover, the variable effectiveness due to pest pressure, crop type, or environmental conditions may discourage adoption.
- Labour and time constraints: physical techniques often demand more frequent monitoring, labour, and maintenance than chemical alternatives, particularly in intensive cropping systems.
- Social and cultural factors: farmers accustomed to conventional chemical practices may resist adopting unfamiliar techniques. Adoption is often influenced by neighbouring farmers' experiences and success stories.
- Policy and institutional factors: the presence of incentives, extension services, or support programs can influence adoption.

Also, advisors experience similar barriers towards the implementation of physical techniques. The availability of knowledge and skills, such as limited training in new physical techniques or lack of practical experience can prevent their adoption. Advisors can also prefer chemical solutions due to the familiarity or past experience, or the limited availability of tools or demonstration materials to show farmers how to implement techniques.

Genetic resources

For some crop species, e.g. apple, pear, grapevine, disease resistant varieties are available, having a diminished susceptibility to some diseases. The use of disease-resistant varieties in European orchards varies by crop, country, and the specific diseases being targeted, but in general is increasing in recent years. The adoption rate is higher in organic farming systems, where alternatives to synthetic chemicals are more crucial. Further adoption is expected, particularly with growing environmental and sustainability pressures and the development of better-tasting, market-accepted resistant cultivars.

Strengths

- Reduced need for chemical plant protection products: plant-resistant varieties have resistant genes for some diseases, reducing the need for

application in field of plant protection products and helping promote more eco-friendly farming practices.

- Sustainability: the use of disease resistant varieties contributes to sustainable agriculture by reducing environmental pollution and increasing biodiversity in the field, promoting beneficial insects population.
- Less environmental impact: disease resistant varieties reduce the environmental damage caused by plant protection products use, such as contamination of soil and water systems.
- Adaptability to different environments: some resistant varieties can be tailored to thrive in different climates and soil types, offering farmers more flexibility and adaptability.

Weaknesses

- Limited availability: not all crops have developed resistant varieties, limiting their application.
- Slow development process: developing new resistant varieties through conventional breeding or new genetic techniques require time and research.
- Need of knowledge: disease resistant varieties need to be managed, and still require the application of PPP, in a lesser extent than traditional varieties. Farmers need to receive appropriate training on the management, and guidelines to get the best from their plantation.
- Regulation limitation: the use of disease resistant varieties needs to be authorised, which is not the case for all Regions in Europe. Moreover, in the case of grapevine, the use of grapes from disease resistant varieties in appellation wine production is still restricted in several regions.
- Resistance break: in the case strains in the pathogen population break the resistance, the advantage of the variety is lost.

Opportunities

- Increasing consumer demand for eco-friendly products: as consumers demand more sustainable and pesticide-free products, resistant varieties can be marketed as an eco-friendly alternative to conventional crops.
- Advancements in biotechnology: advances in genetic research and new techniques can accelerate the development of more resistant crop varieties, including those that are resistant to multiple diseases.

Threats

- Pest resistance: just like chemical pesticides, there is a risk that pests may eventually evolve to overcome the resistance in plant varieties, reducing their effectiveness over time.
- Acceptance and public perception: disease resistant varieties may face opposition from consumers, regulatory bodies, or advocacy groups concerned about food safety and environmental impacts, limiting market acceptance.

Adoption and Barriers

The adoption of pathogen-resistant plant varieties remains constrained by socio-economic, institutional, and technical barriers.

- Socio-economic barriers: cost and affordability, resistant varieties are often more expensive than conventional seeds due to research, development, and distribution costs. Perceived risk and uncertainty: farmers may be hesitant to adopt new varieties without clear evidence of their performance under local conditions. Knowledge and awareness: lack of information on resistant varieties, their management requirements, and expected yield advantages can delay adoption. Cultural preferences: farmers may prefer traditional varieties product characteristics.
- Institutional and market barriers: policy and regulatory: complex variety registration and authorisation processes can slow down the availability of improved varieties, or the possibility to crop them. Inadequate agricultural extension support restricts farmer training in managing new varieties, including disease monitoring, planting schedules, and fertilizer use.
- Technical and environmental barriers: adaptation to local agro-ecologies: resistant varieties developed in research stations may perform poorly under diverse field conditions, discouraging farmer adoption. Resistance breakdown: pathogens may evolve to overcome resistance, creating uncertainty and reducing trust in improved varieties. Compatibility with existing practices: new varieties may require different planting densities, irrigation regimes, or input applications, which can be a barrier if farmers lack resources or knowledge.

Advisors face a different but related set of adoption barriers compared to farmers. Their barriers often affect adoption indirectly, because they are the intermediaries who deliver knowledge, seeds, and management practices to farmers. Advisors need sufficient technical knowledge about pathogen-

resistant varieties, including local performance of new varieties, and best management practices for resistant varieties. Advisors may have limited motivation to promote new varieties, so low advisor engagement can reduce farmer uptake.

Decision Support Systems and models

The use of Decision Support Systems (DSS) and models in agriculture has been growing steadily, with increasing adoption driven by advancements in technology, the need for precision farming, and the drive for greater sustainability and efficiency. The adoption of DSS across Europe can vary based on region and crop type. For instance, in countries like the Netherlands, France, and Spain, which are known for their large-scale and high-tech agricultural operations, DSS adoption is more widespread. Smaller or more traditional orchards may still be less likely to use DSS due to cost, lack of technical knowledge, or simply because they are less familiar with the benefits.

Strengths

- Improved decision making: DSS and models can help farmers to make more informed decisions by exploiting data to predict crop yields, pest outbreaks, or providing advice on daily management operations. The possibility to access up-to-date information on weather forecasts, crop phenology, risk of pest outbreaks, aids in real-time decision-making, ensuring more timely and accurate responses, leading to better resource utilization and productivity.
- Precision agriculture: models and DSS support precision farming practices, enabling farmers to apply technical inputs, such as fertilizers and plant protection products, only where and when needed, reducing waste and cost.
- Increased productivity: the use of predictive models and DSS allows to optimise crop management and improve crop performance, leading to higher yields and better resource management.
- Sustainability: models and DSS can help optimize resource use, reduce environmental impact, and support sustainable farming practices by predicting the environmental conditions and resource needs.
- Risk management: DSS and models can predict risks related to crop failure, pest infestations, and extreme weather events, allowing farmers to take preventive measures, reducing the potential losses.

Weaknesses

- Costs: using a DSS can be costly, as it often requires purchasing hardware, software, and sometimes advanced sensors, which can be financially burdensome. For the farmer, it can also be a cost in term of time for learning how to properly use it.
- Data dependency: the accuracy of models and DSS outputs is dependent on the quality and availability of data. In areas with poor data collection infrastructure or limited internet access, the system's effectiveness may be compromised, leading to inaccurate or incomplete recommendations.
- Complexity: farmers need to commit and invest time in learning how to use the DSS or to interpret the model output and require training. This can be a barrier, especially in regions with low technological literacy.
- Limited access for small-scale farmers: smaller farmers may not have access to the technology or resources to benefit from sophisticated agricultural models and DSS.

Opportunities

- Improved crop management: models and DSS can help improving crop yield and optimizing food production, contributing to food security.
- Technological advancements: the use of DSS and models can contribute to the technological advancement in the agricultural sector, leading these instruments to be more accessible, cheaper, and easier to use, benefiting a wider range of farmers. It can also enhance the collaboration of the agricultural sector with universities, research centres and technological companies, improving the knowledge transfer from the academic research to all the actors in the field. Moreover, the continuous technological advancements can improve the systems, and make them more accurate, accessible, and affordable for farmers of all scales.
- Climate change mitigation and adaptation: as climate change brings more unpredictable weather patterns, DSS and models can become crucial in helping farmers predict and adapt to shifting conditions, instead of relying on usual practices, allowing them to better manage their operations in the face of climate volatility.
- Integration with smart farming equipment: DSS can be integrated with other smart farming technologies (e.g., drones, automated machinery) to create a seamless, data-driven farming ecosystem that can further optimize resource use and increase efficiency.
- Growing market for sustainable agriculture: the increasing global focus on sustainable agriculture presents a growing market opportunity. Driven by regulatory pressure, and private initiatives related to

sustainability, there is an opportunity for digital tools helping improving crop management.

Threats

- Data privacy and security: as DSS collects and processes large amounts of data, data privacy and security need to be taken carefully in consideration.
- Technological inequality: access to DSS is often skewed towards larger, more technologically advanced farms in developed countries. Small-scale farmers, especially in developing nations, may face challenges in accessing or affording DSS solutions, potentially widening the digital divide.
- Over-reliance on technology: there's a risk that farmers could become overly dependent on DSS for decision-making and may neglect traditional knowledge, intuition, or local context that cannot always be captured by the system. The farmer needs to bear in mind that he is the ultimate decision maker when it comes to translate DSS output in actions.
- Unreliable data sources: in some regions, the data used by DSS may not always be reliable, especially in areas with poor infrastructure, outdated weather information, or limited access to satellite imagery. Poor-quality data can lead to inaccurate recommendations, reducing the system's effectiveness.

Adoption and Barriers

Farmers face several barriers when adopting Decision Support Systems (DSS) in agriculture.

- Economic and financial barriers: high initial costs for software, sensors, computers, or subscription services. Limited access to credit for smallholder farmers to invest in digital tools. Uncertain return on investment, making farmers hesitant to adopt new technologies. Small-scale farmers are particularly affected because DSS technologies may be more affordable for large commercial farms.
- Lack of digital skills and training: many farmers have limited digital literacy or technical knowledge. They may have difficulties understanding complex interfaces or system outputs. Training and extension services are key to teach farmers how to use DSS tools effectively.

- Poor infrastructure (Connectivity and Devices): limited internet connectivity in rural areas; lack of access to smartphones, computers, or sensors required for DSS. These infrastructure limitations reduce the practical usability of digital farming tools.
- Lack of trust in recommendations: farmers may doubt the accuracy of recommendations generated by DSS. Many farmers prefer experience-based decision-making rather than relying on algorithms.
- Data and information problems: DSS requires accurate and real-time data (weather, soil, crop conditions), in many areas, such data may be incomplete, outdated, or inaccurate. Poor data quality can lead to incorrect recommendations.
- Social and behavioural barriers: resistance to change from traditional farming practices, and the fear that technology may replace their decision-making role. Farmers often rely on personal experience or advice from extension agents.

While farmers' adoption barriers are often directly linked to usability, cost, and personal risk perception, advisors face barriers more related to capacity, workflow integration, institutional support, and the challenge of translating complex outputs into practical recommendations.

Pest and symptoms detection

European orchards are increasingly embracing technology to tackle pest and disease management, improving both productivity and sustainability. The integration of remote sensing, AI, field sensors, and molecular techniques allows for earlier detection, better-targeted treatments, and reduced pesticide use. The trend toward precision agriculture and digital farming is expected to continue growing, driven by the need for more efficient and environmentally friendly practices in agriculture.

Strengths

- Early detection and prevention: advanced technologies like AI, detection algorithms, computer vision, and drones enable early identification of pest infestations and diseases, allowing for timely intervention and preventing crop loss.
- Precision and accuracy: detection methods provide high-accuracy results, especially with tools like deep learning models, which reduce human error and increase detection precision.
- Efficiency in large-scale monitoring: technologies like UAVs and IoT sensors enable monitoring of large and remote areas, reducing the need for actual inspection from farmers or technicians.

- Data-driven decision making: the integration of big data and analytics allows for informed, data-driven decisions that help farmers optimize pest control and disease management.

Weaknesses

- High initial costs: the implementation of technologies such as drones, AI systems, and IoT sensors can be costly, making it challenging for small-scale farmers to adopt these systems without substantial investment.
- Complexity and training needs: using advanced technologies requires specialized knowledge. Farmers may need to invest time and resources in training to effectively use and maintain these systems.
- Dependence on infrastructure: many technologies, particularly IoT-based systems, rely on robust internet connectivity and infrastructure, which may not be readily available in rural or remote farming areas.

Opportunities

- Integration with precision agriculture: combining pest and disease detection technologies with other precision farming tools (e.g., automated irrigation, variable rate fertilization) can create a more comprehensive farm management system that boosts yields and reduces costs.
- Advancements: ongoing improvements in algorithms can enhance the detection capabilities of these technologies, leading to even more accurate and faster identification of diseases and pests. In the same time, the price of technology decreases, opening wider options for adoption.
- Environmental and Regulatory Support: governments and international organizations are increasingly focusing on sustainable farming practices, which could lead to increased funding or incentives for technologies that reduce chemical use in pest management.

Threats

- Pest resistance and evolution: the rapid advancement of pest control technologies could lead to pests evolving resistance, diminishing the effectiveness of the detection and management systems over time.

- Regulatory challenges: new technologies may face regulatory hurdles, especially concerning data privacy, environmental safety, and the approval of novel detection methods or pesticides.
- Technological dependency: heavy reliance on technology could lead to vulnerabilities, such as system failures or malfunctions that impact farm operations, especially if human oversight is minimized or neglected.

Adoption and Barriers

While extensive research exists on algorithmic development for pest and symptom detection, adoption is still lacking. In order to foster the adoption of the technology, it is key to understand the socio-cultural factors affecting trust and technology acceptance, and investigating scalable training models for farmers to enhance digital literacy.

- Socio-economic barriers: Cost of technology can be prohibitive for smallholder farmers. Moreover, farmers may lack the technical literacy to operate apps or interpret algorithm outputs accurately. Farmers may hesitate to trust automated diagnoses over traditional knowledge, fearing economic losses from incorrect recommendations.
- Technical barriers: Algorithm accuracy and reliability in field conditions, where model accuracy can be reduced. Data scarcity, as many models are trained on limited datasets and may not generalize well across regions or crop varieties. Infrastructure limitations: reliable internet connectivity, devices availability, and electricity can constrain the use of cloud-based detection platforms, especially in rural areas.
- Perceptual and behavioural barriers: farmers' perception of the technology's relevance to their farm management decisions influences adoption. Cultural resistance, as traditional pest management practices may conflict with recommendations provided by algorithms, reducing uptake. Some farmers are wary of sharing farm images or data due to privacy or data misuse concerns.

The barriers for advisors often amplify or mediate the barriers for farmers. If advisors lack confidence, resources, or incentives to adopt image-based detection, farmers are unlikely to use the tools effectively—even if the technology itself is reliable. Addressing advisor-specific barriers is therefore a critical part of any adoption strategy.

4. Conclusion

The initial search carried out contribute to outline the available technologies under study in research project in recent year. They were grouped according to their main focus, and for each group strengths, weaknesses, opportunities and threats were identified, as well as barriers to the adoption from farmers and advisors. This allows to have a clearer overview of the potential benefits arising from the innovations developed, and to outline potential limitation in their application.

The adoption of new technologies in agriculture is complex, and generally the following barriers can be experienced from farmers:

- Economic Factors: Investment cost; Expected profitability; Access to credit; Farm income level; Market demand for sustainably produced products
- Technological Factors: Complexity of technology; Compatibility with existing equipment; Reliability and performance; Data management requirements
- Human and Knowledge Factors: Farmer education level; Digital skills; Access to training; Availability of technical support
- Behavioural and Perceptual Factors: Risk aversion; Environmental attitudes; Perceived complexity of practices; Farmer identity and norms
- Farm Structural Factors: Farm size; Crop type; Labour availability; Production system
- Institutional and Policy Factors: Regulations; Government incentives or subsidies; Rural digital infrastructure; Certification schemes
- Information and Knowledge Systems: Agricultural extension services; Demonstration farms; Research institutions; Peer learning and farmer networks
- Social and Network Factors: Influence of peer farmers; Strength of local knowledge networks; Social acceptance of biodiversity-based practices

Advisors play a critical intermediary role in agricultural innovation systems. They also experience barrier to innovation adoption, which can indirectly affect farmer adoption because advisors influence information dissemination, technical guidance and farmer confidence in new practices. Possible ways to tackle advisors' barriers rely in particular on specialized training programs for advisors; participatory research and demonstration farms; policy incentives for environmentally sustainable; strengthening farmer–advisor knowledge networks.

The information retrieved will contribute to the baseline definition, helping to inform the work of the RENOVATE project in the definition and compilation of training contents aiming to provide knowledge to actors in the agricultural sectors on ways to achieve sustainable crop management through the uptake of innovation.

From the analysis carried out, the following recommendations can be provided for the design of the RENOVATE platform:

- Differentiate training programmes: specific training course need to be developed for farmers and advisors, in order to provide them tailored information, useful for their activity.
- Use simple interface: too much complexity is perceived as a barrier from the users in the agricultural field.
- Use simple language: propose reliable contents in an understandable way for the users.
- Provide practical demonstrations of the use of technologies and results coming from actual use. Farmers and advisor need to see the technology applied in real conditions, and to be able to assess the results achieved.

ANNEX 1: Information sources for technology search

Agroecology partnership: https://www.agroecologypartnership.eu/en/projects

Biodiversa+: https://www.biodiversa.eu/research-funding/funded-projects/

Circular Bio-based Europe: https://www.cbe.europa.eu/projects

Core Organic: https://projects.au.dk/coreorganicpleiades/previous-core-organic

EU CAP network: https://eu-cap-network.ec.europa.eu/projects/search_en?exposed_form_display=1

European Joint Programme Cofund EJP soils: https://ejpsoil.eu/ejp-soil-projects/

European Partnership for Research and Innovation in the Mediterranean Area (PRIMA): https://prima-med.org/projects-portfolio/

Food systems and climate (FOSC): https://foscera.net/projects

Horizon Cordis platform: https://cordis.europa.eu/searchInterreg programmes: https://keep.eu/projects/

Joint Programming Initiatives on Agriculture, Food Security and Climate Change (FACCE-JPI): https://www.faccejpi.net/en/faccejpi/actions.htm

LIFE project databases: https://webgate.ec.europa.eu/life/publicWebsite/search

Suscrop: https://www.suscrop.eu/call-information/1st-call

Water4All: https://www.water4all-partnership.eu/funded-projects

Belgium National projects: https://ilvo.vlaanderen.be/en/research-projects; https://www.cra.wallonie.be/fr; https://www.ccbt.be/en/projects; https://research.kuleuven.be/ ; https://www.pcfruit.be/

France National Projects: https://ecophytopic.fr/recherche-innovation/

Italy National projects: https://www.innovarurale.it/it; https://agritechcenter.it/it/

Poland National projects: https://mapadotacji.gov.pl; https://radon.nauka.gov.pl; https://erasmus-plus.ec.europa.eu/projects;

Portugal National projects: https://www.iniav.pt/projetos; http://www.pdr-2020.pt/

Spain National projects: https://www.fega.gob.es/en/fega; https://cit.upc.edu/en/projects/

ANNEX 2: Extract of the collected information on projects

Country	Funding programme	Title (Link)	Acronym	Start date	End date	Objectives	Crop	Tested innovation
Europe	H2020	Integrated novel strategies for reducing the use and impact of pesticides, towards sustainable Mediterranean vineyards and olive groves	NOVATERRA	Oct-20	Sep-24	The project aims to develop innovative tools and strategies for crop protection, based on alternative products (biosolutions, biostimulants, resistance inducers, nanoparticle-based products, biocontrol agents, mating disruptors, mass trapping and ozonized water), digital tools and variable rate application, and soil management intervention	olive, grapevine	alternative products, DSS, precision application
Europe	H2020	Cost effective robots for smart precision spraying	SCORPION	Jan-21	Dec-23	The project aims to develop a modular unmanned tractor	grapevine	robot spray application
Europe	LIFE	Demonstration project based on UV flashes as stimulator for plant defense and substitute for fungicides	LIFEisLIGHT	Sep-21	Mar-25	The project aims to demonstrate the efficiency of the UV-C technology to protect vines against powdery and downy mildews, deepening the understanding of UV-induced plant resistance to fungi	grapevine	UV light

Europe	LIFE	Low pesticide IPM in sustainable and safe fruit production	LIFE.SU.SA.FRUIT	Jun-14	Dec-17	The project aims to implement innovative practices in the field (e.g. insect exclusion netting systems and biocontrol agents) and post-harvest (e.g. hot water treatments) for fruit production, promoting practices aimed at reducing the use of pesticides	fruit crop	exclusion means; BCA
Europe	LIFE	Demonstration of sustainable alternatives to chemical products for European crop protection (AGROINTEGRA)	LIFEAGROINTEGRA	Jul-14	Jun-17	The project aims to develop Crops Guide to inform farmers of the most appropriate IPM actions for different types of pest avoidance; the establishment of an extensive network of pest alert points to warn farmers and help prevent the spread of pests; and the integration of all the information collected into a web-based GIS decision-making tool for farmers	grapevine, fruit	crop guides, network of pest alert points, web-basedd GIS decision making tool
Europe	LIFE	Efficiency in the use of resources for the improvement of sustainability of vine and wine sector at Priorat region	LIFE PRIORAT+MONTSANT	Jul-16	Jun-20	The project aims to control powdery and downy mildew using natural products, and only low doses of copper and sulphur. A mating disruption technique using pheromones was applied to control vine moth (*Lobesia botrana*)	grapevine	alternative products

Europe	H2020	An EU-wide farm network demonstrating and promoting cost-effective IPM strategies	IPMWORKS	Oct-20	Mar-25	The project aims to reduce the use of pesticide by implementing a Integrated Pest Management (IPM), based on combinations of non-chemical approaches, including a stronger use of ecology-based processes, more diversity and more biodiversity, combined with innovative technologies (robotics, precision agriculture, Decision Support Systems, biocontrol)	grapevine	functional biodiversity, models, precision application
Europe	PRIMA	Regenerative agricultural approaches to improve ecosystem services in Mediterranean vineyards	REVINE	May-21	May-25	The project aims to test the application of biostimulants, biofertilizers, amendments, microbial consortia, consociation with cover crops, and the use of tolerant/resistant grape genotypes, providing environmentally friendly alternatives to the existing control methods, and allow to reduce the use of chemicals, thus increasing food safety and improving human and ecosystem health.	grapevine	resistance inducers, soil management
Europe	LIFE	LIFE Olivares Vivos + Increasing the impact of Olivares Vivos in the EU	LIFE Olivares Vivos +	Sep-21	Sep-26	The project aims to replicate Olivares vivos results	olive	agroecology

Europe	LIFE	Prevention of X. fastidiosa in intensive olive & almond plantations applying productive green farming practices	LIFE RESILIENCE	Jul-18	Jun-22	The project aims to crossbreeding pathogen-resistant and productive olive genotypes along with innovate natural vector control methods that are effective in preventing the negative effects of Xilella	olive, almond	genetic resistance, vector control methods
Europe	LIFE	Sustainable Viticulture for Climate Change Adaptation	LIFE VineAdapt	Jul-20	Jun-25	The project aims to increase natural control of pests and diseases thanks to vegetation in the interrow	grapevine	agroecology
Europe	PRIMA	VALorization of MEDiterranean ALMond orchards through the use of intercropping integrated strategies	VALMEDALM	Jun-22	May-26	The project aims to identify intercropping practices and promote its implementation across the Mediterranean, evaluate the effect of intercropping practices in pests and weed control, assess the nutritional and functional properties of almonds and associated crops	almond	agroecology
Europe	PRIMA	Diversified orchards for REsilient and sustAinable Mediterranean farming systems	DREAM	Dec-22	Nov-26	The project aims to design multi-variety apple and pear orchards adapted to different environments, and exploiting a range of genotypes providing scalar vegetative cycles and natural resistances to biotic and abiotic stressors	apple, pear	agroecology, genetic resistance

Europe	HE	"NextGenBioPest" - Next Generation Biopesticides for the control of the most "difficult-to-manage" pests and pathogens in fruits and vegetables	NextGen BioPest	Mar-24	Feb-28	The project aims to reduce the use of pesticides while delivering new and improved methods for controlling arthropod pests and pathogens. The project will provide a new toolkit for crop protection in crucial fruit and vegetable crops, including diagnostics, biological control agents, RNA-based pesticides, eco-friendly chemicals, and innovative agronomic and ecological practices.	pomefruit, stonefruit	BCA, resistance inducers, alternative products
Europe	Interreg	Agroecology at the Upper Rhine: innovative Practice and Education	AGRO Form	Apr-17	Sep-20	The project focuses on the evaluation and cross-border dissemination of alternative and innovative production methods for the dissemination of the green economy in the fruit, wine, vegetable and arable sectors.	grapevine	agroecology
Europe	H2020	Effective Management of Pests and Harmful Alien Species - Integrated Solutions	EMPHASIS	Mar-15	Feb-19	The project aims to develop practical solutions for effective protection, management and eradication of native and alien threats.	pome fruit	alternative product

Europe	PRIMA	Innovative Approaches Promoting Functional Microbial Diversity for a Sustainable Grapevine Health and Productivity in Vineyard Systems of Mediterranean Areas	MiDiVine	Jun-21	May-25	The project aims to exploit grapevine genetic resources and agricultural practices promoting functional microbial diversity to better improve grapevine production and resistance against the main foliar and trunk diseases (grey mold, downy mildew and esca) under drought stress conditions	grapevine	resistance inducers, functional biodiversity
Europe	Core Organic	Pest management in organic apple orchards - increasing functional agricultural biodiversity	EcoOrchard	Jan-15	May-18	The project aims to improve management of functional biodiversity, which consistently enhance the performance of natural enemies, reduce pest pressure and are adapted to farmers' implementation.	apple	functional biodiversity

Europe	Core Organic	Plant diversity in the vineyard can help controlling grapevine pests	BioVine	Jan-17	Dec-21	The project aims to develop natural solutions based on plant diversity to control pests (harmful organisms, including arthropods, nematodes, oomycetes and fungi), reduce pesticide dependence, increase plant health and services provided from the ecosystems to humans. BIOVINE will exploit plant diversity in the vineyard to control pests in order to provide farmers with alternative solutions to pesticides.	grapevine	functional biodiversity
Europe	H2020	Stacking of ecosystem services: mechanisms and interactions for optimal crop protection, pollination enhancement, and productivity	EcoStack	Sep-18	Mar-24	The project aims to improve crop protection focussing on the management of beneficial organisms within the field	olive, fruit, grapvine	functional biodiversity

Europe	HE	Developing sustainable solutions for viticulture through multi-actor innovation targeting breeding for integrated pest management	GrapeBreed4IPM	Apr-24	Mar-28	The project aims to minimise fungicide use and promote biodiversity in vineyards thanks to grapevine varieties that are resistant to diseases and well-suited to local environmental conditions	grapevine	genetic resistance, decision support
Europe	PRIMA	Sustainable Innovations for Regenerative Agriculture in the Mediterranean Area	SIRAM	Jun-22	May-25	The project aims to develop approaches to address climate change, pollution, pest control, and low-income issues under different smallholder farming systems, while working for restoration and regeneration of soil health.	olive, citrus	BCA, resistant varieties
Europe	FacceSURPLUS	Toward a sustainable viticulture: Improved grapevine productivity and tolerance to abiotic and biotic stresses by combining resistant cultivars and beneficial microorganisms	VitiSmart	Feb-16	Apr-19	The project aims to reduce chemical inputs while maintaining grapevine quality using biocontrol methods; Identification of resilient genotypes (varieties, clones and rootstocks that are more tolerant to abiotic and biotic stresses) according to geographical zones	grapevine	genetic, resistance inducers

Europe	HE	Breeding and integrated pest management strategies to reduce reliance on chemical pesticides in grapevine	SHIELD4 GRAPE	Feb-24	Jan-27	The project aims to exploit grapevine biodiversity and use new breeding techniques, mutagenesis, and demonstration fields in major EU regions to improve the efficacy of applied integrated pest management protocols.	grapevine	genetic resistance
Europe	LIFE	Development of sustainable control strategies for citric under threat of climate change & preventing entry of HLB in EU	LIFE Vida for Citrus	Jul-19	Jun-23	The project aims to test new pathogen- and heat-tolerant rootstocks that can be adapted to Mediterranean citrus production and increase plant resilience; demonstrate techniques to effectively control vector spread and increase defence in the entire ecosystem with sustainable agricultural practices, while providing other environmental co-benefits.	citrus	genetic resistance
Europe	SusCrop	Microbiome and genomic analysis in apple germplasm towards broadening genetic resources to breed for resilient varieties	AppleBiome	Jan-21	Dec-24	The project aims to investigate the combined action of host and microbiome genetics (holobiont approach) under high and low-input management practices to boost the breeding for resilient varieties.	apple	genetic

Europe	LIFE	LIFE GREEN GRAPES - New approaches for protection in a modern sustainable viticulture: from nursery to harvesting	LIFE GREEN GRAPES	Jan-17	Dec-21	The project aims to improve the anti-parasitic response of vineyards through the use of innovative natural products and to increase the biodiversity associated with vineyards, to demonstrate the effectiveness of predictive crop protection models (such as decision support systems), coupled with agronomic techniques and foliar interventions on vine plants, based on the use of products to increase plant resistance and biocontrol agents.	grapevine	alternative products
Europe	H2020	Stepping-up IPM decision support for crop protection	IPM Decisions	Jun-19	May-24	The project aims to create a new and improved DSS integrated with data, tools and resources via a European-wide online platform		decision support
Europe	H2020	Pathways to phase-out contentious inputs from organic agriculture in Europe	Organic-PLUS	May-18	Oct-22	The project aims to minimise the need for copper (Cu) and mineral oils used for plant health control	citrus, olive	alternative products

Europe	LIFE	NATURAL AGROchemical formulations to reduce the environmental impact of pest control in vineyards	Life Natural Agro	Jul-23	Jun-28	The project aims to develop innovative natural PPP formulations for vineyards using circular inputs. The new PPSs will be based on a reduced (or zero) content of copper, a mix of essential oils plus a micronised carrier, already patented.	grapevine	alternative products
Europe	LIFE	PEsticide Reduction using Friendly and Environmentally Controlled Technologies	PERFECT LIFE	Sep-18	Aug-23	The project aims to demonstrate tools for drift reduction and optimal volume rate adjustment, to reduce the amount of pesticide sprayed.	citrus, grapevine	spray machinery
Europe	H2020	EU-CHINA Lever for IPM Demonstration	EUCLID	Sep-15	Nov-19	The project aims to contribute to secure the production of food for the increasing worldwide population while developing sustainable production approaches	grapevine	decision support
Europe	H2020	Turning climate-related information into added value for traditional MEDiterranean Grape, OLive and Durum wheat food systems	MED-GOLD	Dec-17	May-22	The project aims to demonstrate the proof-of-concept for climate services in agriculture using three hallmarks of the Mediterranean food system: grape and wine, olive and olive oil, durum wheat and pasta	Grapevine, olive	decision support

Europe	H2020	Vineyards´ Integrated Smart Climate Application	VISCA	May-17	Dec-20	The project aims to integrate climate data, phenology, irrigation models, and end-users' requirements into a Decision Support System (DSS) co-designed with wine producers in order to make wine industries resilient to climate changes	grapevine	decision support
Europe	H2020	Optimised Pest Integrated Management to precisely detect and control plant diseases in perennial crops and open-field vegetables	OPTIMA	Sep-18	Jun-22	The project aims to improve crop protection by i) novel bio-PPPs use, ii) disease prediction models, iii) spectral early disease detection systems and iv) precision spraying techniques	grapevine, apple	alternative products, decision support, spraying
Europe	HE	Digital technologies for plant health, early detection, territory surveillance and phytosanitary measures	STELLA	Jan-24	Dec-27	The project aims to establish a real-time pest surveillance system comprised of: an early warning system that uses forecasting models and Internet of Things (IoT) sensors; a pest detection system that uses drones, satellites, and a smartphone application; provides data-driven recommendations for containment and counteractive measures.	grapevine, apple	models, remote sensing

Europe	HE	Multiplatform field surveillance for integral crop health, early detection and actuation	CERBERUS	Jan-24	Dec-27	The project establishes a cloud platform merging data from Copernicus-enhanced observation models, IoT insect traps, robot monitoring and citizen-generated data. CERBERUS generates AI-based risk maps and spraying recommendations from its innovative crop surveillance system	citrus, olive, grapevine	models, remote sensong
Europe	LIFE	Precision Agriculture System to limit the impact on the environment, on health and on air quality of grape production	LIFE WINEgROVER	Sep-20	Oct-23	The project aims to decrease the environmental impact related to grape production, by introducing novel Precision Agriculture (PA) technologies (electronically-guided rovers (to replace diesel tractors), drip irrigation, meteorology stations, satellite and airborne remote sensing, geographic information systems (GIS), soil and topographical surveys, and distributed wireless sensor networks recording micro-climate (temperature and humidity), backed by a Decision Support System (DSS)	grapevine	precision agriculture
Europe	Interreg	Reducing risk of vine diseases for better and healther crops	ClimVino	Nov-18	Oct-21	The project aims to reduce the quantity of plant protection products used as a preventive measure by developing treatment recommendations on the base of climate data.	grapevine	model

Europe	LIFE	Implementation of Demonstrative & Innovative Strategies to reduce the use of phytosanitary products in viticulture	LIFE FITOVID	Sep-14	Sep-17	The project aims to inspect sprayers in use, and training of the users to improve the efficiency of the pesticide application process and to develop a prototype that can detect the presence/absence of downy mildew three days before the naked eye	grapevine	detection, smart application, alternative products
Europe	H2020	Biopesticides for olive and almond cultivations	BIOVEXO	May-20	Dec-25	The project aims to develop innovative biopesticides that decrease chemical pesticide input and provide higher protection to the plant.	olive, almond	alternative products
Europe	LIFE	LIFE Zero Residues: towards a sustainable production and supply chain for stone fruit	LIFE Zero Residues	Jul-13	Jun-17	The project aims to implement integrated pest management in stone fruit production - drastically reducing pesticide doses, soil degradation and groundwater pollution.	stonefruits	BCA, bio or botanical based products
Europe	H2020	An effective and environmentally friendly solution to control fire blight disease caused by Erwinia amylovora in pome fruit crops	PhageFire	Aug-20	Mar-24	The project aims to develop phage therapy to control fire blight in pome fruits	apple	BCA

Europe	H2020	BIO-Based pESTicides production for sustainable agriculture management plan	BIOBESTicide	May-20	Oct-23	The project aims to develop an effective and cost-efficient biopesticide to fight Grapevine trunk diseases	grapevine	BCA
Europe	PRIMA	Ecological survey for biological management and protection of Mediterranean vineyards facing climate changes	VINEPROTECT	Mar-22	Feb-25	The project aims to identify plant growth promoters (PGP) and biological control agents (BCA)	grapevine	BCA
Europe	H2020	IPM-4-Citrus, Citrus desease Integrated Pest Management: from Research to Market	IPM-4-Citrus	Apr-17	Jan-23	The project aims to develop a new bio-pesticide active against citrus pests and scale it up from lab to market	citrus	BCA
Europe	Interreg	Nützlinge im Obstbau zur Reduktion der Anwendung von Pflanzenschutzmitteln	Nützlinge im Obstbau	Mar-23	Feb-28	The project aims to reduce the use of plant protection products in fruit production by using and actively promoting beneficial insects	apple, pear	BCA

Europe	LIFE	Addressing Med fly with an innovative and environment friendly attractant through an Integrated Pest Management Strategy	LIFE BIODELEAR	Jun-14	Oct-19	The project aims to implement an innovative, patented, environment friendly and low-cost food attractant (Biodelear) for the full-scale control of Med fly	fruit	alternative products
Europe	H2020	Novel Pesticides for a Sustainable Agriculture	NoPest	Jan-19	Dec-24	The project aims to adopt a novel biotechnological approach based on peptide aptamers, to solve disease issues in commercial crops. Peptide aptamers are high-affinity short molecules that specifically inhibit the activity of a target enzyme, and represent a remarkable green, low-risk, alternative to pesticides. In addition, NoPEST will develop precision farming tools to optimise application sites and timing	grapevine	alternative product, precision agricolture
Europe	LIFE	Environmentally friendly biomolecules from agricultural wastes as substitutes of pesticides for plant diseases control	LIFE EVERGREEN	Oct-14	Sep-16	The project aims to demonstrate the efficacy and reliability of polyphenol-based biomolecules recovered from agricultural non-food biomass and wastes as disease control products against phytopathogenic bacteria and nematodes affecting plants and crops.	olive, kiwi	alternative products

Europe	PRIMA	Innovative farm strategies that integrate sustainable N fertilization, water management and pest control to reduce water and soil pollution and salinization in the Mediterranean	Safe-H2O-Farm			The project aims to reduce the use of pesticides to control weeds, insect pests and pathogens,by mean of: a) development of specific Integrated Weed Management strategies; b) reduction of metallic copper to control plant diseases; c) reduction of chemical input in pest control.	olive	alternative products
Europe	H2020	Replacement of Contentious Inputs in organic farming Systems	RELACS	May-18	Apr-22	The project aims to foster development and facilitate adoption of cost-efficient and environmentally safe tools and technologies, to phase out the dependency on and use of contentious inputs in organic farming systems.	grapevine, apple	alternative product
Europe	LIFE	Sustainable and green agri-waste based biopesticides	LIFE WASTE4GREEN	Jul-18	Jun-23	The project aims to test the effectiveness of two pesticides made from agro-industrial byproducts in protecting stone fruit crops	stone fruit	alternative products

Europe	PRIMA	Innovative tools to combat crop pests in the Mediterranean	INTOMED	Nov-19	Nov-23	The project aims to exploit beneficial interactions between plants and soil-borne microbes, and identifying naturally derived key molecules (peptides, metabolites and RNAs) to enhance the resistance of economically important Mediterranean crops against major agricultural arthropod pests and pathogens	olive, citrus	resistance inducers, beneficial microbes
Europe	HE	Automated monitoring in horticulture through spectral analysis with quantum dot detectors and high-resolution optical filters	HORTIQD	Jan-24	Dec-26	The project aims to develop a hyperspectral short-wave infra-red camera, suitable for orchard monitoring, to detect diseases early and assess plant health in real time using deep learning algorithms. Integrated with autonomous tractors, it promises to enhance farming sustainability and reduce pesticide dependency.	fruit	precision farming
Europe	HE	Innovations and Capacity building in Agricultural Environmental and Rural Uav Services	ICAERUS	Jul-22	Jun-26	The project aims to assess the potential and impact of drones as multi-purpose vehicles. ICAERUS will further develop existing software technology, platform components and knowledge about drones either as positioning systems for visual observation and recording or as instruments for spraying and delivering goods.	grapevine. Olive, apple	drone monitoring,

Europe	H2020	Novel Approaches for Plant Health Monitoring	PANTHEON	Nov-19	Oct-24	The project aims to develop a new way to monitor plant health based on remote sensing coupled with spectroscopy-based approaches, allowing high spatialisation of results during abiotic stress and pest diseases.	grapevine	disease detection
Europe	H2020	Accelerating Innovative practices for Spraying Equipment, Training and Advising in European agriculture through the mobilization of Agricultural Knowledge and Innovation Systems	INNOSETA	May-18	Oct-21	The project aims to establish an innovative self-sustainable thematic network on spraying equipment, training and advising (SETA)		precision application

Europe	H2020	Artificial intelliGence applied to pRecision farmIng By the use of GNSS and Integrated Technologies	AgriBIT	Jul-21	Jun-24	The project aims to deliver higher precision, more accurate and continuously available Precision Agriculture services, combining new high precision Galileo positioning and augmentation services like EGNOS, Earth Observation (EO) information with on-field and on-machine sensors and actuators, Artificial Intelligence (AI) technologies and expert agricultural knowledge.	peach, grapevine	precision agricolture
Belgium	Vlaio-LA (B)	SOS Penta: Focus points to protect Flemish pome fruit against stink bugs	SOS PENTA	Sep-19	Aug-23	The project aims to provide new techniques to protect pome fruit against stink bugs	grape, pomefruit, stonefruit	models, physical means
Belgium	FOD (B)	Datapestfru: improved knowledge about the epidemiology and spread of priority invasive pests in fruiticulture and viticulture	Datapestfru	Mar-21	Feb-23	The project aims to improve knowledge on invasive pests	grapevine, pomefruit	functional biodiversity, nets
Belgium	FOD (B)	Agriltrap: develop and judge monitoring methods of Buprestidae	Agriltrap	Mar-21	Feb-23	The project aims to devleop new strategies to protect orchard from Buprestidae	pomefruit	detection, traps

Belgium	EIP AGRI OPERATION GROPU	Biofruit debuggers		Jan-19	Dec-23	The project aims to exploit and implement new recently acquired knowledge in the development of new innovative and practice-oriented control strategies for controlling forest bugs in apple and pear orchards, addressing brown marmorated stink bug.	apple, pear	nets, traps crops
Belgium	EIP-OG (B)	Flowers banks without voles		Jun-24	May-26	The project aims to study biodiversity in orchards	pomefruit	agroecology, functional biodiversity
Belgium	Vlaio-LA (B)	Novoscab: New insights in the management of scab with pear	Novoscab	Oct-23	Sep-27	The project aims to test new strategies for pear scab	pear	BCA, soil managment
Belgium	FOD (B)	FruQCur: Data driven monitoring strategy for quarantinaine Curculionidae in fruit growing	FruQCur	Jul-24	Jun-26	The project aims to evaluate ata driven monitoring strategy for quarantinaine Curculionidae in fruit growing	pomefruit	decision support
Belgium	FOD (B)	Emphypest: Newly emerging risks of pests for plants and plant products in Belgium	Emphypest	May-23	Apr-25	The project aims to determine the phytosanitary status in Belgium for 6 regulated plant pathogenic fungi and for 5 insect pests	pomefruit	surveillance

Belgium	FOD (B)	Pojama: Integrated and sustainable control methods for Popillia japonica in Belgium	Pojama	May-24	Apr-26	The project aims to study methods for the control of the quarantine nsect Popilia japonica in Belgium	pomefruit	alternative products
Belgium	Vlaio-LA (B)	Agrivoltaics above fruit: can it avoid some crop protection treatments?		Nov-23	Oct-27	The project aims to evaluate the impact of agrivolatic on disease control in pomefruit orchadrs	pomefruit	net
Belgium	EIP-OG (B)	Stemphistress: control of black rot: more than only fungicide treatments?		Feb-25	Jan-27	The project aims to study alternative ways to control diseases	pomefruit	alternative products
Belgium	Vlaio-LA (B)	GOM: Integrated Weed Management in fruit growing		Mar-22	Feb-26	The project aims to test integrated weed managment techniques in orchards	pomefruit	precision spray
Belgium	Vlaio-LA (B)	PhylloxPera: towards a knowledge based control of Phylloxera pear aphid and blossom end rot in Flemish pear cultivation	PhylloxPera	Nov-23	Oct-27	The project aims to investigate new contorl techniques toward insecta and disease in pear orchards	pear	detection, model, alternative products

Belgium	EIP-OG (B)	Minchem: Decreasing the number of crop protection treatments in less susceptible apple cultivars	MinChem	Mar-25	Feb-27	The project iaims to tailor crop protection on the base of plant susceptibility to diseases	apple	variety susceptibility
Belgium	Vlaio (B)	Mety-net+: Improved real time irrigation and diseases warnings in potato and pome fruit based on high resolution precipitation predictions	Mety-net	Dec-22	Oct-25	The project aims to develop disease warning o the base of precipitation forecasts	pomefruit	model
Belgium	Flanders (B)	The impact indicator: a tool to advert growers of the side effects of their treatments against beneficials		Jun-18	May-21	The project aims to provide farmers with a tool allowing to consider treatments side effect on beneficial	grape, pomefruit, stonefruit	decision support
Belgium	Vlaio-LA (B)	Ctrl-Pseudo: Towards an alternative and sustained control of Pseudomonas infections in cherry and pear	Ctrl-Pseudo	Dec-22	Nov-26	The project aims to develop alternative techniques for the control of bacterial infections	pear, cherry	decision support, alternative products

Belgium	Vlaio-LA (B)	Syst-Control: Towards an innovative system approach for a smart and fast detection and effective control of phytosanitary risks in fruit	Syst-Control	Sep-23	Aug-26	The project aims to improve disease control	pomefruit, stonefruti	detection, decision support
Belgium	EIP-AGRI Operational Group	Natural allies in pear cultivation		Jan-19	Dec-21	The project aims to investigate practical implementation and validation of the developed models / apps for decision support management of orchards in integrated and organic cultivation	pear	BCA, model
Belgium	Vlaio-LA (B)	Greenspray: How to implement the Green Deal in fruit growing via precision spray techniques	GreenSpray	Oct-23	Sep-27	The project aims to reduce the use of plan protection products by mean of precision spray technologies	pear	precision spray, model
Belgium	EU-CAP	Optimisation of Crop Protection		Jan-24	Dec-28	The proejct aims to address emerging problems with pests or diseases in orchards	pome fruit	alternative products
Belgium	CCBT (B)	Raadselspot : Mystery of black spots on Natyra and other robust apple varieties	Raadselspot	May-24	Dec-25	The project aims to set up a sustainable control strategy based on analysis of environmental conditions and the most efficient products	apple	alternative products

Belgium	CCBT (B)	A derivative of pelargonic acid : opportunity for scab control in pear		Feb-22	Dec-23	The project aims to determine whether a product based on a derivative of pelargonic acid is suitable as a plant protection product for the control of scab in pear	pear	alternative products
Belgium	Vlaio-LA (B)	Disarm pear decline		Dec-24	Nov-28	The project aims to evalute alternative strategies to control pear decline	pear	alternative products
Belgium	EIP-OG (B)	Tackle pear decline		May-24	Apr-26	The project aims to evalute alternative strategies to control pear decline	pear	alternative products
Belgium	Flanders (B)	Alternative control of pear scab in organic production		Jan-23	Dec-25	The project aims to evalute alternative strategies to control pear scab	pear	resistance inducers
Bulgaria	EIP-AGRI Operational Group	Precise fruit-growing		Jan-23	Dec-25	The project aims to propose and implement measures for sustainable management of orchards	fruit	models
Bulgaria	EIP-AGRI Operational Group	Smart fruit-growing		Jan-20	Dec-24	The project aims to monitor microclimate and fruit ply population, to drive the precision application of treatments	stonefruit	precision spray, model

Cyprus	EIP-AGRI Operational Group	Internet of grapes: exploiting smart farming services for wine grapes		Jan-20	Dec-24	The goal is to develop an application that will provide intelligent agriculture services in the fields of plant protection, for given grape varieties, which will be adapted to the soil and climate specificities of the application site.	grapevine	decision support
France	EIP-AGRI Operational Group	Captrap Arbo		Jan-16	Dec-18	The project aims to contribute to the adaptation of an automated trap for the main pests affecting fruit trees	apple, peach	traps
France	ANR Ecophyto Maturation	Self-guidance of tractors can be done for a zero transition viticulture herbicide	VitiGuid	Jan-21	Dec-24	The project aims to develop an open-source self-driving prototype that can be fitted to a vineyard tractor, representing an important step forward in making mechanical weeding sustainable and enabling the viticulture sector to evolve towards zero herbicide.	grapevine	autonomous tractor
France	CASDAR	Mechanical solutions against insects in orchards (vacuum)	BUG BUSTER	Jan-22	Dec-25	The project aims to develop mechanical solutions against insects in orchards (vacuum)	peach, apple	mechanical insect control

France	EIP-AGRI Operational Group	Vacuum Bug: The development of a mechanical process adapted to vines that contributes to decrease the number of the leaf hopper (Scaphoideus Titanus).	Vacuum Bug	Jul-17	Jun-20	The project aims to develop a mechanical process adapted to vines in order to decease the number of leafhoppers	grapevine	vacuum
France	AP MAA DEPHY EXPE	Methodology and experimental design for the reduction of pesticides in apple orchards	BioREco	Jan-15	Dec-18	The project aims to develop methodology and experimental design for the reduction of pesticides in apple orchards	apple	agroecology, varieties
France	EIP-AGRI Operational Group	Zero herbicides in Mediterranean perennial crops		Jan-15	Dec-18	The project aims to evaluate the agronomic impact of the cover crop on grapevines or trees	grapevine	agroecology
France	ANR Ecophyto Maturation	Disinhibition of grapevine immune responses: an innovative strategy to improve biocontrol efficiency	DEREBIO	Jan-24	Sep-26	The project aims to develop an innovative biocontrol method for the protection of vineyards.	grapvine	BCA

France	EIP-AGRI Operational Group	GASCON'IDEOS: Creation of varieties resistant to cryptogamic diseases dedicated to the vineyards of Gascony and the Pyrenean foothills	GASCON'IDEOS	Jan-19	Dec-22	The project aims to create new varieties of vines resistant to powdery and downy mildew fungal diseases	grapevine	genetic resistance
France	OFB ECOPHYTO	Decision support system to apply PPP in viticulture	DECITRAIT	Jan-18	Dec-20	The project aims to develop a decision support system to apply PPP in viticulture	grapevine	decision support
France	ANR Ecophyto Maturation	PARASitisme and decision tool to reduce the usages of insecticides against pests in vineyards and grains	PARADE	Jan-19	Dec-22	The project aims to develop a decision-making tool that will support farmers in implementing agroecological strategies to combat the main pests of vines and cereal crops, favoring natural regulation services over the use of pesticides.	grapevine	predictive models
France	ANR Ecophyto Maturation	Development of a new phytosanitary concept applied to apple scab	ENFIN !	Jan-21	Dec-24	The project aims to develop a new technical alternative to chemical control by combining two inventions patented by INRAE using a line of non-pathogenic apple fungi.	apple	resistance inducer

France	ANR Ecophyto Maturation	Innovative formulation by micro-encapsulation of entomopathogenic nematods against codling moth, Cydia pomonella.	CAPCYDIA	Jan-24	Dec-26	The project aims to develop an innovative formulation by micro-encapsulation of entomopathogenic nematods against codling moth, Cydia pomonella.	apple	BCA, attract and kill
France	EIP-AGRI Operational Group	DELEDUR : Identification and deployment of leverage action for sustainable Bordeaux wines production	DELEDUR	Jan-22	Dec-23	The project aims to identify, describe and prioritize available leverage actions in order to promote a sustainable Bordeaux wines production.	grapevine	BCA
France	OFB ECOPHYTO	Mitigate the impacts of PPP in southern viticulture at territory scale	RIPP VITI	Jan-20	Dec-23	The project aims to mitigate the impacts of PPP in southern viticulture at territory scale	grapevine	BCA
France	ANR Ecophyto Maturation	Precision On Farm Experiment to improve bioPPP against fungi in viticulture	BIOSPRAYTECH	Jan-24	Sep-26	The project aims to perform precision on farm experiments to improve bioPPP against fungi in viticulture	grapevine	precision appilcation, BCA
France	CASDAR	Spray deposition modelling to canopy architecture adjustment	CANNOPHY	Jan-22	Dec-26	The project aims to experimentallly modelling spray depsoition in vines as a function of the canopy architecture	grapevine	optimising application

France	CASDAR	Spray deposition modelling to canopy architecture adjustment	Technodoseviti	Jan-18	Dec-22	The project aims to experimentallly modelling spray depsoition in vines as a function of the canopy architecture	grapevine	precision application
France	OFB ECOPHYTO	Multidimensionnal indicators of the spray quality to understand the biologicial efficacy of bioPPPs	NEOSPRAYVITI	Jan-24	Dec-26	The project aims to develop multidimensionnal indicators of the spray quality to understand the biologicial efficacy of bioPPPs	grapevine	BCA
France	OFB ECOPHYTO	Classification of vineyard sprayers performance	LABELPULVE	Jan-18	Dec-20	The project aims to elaborate a classification of vineyard sprayers accroding to the performance in terms of canopy deposit	grapevine	evaluation of the spray equipment
France	CASDAR	Development of a methodology for measurement of the spray drift to compare vine sprayer's performance	EOLEDRIFT	Jan-16	Dec-18	The project aims to develop a methodology for the measurement of the spray drift to compare vine sprayer's performance	grapevine	drift reduction
France	OFB ECOPHYTO	Spray drift reduction in viticulture	STOPDRIFT	Jan-18	Dec-20	The project aims to mitigate spray drift in viticulture	grapevine	drift reduction

Germany	EIP-AGRI Operational Group	Promoting new organic vineyards with piwi cultivation through disruptive and innovative site refinement and building a new value chain		Jan-22	Dec-24	The project aims to test new grafting method on piwis	grapevine	genetic resistance
Germany	EIP-AGRI Operational Group	Online tool to identify pests, diseases and weeds in agriculture		Jan-15	Dec-19	The project aims to develop an online tool for identification of pests, diseases and weeds	grapevine	decision support
Germany	EIP-AGRI Operational Group	Development of an optical method for the diagnosis of pathogens in fruit plantation		Jan-20	Dec-22	The project aims to develop an electronic warning system with automated diagnosis of pathogens of important plant diseases	apple	diagnosis, model
Germany	EIP-AGRI Operational Group	Innovative plant protection strategies to reduce the use of resources for sustainable fruit production in the face of climate change		Jan-17	Dec-20	The project aims to develop new and alternative approaches using resistance of varieties or adapted crop management	apple	BCA, optical sensors

Germany	EIP-AGRI Operational Group	Implementation of spry drones in steep slope viticulture		Jan-20	Dec-23	The project aims to detect the disease impact via multispectral sensors during the overflight in order to simultaneously enable a differentiated and infestation-oriented application of pesticides	grapevine	detection, precision application
Hungary	EIP-AGRI Operational Group	Elaborating a crop-specific control technique against the invasive Drosophila suzukii		Jan-20	Dec-23	The project aims to create a prediction model for the rationality of Drosophila suzukii control	fruit	model
Italy	EIP-AGRI Operational Group	Integrating preventive strategies and biological control to combat the brown marmorated stink bug - Vindicta	Vindicta	Jan-20	Dec-23	The project aims to implement a management plan to combat the brown marmorated stink bug, which wil include: conventional monitoring integrated with new electronic and IT applications and new capture systems based on the integration of the aggregation pheromone with vibrational signals; biological control actions; interventions related to the enhancement of agrobiodiversity practices; forecasting models	fruit	traps, BCA, functional biodiversity, model

Italy	EIP-AGRI Operational Group	Innovation of integrated and early production of fruit trees threatened by physiopathies and invasive alien pests.		Jul-20	Jul-22	The project aims to develop new crop covering materials and techniques for fruit treesand entering smart technologies in farming process as decision support system	cherry, apricot	model
Italy	EIP-AGRI Operational Group	Technical / phytosanitary, agronomic and economic validation of new multifunction plant protection systems for cherry tree cultivation - Smile	Smile	Sep-21	Mar-27	The project aims to verify the effectiveness of a plant protection system capacity against main adversities of the cherry tree	cherry	rain protection, nets
Italy	EIP-AGRI Operational Group	Development of sustainable techniques for weed management and phytosanitary defense in fruit growing - SPOTS	SPOTS	Mar-23	Feb-24	The project aims to broaden the knowledge on the biology and ethology of some pests, validate new monitoring tools, evaluate the efficacy of natural active substances and agronomic techniques	apricot, peach, apple	alternative products, agroecology, model

Italy	EIP-AGRI Operational Group	Monitoring tools and innovative strategies to control the Brown Marmorated Stink Bug (Halyomorpha halys)		Jan-16	Dec-19	The project aims to evaluate the use of pheromone traps aggregation for monitoring and to perform agroecological investigation	pomefruit, stonefruit	traps, agroecology
Italy	EIP-AGRI Operational Group	Synergic approach for the sustainable protection of fruit and horticultural crops against the brown marmorated stink bug - Contr.Halys	CONTR-HALYS	Mar-20	Feb-23	The project aims to implement a double protection perimeter against Halyomorpha halys in tree and horticultural crops in integrated production	pear	attaract and kill, trap crops, alternative products
Italy	EIP-AGRI Operational Group	Cover cropping as a management tool to enhance orchard sustainability		Jan-23	Dec-24	The project aims to study innovative management of the inter-row of pear crop	pear	cover crops

Italy	EIP-AGRI Operational Group	PV SENSING - Operational Group for the deployment of innovative sensors in the vineyard for the prevention of infections by Plasmopara viticola	PV SENSING	Jan-18	Dec-20	The project aims to demonstrate the performance of a new system for the prediction and prevention of the infections by Plasmopara viticola, composed by innovative sensors in the vineyard and a previsional model integrated in a DSS	grapevine	diagnosis, model
Italy	POR-FESR 2014/2020 - Misura 16	New Application of Vegetation Indexes in agriculture	NOVIAGRI	Nov-20	Oct-23	The project aims to develop a variable rate sprayer and a DSS	Vineyard	variable rate smart sprayer
Italy	EIP-AGRI Operational Group	BODI - Integrated System of phytosanitary defence for the digital reporting	BODI	Jan-17	Dec-20	The project aims to implement an innovative tool supporting vinegrowers in the decision making process in order to optimize the phytosanitary treatments.	grapevine	decision support
Italy	EIP-AGRI Operational Group	VITA - Harmonious Viticulture: sustainability principles in Piedmont wine area	VITA	Jan-20	Dec-23	The project aims to develop a shared model of management of the vineyard oriented towards sustainability, with regard to the aspects with potential impact on water bodies with particular attention to defense, carried out through the vite.net® DSS.	grapevine	decision support

Italy	EIP-AGRI Operational Group	Evaluation of sustainable and innovative control and nutrition techniques for the reduction of chemical inputs in tree crops in organic and integrated	INPUT.ARB	Jan-20	Dec-23	The project aims to develop control techniques, both for integrated and biological production, adapted to the new challenges	pear, cherry, nut	model, alternative products
Italy	PRIN-PNRR	Implementation of a digital tree to optimise technical and environmental performances of crop protection equipment	IM GROOT	Nov-23	Jun-26	The project aims to develop predictive spray models under different conditions	olives	model
Italy	EIP-AGRI Operational Group	Innovative strategies for the sustainable management of the grapevive yellows – GO.Vite	GO.vite	Jan-17	Dec-23	The proejct aims to limit the presence of the grapevine yellows through preventive and symptom containment practices for a more sustainable management of the disease	grapevine	BCA

Italy	EIP-AGRI Operational Group	Biological direct control methods for defense, aimed at reducing biotic potential of the brown marmorated stink bug - BioVitamina		Jan-20	Dec-23	The project aims to test entomopagenic microorganisms for Halyomorpha halys	pear	BCA
Italy	EIP-AGRI Operational Group	Application of sustainable techniques and methods for crop protection, irrigation and nutrition in viticulture		Jan-16	Dec-19	The project aims to innovate crop protection testing new compounds and strategies aginst Plasmopara viticola, Botrytis cinerea, Erysiphe necator and bunch rot and validating of application techniques with low volume	grapevine	low volume application, alternative products
Italy	EIP-AGRI Operational Group	Geomaterials for sustainable pear cultivation - GeoSosPe	GeoSosPe	Jan-23	Dec-24	The project aims to use geomaterials or other products with low environmental impact, for a sustainable defense aimed at contrasting the spread of the Brown Marmorated Stink Bug (Halyomorpha halys), Alternaria Porri (Stemphylium vesicarium) and thermal stress	pear	alternative products

Italy	EIP-AGRI Operational Group	VI.P - Precision viticulture	VI.P	Jan-20	Dec-23	The project aims to create a model for precise diagnosis of the vineyard through remote sensing and multispectral analysis systems to identify the different causes of stress and diseases present in the farming	grapevine	precision application, variable rate, autonomous machinery
Italy	Piemonte Region - Programma regionale di ricerca	Valutazione dell'efficacia dei droni per io monitoraggio e la difesa della vite dall'insetto di quantena Popillia japonica Newmann	DANTE	May-23	May-25	The project aims to develop application techniques by UAVs	Vineyard	UAVs, scouting by UAVs
Italy	EIP-AGRI Operational Group	Rationalization of the methods of distribution of plant protection products in order to mitigate the drift and safeguard the quality of surface water		Jan-20	Dec-23	The project aims to improve PPP distribution in pear orchards	pear	variable rate, dose calculation, reduce drift

Italy	EIP-AGRI Operational Group	Kit per la modifica di Atomizzatori in grado di eseguire Trattamenti con Tecnologia Innovativa a dose Variabile Ottimizzata	KATTIVO	Jan-19	Dec-22	The project aims to develop a technological kit which, applied to traditional atomizers, allows the distribution of plant protection products at variable dose according to the volume of the canopy to be treated	grapevine	variable rate application
Italy	POR-FESR 2014/2020 - Misura 16	Macchine agricole elettriche	Marcel	Jan-20	Jun-23	The project aims to the electrification of agricultural machineries	Vineyard	electrification of airblast sprayer
Italy	PRIN-PNRR	Operative solutions for efficient, effective and environmental-friendly UAV-spray applications in vineyards	3E-UAVspray	Nov-23	Nov-25	The project aims to develop an application system (hydraulic circuit and nozzles) for application of PPP by UAVs	grapevine	UAVs
Netherlands	EIP-AGRI Operational Group	Innovative sustainable fruit growing systems		Jan-22	Dec-24	The aim of the project is to make fruit farming more sustainable by growing healthy and robust crops while preserving nature and biodiversity in an economic perspective for the sector.	appe, pear	soil management, resistant varieties, alternative products

Netherlands	EIP-AGRI Operational Group	Intelligent Total Solution Precision Agriculture Fruit Growing		Jan-22	Dec-24	The aim of the project is to develop eTrac, an autonomous and electric narrow-track tractor robot equipped with sensors and based on deep learning technology to create a 3D model of the orchard	appe, pear	robot
Poland	MRiRW	Organic fruit growing		Jan-22	Dec-24	The aim of the project is to reduce the risk of damage caused by seed mites and May beetle by adapting new traps and optimising existing traps for the mass capture	stonefruit	mass trapping
Poland	MRiRW	Tetraploid apple as a source of resistance to biotic and abiotic stresses - analysis of resistance mechanisms to fire blight, apple scab and drought and evaluation of crossbreeding capacity	ZADANIE 49	Jan-17	Dec-21	The project aims to analyze the mechanisms of increased resistance to drought and dangerous apple diseases in autotetraploid apple clones	apple	resistance inducers

Poland	Erasmus +	Prevention of Water Contamination from Point Sources with Plant Protection Products by Improving Extension Specialists' Vocational Competences	ProtectLife	Dec-17	Dec-20	The project aims to develop and implement best managment practices for handling PPPs in Turkey and providing training materials resulting from TOPPS project	All crops	best managment pratices guidelines and training materials
Poland	National Science Center	Search for new chemical compounds that induce apple resistance to diseases and determination of the molecular mechanism	SONATA 18	Jul-23	Jul-26	The project aims to search for new chemical compounds that induce apple resistance to diseases and determination of the molecular mechanism	apple	resistance inducers
Poland	Smart Growth Operational Programme 2014-2020	A family of innovative tunnel orchard sprayers with spray liquid recovery system	TUNELO WIEC	Apr-16	May-19	The project aims to develop a family of tunnel orchard sprayers with spray liquid recovery system to mitigate the influence of wind on PPP application process, as well as reduce the water and PPPs use	pomefruit, stonefruit	tunnel sprayer

Poland	Smart Growth Operational Programme 2014-2020	An innovative double-fan sprayer with asymmetrically adjustedair discharge system	DIVENT	Jul-17	Oct-20	The project aims to develop an innovative orchard sprayer with individual air flow adjustment system based on two independently driven and adjusted fans for precise application of PPPs in orchards	pomefruit, stonefruit	double-fan orchard sprayer
Poland	Smart Growth Operational Programme 2014-2020	Innovative two-row sprayer for protection of berries in conventional and organic fruit production	AGROLA1	Jan-17	Jun-18	The project aims to develop and test a prototype sprayer with two-row spray liquid and air emission system	pomefruit, stonefruit	two-row tunnel sprayer for orchards
Poland	Regionalny Program Operacyjny Województwa Łódzkiego	A family of innovative orchard sprayers	OPTIVENT	Jul-20	Dec-22	The project aims to develop and test orchard sprayers with an innovative airjet emission systems to optimise spray application process	pomefruit, stonefruit	innovative sprayers
Portugal	EIP-AGRI Operational Group	SIVID - Integrated Dynamic Intelligent Viticulture System	SIVID	Jan-17	Dec-21	The project aims to develop an Integrated Dynamic Intelligent Viticulture System for the application of efficient models of agronomic management of the vineyard	grapevine	decision support

Portugal	EIP-AGRI Operational Group	Phytosanitary protection strategies for sustainable apple production		Jan-17	Dec-21	The project aims to contribute to the increase of quality, economic competitiveness of the sector and sustainability, through the correct evaluation of pest and disease risk and subsequent decision making.	apple	model
Portugal	Portugal2020	SPIN - Solução de Pulverização de Precisão Inteligente	SPIN	Jan-21	Jun-23	The project aims to develop an innovative sprayer for tree and shrub crops	tree and bush crops	sprayer with adjustment of air flow
Portugal	PRR	PhenoBot: Fotónica Inteligente para Fenotipagem de Culturas Agroalimentares	PhenoBot	Oct-22	Sep-25	The project aims to develop a robotic platform and intelligent point-of-measurement photonic sensor to monitor metabolism and implement precision agriculture at the level of plant physiology, with specific molecular targets, enabling the efficient use of plant protection products, fertilisers, water and energy.	Vine and Pome and Stone fruits	robotic platform and intelligent photonic sensor to monitor metabolism
Portugal	PRR	Robotics 4 Farmers - Sistemas Robóticos Ecoeficientes e Colaborativos para uma Agricultura Inovadora, Inclusiva e Sustentável	Robotics 4 Farmers	May-22	Sep-25	The project aims to reducing costs and increasing sustainability in attacking weeds by eliminating the consumption of water, herbicides and fossil fuels; tackling the shortage of human resources by adopting autonomous and safe agricultural equipment; assist in decision-making and optimise interventions based on IoT, Artificial Intelligence and Robotics technologies	Vine	Collaborative, mobile and manipulative agricultural robotic platform

Romania	EIP-AGRI Operational Group	The use of ecofriendly techniques for orchard insect pest management to obtain organic fruits in operational group eco_fruct_bn	ECO_FRUCT_BN	Jan-19	Dec-23	The project aims to develop, apply and demonstrate an economically viable strategic plan to implement integrated pest management, by promoting the use of low-chemical approaches in orchards and post-harvest fruit production	apple	mating disruption, alternative products
Slovenia	EIP-AGRI Operational Group	BONITA, new resistant club apple variety in Slovenia - from production to marketing		Jan-19	Dec-22	The project aims to test a new disease resistant apple variety	apple	geentic resistance
Slovenia	EIP-AGRI Operational Group	The implementation of new mechanical and autonomous automated technologies for the sustainable production of grapes in vineyards		Jan-19	Dec-22	The project aims to demonstrate various non-chemical methods of controlling weeds in the belt under vines (without the use of herbicides), use of hightech modern spray techniques equipped with LIDAR sensors to the effectiveness of controlling diseases and pests of vines, conservation of biodiversity in the vineyard and its surroundings	grapevine	improved spray machinery

Spain	EIP-AGRI Operational Group	Use of rain nets to reduce the application of fungicides to control apple scab disease		Jan-18	Dec-20	The project aims to assess the feasibility of installing rain nets to control apple scab and to assess the effectiveness of Venturia inequalis inoculum removal techniques to improve disease control	apple	net, inoculum removal
Spain	EIP-AGRI Operational Group	Biological pest control in commercial appel plantations		Jan-15	Dec-17	The project aims to achieve the biological control of pests in apple orchards fully protected with polyethylene nets	apple	net, alternative products
Spain	EIP-AGRI Operational Group	Precision treatment systems and inoculum management techniques for rationalising the use of phytosanitary products to control apple scab	SCABKILL	Jul-21	Jul-24	The project aims to test precision treatment systems and inoculum management techniques for rationalising the use of phytosanitary products to control apple scab	apple	models, precision spray, biological products
Spain	EIP-AGRI Operational Group	Control of Myzus cerasi in cherry trees through functional biodiversity (using ecosystem services)		Jul-19	Jul-21	The project aims to assess the capacity of auxiliary fauna as the main or combined method for controlling Myzus cerasi in cherry cultivation	cherry	soil managment, functional biodiversity

Spain	EIP-AGRI Operational Group	Control of Monilinia spp. in stone fruit: use of prediction models and cultural practices		Jan-15	Dec-17	The project aims to improve the control of Monilinia spp. in stone fruits through the use of predictive models and preventive practices.	stonefruit	model
Spain	EIP-AGRI Operational Group	Rationalisation of the use of phytosanitary treatments to control Alternaria in apple trees using risk prediction models and crop management technique		Jan-20	Dec-22	The project aims to improve control of Alternaria by minimising the use of phytosanitary treatments, by mean of validating and assessing various risk prediction models and influencing the source of primary inoculum in order to reduce the pressure of inoculums on farms, thereby reducing the incidence of the disease.	apple	model, soil managment
Spain	EIP-AGRI Operational Group	Rationalisation of the use of plant protection products in the control of Alternaria in apple trees using risk prediction models and crop management		Jan-19	Dec-22	The project aims to improve the control of Alternaria, validating and assessing different models for predicting the risk, and influencing the primary inoculum source	apple	models, soil managment

Spain	EIP-AGRI Operational Group	Control of Monilinia spp. and Rhizopus spp. in stone fruit using new strategies during the harvest		Jan-19	Dec-21	The project aims to assess the efficacy of alternative products to chemicals	stonefruit	alternative products
Spain	EIP-AGRI Operational Group	FITOSCEREZO Operational Group: Phytosanitary products availability and integrated control strategies in cherry tree	FITOSCEREZO	Jan-20	Dec-22	The project aims to promote the availability and registration of new phytosanitary products, including non-chemical methods and new active substances	cherry	alternative products, functional biodiversity
Spain	EIP-AGRI Operational Group	Strategies for sustainably controlling Monilinia spp. in almond trees	MONCONTROL	Jan-21	Dec-24	The project aims to study different cultural practices complementary to fungicide treatments to reduce inoculum pressure in the field	almond	product timing, practices for inoculum reduction
Spain	EIP-AGRI Operational Group	Renaturing and promoting biodiversity in apple orchards in Girona	POMELIFE	Jan-21	Dec-24	The project aims to include several actions to promote wild life in apple orchards, helping control pests and reduce the use of phytosanitary products.	apple	functional biodiversity

Spain	EIP-AGRI Operational Group	Integrated and sustainable control of bacterial spot to minimise the economic and environmental impact on almond and peach trees	XAPFREE	Jan-21	Dec-24	The project aims to define different management strategies for controlling Xanthomonas arboricola pv. Pruni	almond, peach	model, varietal susceptibility
Spain	EIP-AGRI Operational Group	Organic plantation of traditional and resistant apple tree varieties to solve spontaneous vegetation management problems and rodent mammals control		Jan-15	Dec-17	The project aims to strengthen the organic apple production system with traditional and resistant varieties	apple	genetic resistance
Spain	Ministerio de Ciencia, Innovacion y Universidades	Smart spraying for sustainable vineyard and olive grove	PIVOS	Jun-20	Feb-24	The project aims to demonstrate the benefits of implementing new technologies in crop protection, with a particular focus on vineyards and olive groves.	grape, olive	variable rate application, prescription maps

Spain	Ministerio de Industria, Comercio y Turismo	Sensorización y digitalización de paneles recuperadores de fitosanitarios para viticultura vinculada a una plataforma de toma de datos y decisiones.	SENSORE CUFIT	Jul-22	Apr-23	The project aims to adapt a prototype sprayer with recovery panels to enable automated capabilities that adjust spraying based on crop characteristics, while also collecting data and generating maps of vine conditions by incorporating sensors and onboard intelligence the aim is to make pesticide applications more environmentally sustainable reducing both their impact and product loss	grape	drift recovery screens
Spain	Generalitat de Catalunya. Departament d'agricultura, Ramaderia I Pesca	Demostració pràctica de l'apliabilitat de mapes de vegetació per a l'aplicació variable de productes fitosanitaris a la vinya. Reducció de l'ús de plaguicides i disminució de la contaminació.		Feb-18	Jun-19	The project aims to demonstrate the technical, agronomic, economic, and environmental benefits of using aerial imagery to generate vegetation maps for variable rate application	grapes	variable rate application, prescription maps

Spain	Ministerio de Agricultura, Pesca y Alimentación	Optimization of pesticide use in viticulture based on vigor maps.	GOPHYTOVID	Aug-18	Jun-20	The project aims to develop and optimize a universal compatible system for variable application of plant protection products in vineyards, based on maps of different vegetation vigor.	grapes	variable rate application, prescription maps
Spain	Ministerio de Economía y Competitividad	Herramientas de base fotónica para la gestión agronómica y el uso de productos fitosanitarios sostenible en cultivos arbóreos en el marco de la Agricultura de Precisión.	AgVANCE	Jan-14	Dec-16	The project aims to use photonic-based tools to develop solutions related to the use of plant protection products in fruit crops and vineyards, aiming to improve the efficiency and sustainability of pesticide applications.	grape	LiDAR sensor
Spain	EIP-AGRI Operational Group	Pilot project of phytosanitary treatment remote sensing and management in vineyard		Jan-15	Dec-17	The project aims to validate a DSS in vineyard, based on weather data collected at vineyard level	grapevine	decision support, model
Spain	EIP-AGRI Operational Group	Sustainable citrus farming in the Guadalquivir Valley		Jan-22	Dec-24	The project aims to develop an Intelligent Digital System for the management of data, related to the citrus sector	citrus	decision support

Spain	EIP-AGRI Operational Group	OLIVITECH: Optimization of Olive Growing through Technological and Aerobiological Analysis	OLIVITECH	Jan-23	Dec-25	The project aims to predict disease risk and phenological state changes based on aerobiolgy analysis for olive diseases	olive	models
Spain	EIP-AGRI Operational Group	Adaptation of disease prediction models to vineyards within the DOCa Rioja for a sustainable aplication of protection products		Jan-17	Dec-19	The project aims to develop a tool to support growers decision making based on bioclimatic models to make the best decisions from the economic and sustainability point of view	grapevine	model
Spain	EIP-AGRI Operational Group	POM-ZERO: apple production minimising the use of phytosanitary chemicals	POM-ZERO	Jan-17	Dec-23	The project aims to evaluate biological control methods and other alternative methods to phytosanitary treatments	apple	alternative products

Spain	EIP-AGRI Operational Group	New protocol for the application of Yeskap® in dry vineyards of the bobal variety as a non-phytosanitary ecological control strategy of vinewood diseases		Jan-22	Dec-24	The project aims to develop an application protocol for the YesKap product in dry vineyards	grapevine	application machinery