Conclusions and Recommendation Report

D.2 – Conclusions and recommendations

LIFE RESILIENCE

LIFE17 CCA/ES/000030

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Action D.2: Conclusions and recommendations

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1. Summary

The current deliverable contains the LIFE RESILIENCE project's conclusions and recommendations. It has been conceived as a stand-alone document. This document includes the conclusions obtained with the main activities of the project: developed of new varieties resistant/tolerant to *Xylella fastidiosa* (XF) and implementation of best practices model in olive and almond super intensive farms.

In 3 different chapters of the document, we are presenting the socio-economic and environmental impact of the LIFE RESILIENCE PROJECT .The document has been conceived as a stand-alone document that includes not only the environmental impact of the sustainable practices but also the contribution to the adaptation to climate change. In this sense, the main conclusions and recommendations to ensure the replicability and transferability of the project concept and its market potential have been included.

2. Introduction

LIFE RESILIENCE Project is a project to prevent dissemination of X. fastidiosa in intensive olive & almond plantation applying productive green farming practices.

The project is aligned with the main challenges of different EU Strategies, especially with the EU Strategy on Adaptation to Climate Change and the specific legislation about Plant Health and Biosecurity (Directive 2000/29/EC) through preventive measures and control of the spread of XF. The obtention of new olive varieties resilient to future plagues, which may be intensified by CC, is an of these measures. Other activities of the sustainable measures plan of this project have an impact in several European police priorities, as set out below.

Introducing auxiliary flora and fauna through nest boxes and cover crops to balance population control is contributing to achieve several targets (1, 2, 3 and 6) of EU Biodiversity Strategy to 2020. Other activities such as the use of biostimulants to improving soil and plant health are closely linked to the Soil Thematic Strategy. With measures in addition to improve farm biodiversity and soil health, we are reducing the use of chemical phytosanitary products, which has a very positive impact on the reduction of GHG emissions.

Moreover, a regulated deficit irrigation strategy implemented in the project, contributes on the one hand to the Resource Efficient use, not only by reducing water consumption but also GHG emissions, because of reducing the energy required for water pumping. Furthermore, it has been proven that a controlled water stress influences positively the final product quality.

To date, different tasks were undertaken thought the implementation actions that are also contributing to the European Green Deal Strategy: we are focusing on a minimal use of chemical phytosanitary products and fertilizers, improving soil health through good management practices, implementing biological control of pests and diseases, arising efficient use of resources like the use of water, implementing green infrastructure in agricultural fields, sowing cover crops, in consequence achieving reduction in GHG emissions.

However, we are still in the learning process of how to minimize seedling infection and propagation. We are aware of the potential risk of transporting plants and the phytosanitary certificate that is needed. For now, we follow the communication from the EU: "COMMISSION IMPLEMENTING DECISION (EU) 2015/789 OF 18 MAY 2015 Commission Implementing Decision (EU) 2015/789 of 18 May 2015 as regards measures to prevent the introduction into and the spread within the Union of Xylella fastidiosa (Wells et al.) (notified under document C (2015) 3415)

LIFE RESILIENCE activities allow farmers to adapt to the new demands of modern agriculture, such as compliance with the United Nations Sustainable Development Goals (SDGs). Best sustainable practices that promote the achievement of the SDGs, such as the use of natural methods to control vector insects, the application of irrigation strategies that reduce water consumption and the implementation of cover

crops that increase fixation of carbon. In addition to being a project that gives value to alliances between companies, farmers' associations, universities and research centres.

These policies have been the backbone of the project, allowing after its execution that the results have been aligned with the main remains raised previously, as will be demonstrated in the following chapters.

3. Chapters

The document includes the following chapters:

- Chapter I: Base Socio-economic impact.
- Chapter II: Replicability and transferability
- Chapter III: Business plan

Chapter I. Socio-economic impact

1. Social perception

At the beginning of the project, surveys were carried out to assess the socioeconomic aspects. The surveys consisted in 14 questions selected considering the source of the European Commission: Brussels, 17 July 2015. 2 Wageningen University & Research, Food safety and phytosanitary research. The questions were aimed at identifying the information and knowledge that the main project stakeholders had at that time. This allowed us to establish the roadmap mainly for communication and dissemination. These surveys were conduct to different technician and farmer in the 3 countries, Spain (9), Portugal (7) and Italy (7), close to the areas of the demonstration farms. In addition, ASAJA survey 49 associated farmers (40. FR Annex 38).

The analysis of the 72 surveys conducted at the beginning of the project showed the lack of knowledge at that time, observing that there were basic aspects of XF, since what are the problems caused or how to prevent it. However, the Italians already lived with the bacterium and therefore showed a much deeper and more critical knowledge of the environmental, social, and economic impacts of this disease. Soon before the project ends, the surveys were done again and analysed this is described in 41. FR Annex 39. In general, the surveys show a greater understanding about XF of technicians versus farmers. In addition, Italian technicians and farmers stand out with greater knowledge about the disease in all aspects for which it has been asked. The main observations are:

- There is a disparity of profiles within the associates of ASAJA about the perception of the impacts on XF.
- A small part of the respondents considered that plant material controls that are carried out in customs controls, as well as good agronomic and nursery practices as a control method are fundamental to avoid the propagation.
- Communication and Dissemination Plan are essential for transfer of knowledge. Thanks to the communication channels this project has reached about 1,140,200 people.

- Reduction in management costs is mainly due to the reduction of herbicides and pesticides use, which in most cases were abandoned and more attention has been put in the agrobiodiversity maintenance and development.
- Jobs have been created for the implementation of the model within the demo and the replication areas.
- This project facilitates the transfer to precision agricultural practices by integrating the use of new technologies in the field
- There is an acceptance for integrate new plant material in different regions.

2. New XF resistant varieties

The socio-economic impact of the generation of new olive variety resistant to XF is remarkable. The breeding program initiated by the UCO for plants resistant/tolerant to XF was pioneering.

Obtaining these new varieties means that the sector has **resistance** plants against to **diseases**, including this pathogen, which **adapts** to the adverse situations that the **climate change** situation generates in the Mediterranean area, where the olive grove and olive oil market has an important weight.

In **social benefits**, that make clear the importance of developing these varieties, were significant, such as, the provision of a range of varieties with different agronomic characteristics that will allow farmers in the infected area to generate new oils and enter new markets. The generation of many jobs, nurseries and plantation management, as well as indirectly in service companies, phytosanitary products, oil mills, packaging companies and those in charge of materials for the implementation. One of the most notable social effects of this action would be the revitalization of social motivation, since olive cultivation in Puglia is a way of life that had been lost in recent years. An area of more than 150,000ha devastated in Italy by this pathogen would have an alternative for

its population. Additionally, the olive sector in risky areas would have the security of knowing that their investments and their well-being security would be guaranteed without catastrophic risks. Therefore, new tolerant/resistant varieties are a key aspect for the Action Plan for the Olive Oil Sector

Regarding **economic aspect** (in detail in the chapter III), the commercialization of 2 new varieties of olive trees. There are currently 150,000 ha that we can consider with potential for replanting in the medium term. It could generate -being conservative- a sales volume of 88.5 million euros, introducing them in three different markets: in the Apulia area, areas with the potential to be infected by the bacterium and in the world olive market. However, the economic impact would be greater, since the significant increase in jobs in the olive sector would imply, in turn, a greater spending capacity of the citizens of the area. To estimate the income from sales of the new resistant varieties, we established the following assumption: of the total sales, 60% of them will be of variety A (intended for intensive cultivation of 200 trees per ha) and the remaining 40% it will be of variety B (intended for super-intensive plantation systems of 2,000 trees per hectare).

3. Sustainable best practices model

The LIFE RESILIECE model has been accepted by the farmers and it is demonstrated that is an economically and technically feasible option to enhance the sustainability and increase resilience of intensive olive and almond production in the Mediterranean. In addition, the best practices model has made it possible to implement precision agriculture in farm management, for which more trained personnel are required, thus improving the training and well-being of workers. In most cases, creating new jobs for the implementation of these innovative techniques.

The 3 main practices implemented (Cover crops, Bioestimulants and Regulated Deficit Irrigation) have a positive impact on climate change mitigation:

- **Impact cover crops** strategy:

1) improve the stability and structure of the soil, protecting the soil against erosion, improve infiltration.

2) improve the water balance, improving the storage of water in the soil by increasing infiltration and reducing the evaporation of the water found under the roof in the hottest seasons

3) improve soil heath, increasing organic matter in the soil by the contribution of plant mass

4) improve biodiversity of microorganisms that allows increasing the content of organic matter in the most superficial layer of the soil.

5) improve availability of macro and micronutrients for the crop

6) control of pests and diseases since the increase in plant biodiversity leads to a greater diversity of food and microhabitats that favor the increase of natural enemies.

7) Nitrogen fixation, forming symbiosis with bacteria of the Rhizobium genus.

8) Fix atmospheric carbon dioxide (CO2). About 8 tons of CO2 per hectare of plant cover

9) reduction nutrition needs, fertilizer and fuel cost

10) reduction CO2 emission due to reduce tractor passes and reduction of fertilizer application

- **Impact Bioestimulants** use strategy:

1) Increment of soil microbiological activity due to an increment in soil enzimes as ß-Glucosidasa and DHA ,

2) Increasing soil nitrogen fixing and potassium and phosphate solubilizing bacteria which improves in soil fertility,

3) Soil microbiological activity activates plant defenses increasing soil-plant resiliency.

4) Reduction of 30% of NPK fertilizers reducing soil and environment pollution with nitrogen and phosphorus leaching

5) Money saved with 30% of NPK reduction incrementing crop rentability

6) Application of soil microorganism improves plant diseases management through induced disease resistances

7) stimulation of plant's nutrient assimilation incrementing nitrogen, phosphorus and potassium plant content.

- **Impact Regulated deficit Irrigation** strategy:

1) increase olive oil quality (phenolic compounds in olives)

2) reduction Water footprint and Carbon Footprint.

3) energy and water cost reduction

These best practices model are key strategies to increase the **biodiversity** in the soil and in farms. Introducing auxiliar flora and fauna with cover crops, bioestimulants, microorganisms, nest boxes, insect hotels, hedgerows we achieved this goal, in addition it is improved the soil and plant health and minimize the use of chemical phytosanitary products.

4. Environmental impact

An objective of the project was to demonstrate that crop manage under the sustainable best practices contribute to an efficient use of resources and therefore to the improvement of the sustainability of the farms implementing LIFE RESILIENCE project. In the **water footprint** and the **carbon footprint assessment** were calculated at the beginning and at the end of the project to determine the impact on both resources. Both indicators have been calculated on the demonstration farms and estimated on the replica farms, which are developed in detail in the reports 42. FR Annex16 and 43. FR Annex 13.

- In the Water footprint assessment report was determined that the **total water consumption reduction** achieved thus far because of the project's implementation is: **1.261.301,50 m^3.** In the demo farm the water reduction was 105.096,16 m^3 and in the 13 replication farms (where the best practices model was implemented) was estimated as a reduction of 1.156.205,34 m^3.
- In term of **GHG emission reduction,** considering all the areas in which the measures were applied, at the demonstration sites (3.568,7 tn CO_2 eq removed) and the replication sites (6.580,02 tn CO2 eq removed), a **total of 10.148,72 tn CO_2** q was removed from the atmosphere up to this moment.

Clearly demonstrates the project's significance in terms of reducing carbon emissions. In that sense, it is reasonable to consider the project's potential to have a positive impact on the environment if its scope of action is expanded. For example, just considering the countries where the activities took place, Spain, Italy, and Portugal, they have a total of 19.526.432 ha of arable land. If we assume that 1% of this land (195.264,32 ha) will replicate this project's activities, we can estimate the average reduction in CO_2 emissions as follows: 3.025.872.529,37 ton CO_2/year

- The aforementioned information demonstrates how the LIFE RESILIENCE project's actions had a positive impact on the environment and on climate change mitigation. It is also advised to replicate it in all the regions and crops where it can be used successfully.

5. Innovation in the use of technologies in the agro sector

The **technology** used in this project, such as drones or satellites, helped to understand how to use satellite data to gain information about the sustainability within the climate changes we are experiencing. This technology allowed to implement **precision agriculture on farms**. This allows us to be *more efficient in the use of resources* (water, energy, soil, fertilizers, nutritional, etc.) and improves all farm management activities (design of pruning strategies, irrigation, nutrition and pest control, sampling ,etc.). This has had a great positive impact on the environment, social and economic. LIFE RESILIENCE has tried to make available to the farmer the most innovative technology that we have used in the project. The project helped to understand how to use satellite data to gain information about the sustainability within the climate changes we are experiencing.

Chapter II. Replicability and transferability

1. Transfer of knowledge

LIFE RESILIENCE has made a significant effort to transfer all the learning and results of the project to different stakeholder groups (i.e. researchers, NGOs, private companies, foundations and governmental organizations, citizens, agri-food companies, plant protection producers, research groups, farmers' associations and cooperatives etc.) and to the main target groups of stakeholder's olive and almond farmers in Mediterranean areas with a high risk of XF spread. The scope of the project has been important, since we have reached different regions (Mediterranean area) and crops (citrus, grapevine, etc), to which we have provided the tools, management plans and technical advice to implement the model of sustainable practices and the socioeconomic and environmental impacts that it generates.

The new olive genotypes tolerant to XF were planted in **4 genotypes replication farms (2.8 ha)** in Spain and Italy. Two experimented field to test the selected genotypes under natural infection condition to XF and other two (Tuscan and Sevilla) to evaluate the adaptability of the selected genotypes to the Tuscan climate and edaphological condition.

A total of the **13 replication farms (1.8762 ha)** were managed with the *sustainable practices model* in Italy, Spain and Portugal. **4 additionally replica farms (40 ha)** were advised on the use of innovative methodologies and tools to develop precision agriculture on their farms. These replica farms used the original data set of NDVI provided by GREENFIELD through the innovative methodology developed in the LIFE RESILIENCED project. In addition, **30 replica farm (2194 ha)** will continue to implement the model of good practices *after project period* (2022-2026). It is expected that the impact will increase with the continuation of the communication and dissemination efforts by AGRIFOOD and mainly due to the transfer of results that ASAJA will continue to carry out at a national and European level through COPA-COGECA who has a direct line of contact with 22 million farmers.

Agrifood's role was essential in the relationship with European government institutions, at local, regional or national level that were interested in the Life Resilience project.

To this end, numerous meetings were held to disseminate and communicate the project with representatives of administrations and political parties who were made aware of the initiative, such as Luis Planas, Minister of Agriculture, Fisheries and Food (MAPA). In addition, it was possible to count on the assistance of various representatives in various meetings that were organized during these four years, such as, for example, the final day of presentation of the project's results, which was attended by Valentín Almansa, general director of Health and Agricultural Production. of the MAPA.

All these relationships, together with the dissemination and communication of the good practices and results of the project, reached the institutions, raising great awareness about the problem of the Xylella fastidiosa bacterium in Mediterranean agriculture. It should be noted that, even before the start of the project, 10 signed commitment letters were received from various institutions at European level, including COPA-COCEGA.

Thanks to the communication of valuable strategies and results through meetings and other materials, such as press releases and newsletters, this topic was a protagonist in the European political agenda, allowing the future adoption of prevention strategies promoted by regional and international political leaders.

2. Recommendation to ensure replicability and transferability

The purpose of this section is to discuss possible strategies or measures that would allow the results obtained to be implemented in other areas (different from the replications made).

1. Environmental education

Agricultural biodiversity loss is one of the main concerns of the scientific community and constitutes an important issue of the educational curricula in many countries. Many researchers emphasized the importance of outdoor activities with a biodiversity and ecological educational strategy in order to develop concepts, construct attitudes, and the overall personality. Direct contact with biodiversity and a better understanding of its importance and threats are essential to raise public awareness and engagement in community-driven biodiversity conservation and monitoring programs. However, most of the population lives in urban areas and have decreasing direct contact with nature, limiting the efficacy of education towards environmental and biodiversity awareness. From this point of view, hands-on activities in proximity habitats may help to overcome this gap by providing experiences to students, enhancing their literacy and their active participation in conservation. For this purpose in El Valenciano Rural Innovation Hub environmental education to students and visitors will be developed. The model of best practices will be demostrated in situ to students, farmers and visitors after the LIFE PROJECT. Furthermore, nest boxes and insect hotels will be a good example of how simple tools can be used to increase diversity in agricultural environments, thus decreasing the environmental impact of farms.

2. Technical Training

Although scientists have highlighted the innumerable advantages of using cover crops, many farmers are still reluctant to implement them due to the belief that they compete with the crop for resources. It is therefore important to hold training sessions for technicians where the advantages of cover crops are demonstrated in situ on demo farms.

On the other hand, training sessions will also be held on the use of soil microorganisms as a substitute for some of the chemical fertilisers that are currently used on many crops. Soil microorganisms have many advantages, but to get the most out of them it is important, for example, not to mix them with other products, not to disinfect the soil, all these concepts will be conveyed in the technical seminars that will be held after the end of the project and as a continuation of the project.

BALAM has 4 Rural Innovation Hubs (RIH) distributed throughout different areas of Spain, where training sessions will also be held with the results of the LIFE RESILIENCE project on an ongoing basis.

The RIHs are centres that are a meeting point for technological and innovation demonstrations that help optimize resources, sustainability and productivity in the agri-food sector. Where continuous training is carried out for the sector to empower rural areas.

3. Commitment or replication in the After-Life period

Agrifood over the next five years, will continue updating the website, as well as the social networks and Newsletter, in order to continue disseminating and communicating the project's activities. Likewise, dissemination actions of the project will continue to be developed in collaboration with media specialized in the olive sector such as Olimerca, ÓleoRevista, Mercacei, or agriculture such as Revista Agricultura, Vida Rural, Agronegocios, Revista COAG and Revista UPA. Likewise, any new information on the project or on the completion of the work in progress will be sent through a press release and will be disseminated through https://www.qcom.es/inicio and https://www.euroganaderia.eu/portada.

ASAJA will continue transfer of results at a national and European level through COPA-COGECA.

Chapter III. Business plan

The variety in site conditions and trials laid out in the Resilience project, warrants a comprehensive comparison of trees established and managed by sustainable management versus those managed with conventional practices. The diverse data collected during the project allow us to assess not only the environmental and climate change impact but also the market potential. (46. FR Annex 20) This chapter entails 2 strategies:

1. Contracting of services

In addition to the 3 demonstration farms and 13 replica farms of the project where the measures have already been implemented, the results obtained throughout these four years of the project have been proven that are highly beneficial to be replicated in other farms.

A training and advising service will be provided in this regard for farmers who want to practice a more sustainable and resilient agriculture.

This training and advice include measures to manage a farm efficiently, optimize the use of natural resources, reduce the water and carbon footprint of a farm and prevent pests and diseases, such as *Xylella fastidiosa*. The results of the tests carried out within the framework of this project serve as the basis for improving this advisory service provided to clients, since it is based on empirical data and on a variety of application scenarios.

Each client will receive guidance that is developed just for them, taking into account their needs and short- and long-term goals.

Communication and dissemination activities for the project and its outcomes will be implemented in order to spread this service and reach a larger audience. The study results will be available online on the project website.

Dissemination campaigns for new stakeholders who might be interested in adopting this model of sustainable practices will also take place, increasing the project's visibility. These actions will be adopted by all members of the consortium after the project ends.

In this regard, each partner plays a crucial part in increasing the visibility of these services and enabling more farmers to adopt the project's measures:

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BALAM already provides specialized ***agricultural advisory services*** and works with clients that in total own more than ***40,000 hectares*** of land spread across Spain and Portugal. As more precise results are obtained, this advice will be improved. In addition, thanks to the agreement signed between **UCO** and BALAM to continue evaluating the ***new varieties*** for at least the next few years. As well as for

GREENFIELD's commitment to maintain operation of its ***platform,*** which monitors the crops, for a predetermined period of time after the project is over.

On the other hand, BALAM has its **rural innovation hub** El Valenciano, which includes an experimental farm where tests related to the LIFE Resilience project were conducted. Farmers, nurseries, associations, and other industry-related organizations constantly visit this innovation hub throughout the year. In this way, the results of the project are visible for all visitors, resulting in an even greater impact of the project. The project, its goals and successes will also be shared at the three additional rural innovation hubs that BALAM operates in Spain. These hubs also host conferences and welcome visitors from the sector.

In this regard, it is also important to emphasize **ASAJA's** contribution to reaching ***more farmers.*** Thanks to the high relevance of this entity in the sector and broad national and international reach, it serves as a crucial channel increasing numbers of farmers to adopt the sustainable farming practices studied in the project. In this way, Asaja will keep informing its members and taking part in meetings and conferences where the outcomes can be presented and discussed.

AGRIFOOD Comunicación will continue to carry out the ***project's dissemination and communication*** activities for the following five years after the project has ended. In this way, the project's impact will keep growing due to communication efforts on the project website, on social media, and through press releases, among other channels.

NUTRIPARADO will offer ***cover crop seed mixes*** to farmers in addition to technical assistance services. The sustainability and biodiversity program created by this entity will also be a supplement to these services. All of this will result in a ***sustainable agriculture advice service*** for the client based on the project's results as well as the ongoing evaluations and research.

Equally important, are the actions carried out by the Portuguese and Italian partners, to continue with the research and exploitation of results in both countries. In this sense, both **SAHC** and the Società Agricola Villa Filippo Berio will continue their studies in the coming years. Likewise, **VILLA FILIPPO BERIO** together with **CNR** will work on a program of ***best agricultural practices for precision agriculture***

in olive. The outcomes of this collaborative effort will be made available to farmers in Italy so that they can put these measures into action.

Lastly, it is worth highlighting the **replication potential** of these services in the three countries involved in the project. In this sense, the arable land according to the FAO of the countries involved in this project is considered:

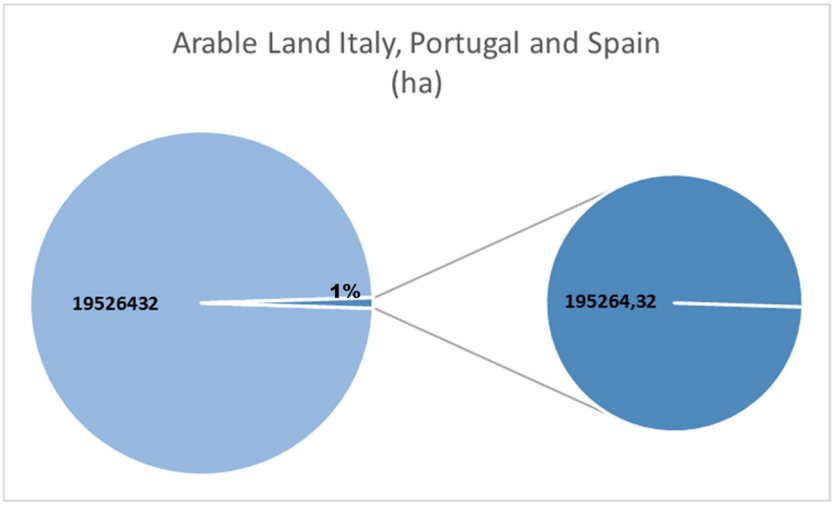


Image 1: Arable land. [1]

As shown in the graph above, despite considering only 1% of the arable land, the potential to offer services and advice in these three countries based on the project's findings is significant, almost being able to reach **200.000 has**. If we consider an average of €60/ha for sustainable advisory and monitoring services per year, we can generate up to **1.2M€** per year in profit.

[1] FAOSTAT: https://www.fao.org/faostat

This section of the business plan was developed by UCO in collaboration with a third party subcontracted. This study is presented next.

Introduction of new olive varieties resistant to Xylella fastidiosa from the Life Resilience Project: Impact and market potential

Vector Horizonte

Executive Summary

This market study reveals the importance of developing new varieties resistant to *Xylella fastidiosa* for the olive grove sector and, especially, in areas devastated by the bacterium.

Until now there were only two varieties cataloged how capable of combating the disease,however, with those cultivars developed in the LIFE RESILIENCE program, not only is theavailable range expanded, but the characteristics of those already on the market are improved, providing farmers with farmers greater profitability.

The potential market is very wide, therefore, the most important target audience is the infected area of Apulia, for which it will mean the generation of many jobs that had been lost. Subsequently, the sale may be extended to those areas susceptible to the *Xylella* pandemic; tending as ultimate objective, the introduction of new varieties in the world olivemarket.

The estimated minimum income exceeds 85 million euros, although, without a doubt, themain beneficiary of the development of this project is the agricultural society.

1. Business Opportunity: problems in the olive sector.

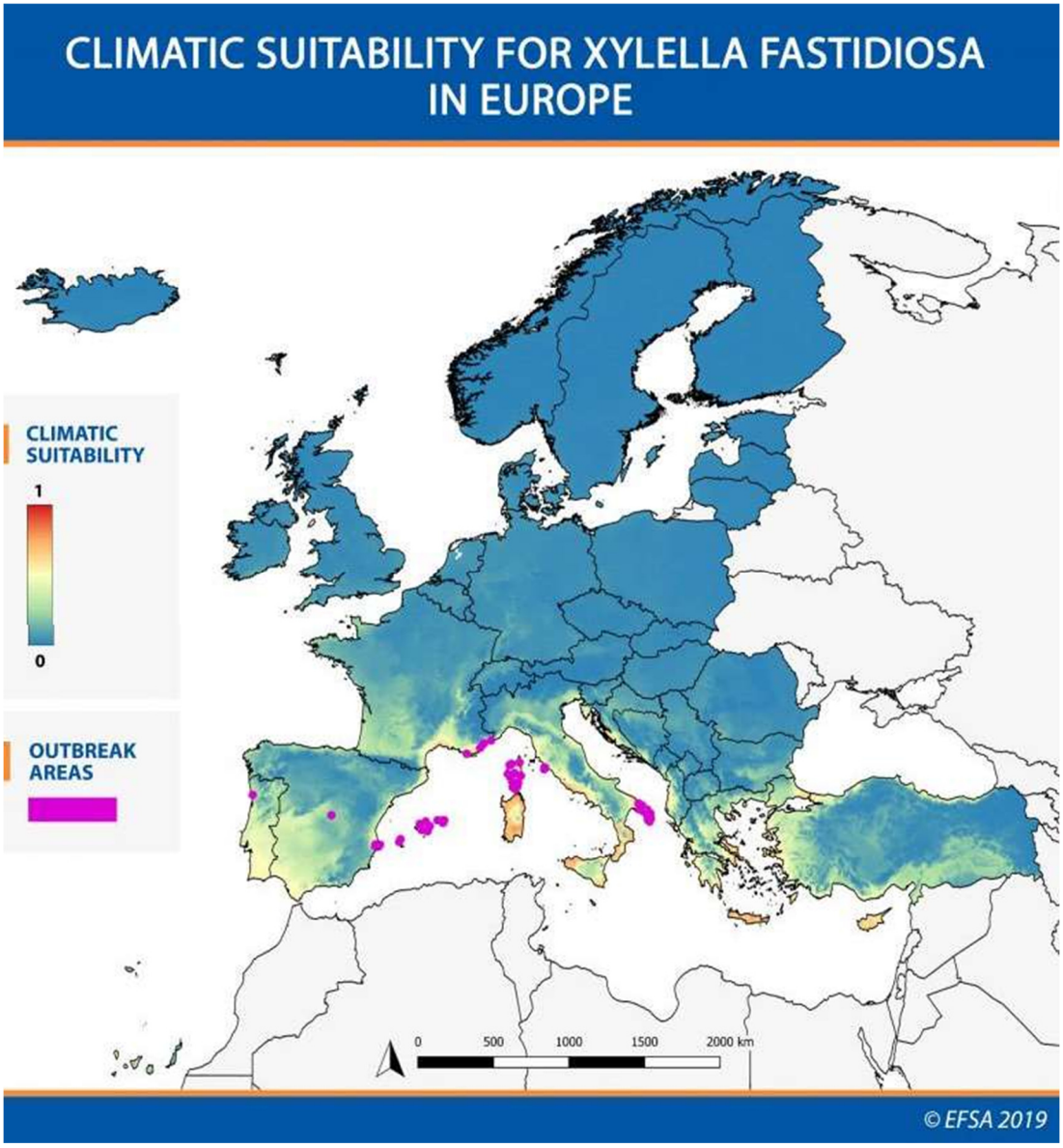
In 2010, it began to be detected that the olive trees in the Salento region were drying outquickly and gradually, even causing the tree to die. However, it was not until October 2013 when, with the outbreak aggravated, it was detected that the *Xylella fastidiosa* bacterium was the main cause of this disease, capable of generating an extremely serious situation without precedent in Europe.

The Xylella fastidiosa disease is transmitted naturally from one plant to another with thehelp of insect vectors; These act as short-distance transmitters of the disease, althoughin long distances the main route of spread of the bacteria is the trade in plants that are contaminated. Currently, according to the European Food Safety Authority (EFSA), thereare 595 plant species registered as hosts, although not all plants are sensitive or show the same level of susceptibility to the four subspecies (fastidiosa, multiplex, pauca and sandyi) of *Xylella* recognized.

The bacterium colonizes the xylem network of plants, whose main function is to transportwater from the roots to the leaves, so that the xylem vessels become clogged and the flow of crude sap is obstructed, causing its characteristic symptoms, which are resemblethose of lack of water and scarcity of nutrients. However, many host plants may not showany symptoms; therefore, the identification of asymptomatic host species is crucial to prevent them from acting as carriers of this bacterium in new areas or among the most sensitive crops, such as olive trees, almond trees, vines, oleander or citrus.

Specifically, in the olive tree the most observed symptoms are wilting, defoliation and general decay of the leaves and branches, even causing the death of the tree in a shortperiod of time. Dry, brown areas with irregular distribution and curling of the leaves towards the underside can be observed on the leaves. Other prominent symptoms are the pronounced chlorosis of the central nerve of the leaves or the necrosis of the apex.

It has been shown that one of the determining factors for the spread of *Xylella* in olive trees is the climate. High temperatures directly affect vector performance, density, and transmission rate, so the disease thrives more easily in tropical or subtropical regions with mild winters, such as the Mediterranean climate. Detected in Italy, France and Spain, the disease has the potential to spread from the Iberian Peninsula to Turkey or toother species such as almond trees, which would have a great economic impact on agriculture.



As can be seen, the main world producers of olive oil (Spain, Italy and Greece) are currently at risk of losing millions of euros due to this bacterium. Specifically in the conflictzone of Spain, there are more than 2.5 million hectares dedicated to olive cultivation, which makes the control of *Xylella* a priority for the Spanish economy.

Attempts have been made to eradicate the bacterium in infected areas around the world,but no system has been effective in containing the spread: conventional vector control methods or the application of systemic insecticides in infected fields have been unsuccessful, even emitting dangerous Greenhouse Gas emissions in the process.

According to the Phytosanitary Technical Commission of the EFSA, there is currently nomethod available to cure diseased plants in the field. Changes in cropping systems (eg

pruning, fertilization and irrigation) could have an impact on disease development, but this is not enough to cure the plants. The control strategy has to focus on the insect vector and the elimination of infected plants which, if left in the field, can act as a reservoirfor the seed bacteria. For the control of the vector population, adequate phytosanitary treatments are required, but also the specific use of phytosanitary products, especially before the elimination of infected plants. These treatments must be applied in conjunctionwith appropriate agricultural practices, because if other measures are not taken, the mass death and systematic elimination of crops could change the composition of the flora and fauna of entire ecosystems.

Therefore, it is essential to learn how to manage *Xylella* through integrated disease control: plantation management, vector control or the use of resistant varieties - those that, despite being colonized by *Xylella*, are asymptomatic or suffer from mild symptoms.

With the aim of preventing the effects of *Xylella fastidiosa* on intensive olive and almondcrops, LIFE RESILIENCE has emerged. The project develops genotypes of productive plants resistant to pathogens, applies practices and innovates in natural vector control methods to demonstrate their effectiveness in preventing the negative effects of *Xylella*.

The actions undertaken to achieve the objectives set out in the project allow theorganoleptic quality of the products to be increased by 30%, as well as reducing 20% ofthe water applied in the olive fields, which means that the olive tree can produce a moreconcentrated fruit.

The development of the project aims to develop new varieties of olive trees resistant to *Xylella fastidiosa*, improving the characteristics of the two varieties currently on the market: Leccino and Fs-17, cultivars planted in the area where the epidemic began andwhich have survived the disease.

Finally, a replicable model of best practices will be provided for olive and almond trees, as well as other woody crops, citrus fruits and vines in Europe, increasing their ability toadapt to climate change and future epidemics.

2. Objectives description.

The main objective of the study is to establish the potential market for the new varieties developed in the LIFE RESILIENCE project.

Among the specific objectives we can distinguish the following:

- Establish the regions and the target audience of the market that we are going to address.
- Determine the competitive possibilities to export the varieties, studying whether the characteristics are sufficient to establish the species as a reference.
- Notice the possibilities of positioning itself in the market, since it will be able to commercialize a variety of olive groves that is unique worldwide that will improveimportant aspects for the olive oil producer in terms of economic benefit and/or the quality of its product, benefiting in turn to the national, European and even global sector.
- Once the project is finished, find out the viability of the production and sale of the new varieties, locating possible opportunities to achieve a balance between demand and supply.
- In short, study and analyze the success or failure in monetary and economic terms of launching new varieties on the market.

3. Current situation analysis.

A. External analysis.

The most relevant factors for the success of this study are the legal variables and the direct variables such as the new varieties of the competition resistant to *Xylella*.

In relation to the legal environment, it is essential to highlight that the European Union regulates *Xylella fastidiosa* as a quarantine pest under Regulation (EU) 2019/2072, which dictates that its introduction, transfer, maintenance, multiplication and release in all Member States is prohibited. In addition, it has been classified as a priority pest as it has a potential serious economic, environmental or social impact for the European territory.

On August 14, 2020, the Commission adopted new measures against *Xylella fastidiosa* (Execution Regulation (EU) 2020/1201 of the Commission), establishing that in case of detection, regardless of the symptoms and subspecies in question, they will take all necessary measures to eradicate it or prevent its spread if it is no longer possible to eradicate it.

Among the control measures established in the Union to prevent the spread and that directly influence the expansion of new varieties are:

1. Establishment of the demarcated zone: As soon as the presence of Xylella fastidiosa is confirmed in the territory of a Member State, the infected zone is demarcated with a radius of at least 50 meters around the detected plant and another buffer zone, whose The minimum width will be 2.5 km if the established objective is the eradication of the bacteria or 5 km, if the objective is thecontainment of the bacteria in a certain area of the territory, once it has been determined that it is not feasible to eradication.

2. Eradication measures: Within the infected zone, all infected or symptomatic plants must be extirpated. In addition, those species sensitive to that specific subspecies of Xylella fastidiosa will be removed if they have not been immediatelysampled and tested. All other host plants in the infected zone should be sampledand tested for the presence of the bacteria. Within the buffer zone, intensive surveillance consisting of sampling and testing of host plants should be carried out.

3. Agricultural practices such as weeding or soil plowing should be applied both in infected areas and in buffer zones, in order to avoid the presence of the bacterium in its herbaceous hosts and reduce the vector population in the area.

area in question. Eradication measures apply to any outbreak of Xylella fastidiosadetected in the Union territory, with the exception of infected areas where containment measures are authorised.

4. Containment measures: these measures are applicable to southern Apulia (Italy), Corsica (France) and the Balearic Islands (Spain), since the bacterium is already widely established in these areas and eradication would not be feasible. Within the infected zone, lighter measures are applied, consisting of intensive surveillance and immediate removal of infected plants. Within the buffer zone, thesame rules apply as in the eradication measures.

5. Planting of specified plants in the infected zone: The Member State concerned may authorize the planting of specified plants in the infected zone in several specific cases. It will be allowed, first, if the plants are grown in insect-proof production sites free of *Xylella* and its vectors. Second, in the containment zones,if these plants belong to varieties considered resistant or tolerant to the specifiedpest and have been planted in the infected zones but outside the special surveillance zones. Finally, in infected areas with an eradication strategy, if thesespecified plants belong to a species free of the pest according to the analyzes carried out in said demarcated area in the last two years.

6. Movement of plants into and out of demarcated areas: Strict requirements apply for the movement of specified plants out of demarcated areas and from infected areas to buffer zones. This movement is only allowed if they meet certainconditions (eg grown under protected conditions, sampled and tested prior to movement, with traceability requirements in place). Specific exceptions apply to specified plants found not to be infected in demarcated areas as part of the annualmonitoring campaign.

The same conditions as for EU Member States also apply to host plants imported from third countries. More specifically, the importation of host plants from infected third countries is only possible if such plants are grown under protected conditions and, prior to export and upon entry into the EU, are inspected, sampled and tested for the absenceof the bacteria. . Strict conditions also apply for these imported plants to move within theEU.

In August 2021, it was authorized, in accordance with letter b) of art. 18 of EU Reg. 2020/1201, the planting of immune, tolerant or resistant species in the infected area, in addition to almond, cherry, peach, plum, apricot and citrus varieties.

Analysis of the sector and the reference market

The two species of olive tree resistant to Xylella that are currently being marketed in the reference market are the FS-17 and Leccino variety.

FS-17, a variety patented by the National Research Council (Consiglio Nazionale delle Ricerche), is sold on the market at an average price of €2.40, with the drawback that it can only be sold in nurseries with a marketing patent. The ideal planting framework for this variety is 800 trees/ha, this being a species for super-intensive cultivation (on average >500 plants/ha).

The 40 cm plants of the LECCINO variety are sold freely on the market for an average of €2.20. It is a species for intensive cultivation (on average 150-500 plants/ha), in whichits ideal planting framework would be between 200 and 400 plants per hectare.

B. Internal analysis.

Cost analysis

The costs associated with the production of resistant varieties developed in the LIFE program are the same as for other varieties on the market. Estimating that the unit cost of each unit sold at one euro is 60 cents, that is, 40% of sales are profits.

Product analysis

The new varieties that have been developed in the program have given satisfactory results, proving their resistance to *Xylella fastidiosa* and good agronomic characteristics. Among these particularities, the following stand out:

- Early production.
- High quality of oils.
- Low alternace in the production.
- Adaptation to different farming systems, from an intensive system to super-intensive systems. In other words, from plantations of 200 trees per hectare to plantations of more than 2,000 trees per hectare, depending on the new variety chosen, since several are being developed.

The target public, with the acquisition of these varieties, intends to avoid any future problem

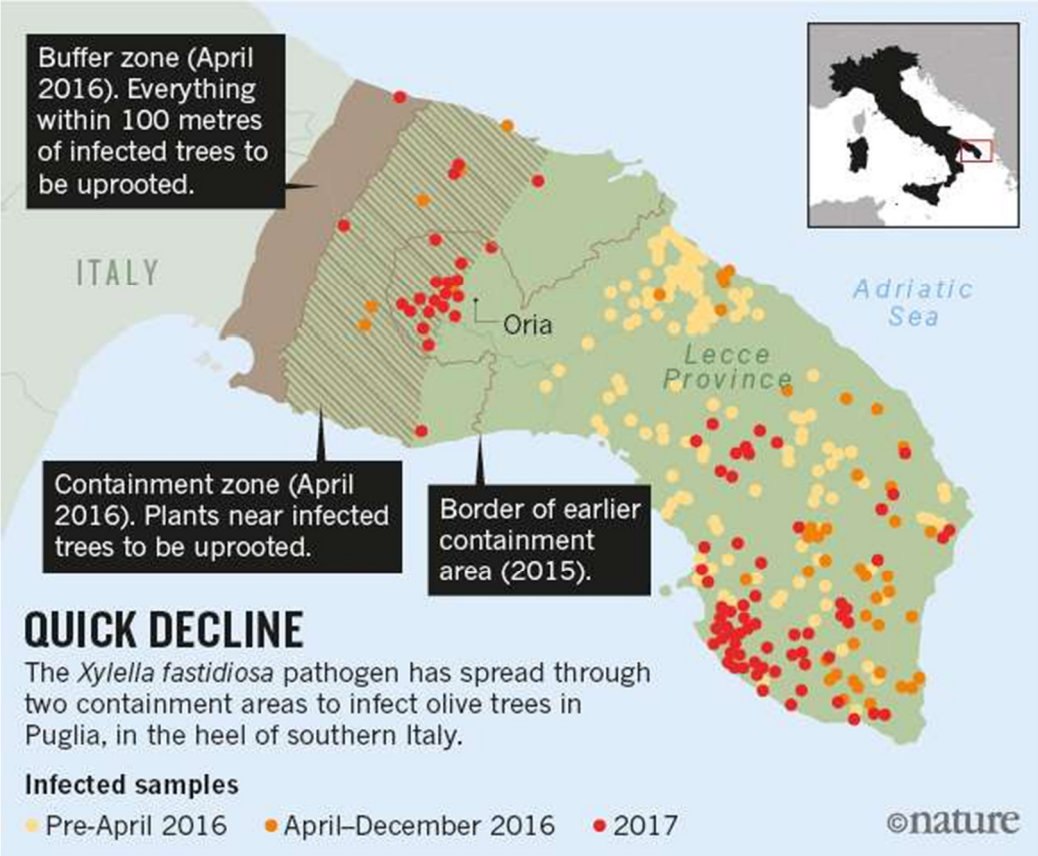
related to new foci of *Xylella fastidiosa* and/or to replant plantations of susceptible varieties that are devastated by the disease; at the same time that they are capable of producing a high quantity of olive oil with optimal characteristics.

Potential market determination.

The geographical demarcations to which we can address are the following:

7. Zone affected by *Xylella fastidiosa* in southern Italy and the adjacent area:

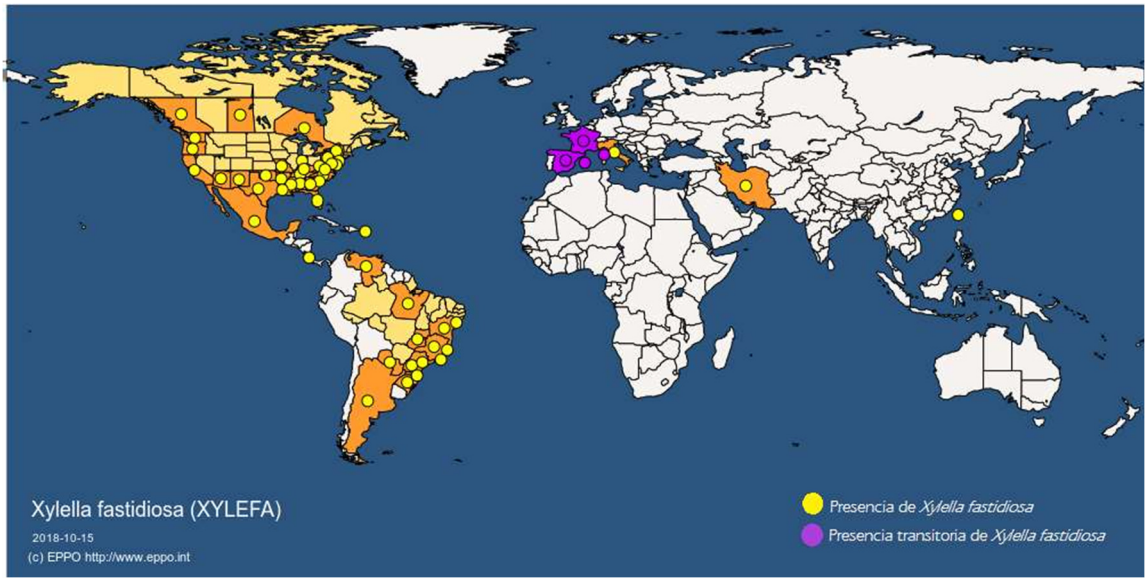
a. Olive groves: there are currently 150,000 ha that we can consider with potential for replanting in the medium term.



8. Areas in the rest of the world affected by *Xylella* or potentially susceptible:

a. Olive grove crops: this includes the countries with the greatest exploitation of olive groves, such as Spain, Tunisia, Greece and Turkey.

b. Other crops: in the American continent, the area with the greatest worldwide presence of Xylella fastidiosa, almond trees, blueberries and grapevines have been affected by this bacterium, mainly.



9. Olive grove market worldwide: there are 3.5 million olive grove farms in 11.6 million hectares of surface throughout 63 countries on 5 continents. This implies that the olive tree occupies 25% of the permanent arable land on the planet.

4. SWOT analysis.

Weaknesses	Strengths
- Ignorance of the productive capacity and the real characteristics of the varieties of theproject. - The study of resistance to bacteria has been donein a short period of time.	- First genetic improvement program with the aim of obtaining a resistant variety. - Capacity and experience of breeders of genetically improved varieties.
Threats	**Opportunities**
- Efectividad de un tratamiento alternativo contra la *Xylella fastidiosa*. - El desarrollo de otras variedades resistentes.	- There is no method for healing an infected tree. - *Xylella* resistance exclusion zones. - Threat of introduction ofthe bacteria in other areas.

5. Marketing plan.

After carrying out an analysis of the current situation of the olive sector in the world, we can establish our target audience with greater criteria and estimate a market share according to the characteristics of the new varieties.

The market that we can target is very broad, but in the process of increasing efficiency, we will try to focus on the most profitable audience and markets. Therefore, we are goingto divide our target audience into three main segments:

1. Infected zone and surroundings in Apulia (Italy): this is our main market in the short term. Since, as previously mentioned, only the planting of resistant varietiesis allowed in this area and currently only the FS-17 and LECCINO varieties are recognized as such, in addition to those generated in this project.

2. Main producers of olive oil or areas with potential for introduction of the bacteria in which an epidemic similar to the one that occurred in southern Italy could develop.

3. World market for olive groves: the good characteristics of the new varieties shown up to now, make it possible to establish the objective of introducing them on the world market in the medium and long term.

To estimate the income from sales of the new resistant varieties, we are going to establish the following assumption: of the total sales, 60% of them will be of variety A (intended for intensive cultivation of 200 trees per ha) and the remaining 40% it will be ofvariety B (intended for super-intensive plantation systems of 2,000 trees per hectare).

	Olives/Ha	% Total sales
Variety A	200	60,00%
Variety B	2.000	40,00%
		100,00%

With these premises, the sales forecasts for the commercialization of the new varieties in each of the segments are specified below.

Zona de Apulia.

It is estimated that from the 150,000 hectares of olive trees we could obtain in the short term 20% of the market share of the olive trees sold in the southern part of Italy affectedby the Xylella pandemic.

Total Ha Italy	150.000	Market share	20,00%

Depending on the sale price of the new varieties, the income may be as follows:

Variety A		PRICE			
		2,00 €	3,00 €	4,00 €	5,00 €
% Market share	20,00%	7.200.000,00 €	10.800.000,00 €	14.400.000,00 €	18.000.000,00 €

Variety B		PRICE			
		2,00 €	3,00 €	4,00 €	5,00 €
% Market share	20,00%	48.000.000,00 €	72.000.000,00 €	96.000.000,00 €	120.000.000,00 €

TOTAL SALES REVENUES		PRICE			
		2,00 €	3,00 €	4,00 €	5,00 €
% Market share	20,00%	55.200.000,00 €	82.800.000,00 €	110.400.000,00 €	138.000.000,00 €

<u>Susceptibles zones: the Spain´s example.</u>

Spain is the country in the world that dedicates the most area to olive groves, with a totalof 2,750,000 Ha, for this reason and because of the presence -although controlled- of the bacterium, we expose the situation in the event that *Xylella* is spread throughout Spanish territory, although it can be extended to other potentially susceptible areas.

Total Ha Olives Spain	2.750.000	Market share	10,00%

In this market, the initial price is €1, since, at present, the 60 cm olive plant is sold for that amount. With this and estimating a 10% market share, the income would be as follows:

Variety A		PRICE			
		1,00 €	1,75 €	2,50 €	3,25 €
% Ha infected with Xylella	10,00%	3.300.000,00 €	5.775.000,00 €	8.250.000,00 €	10.725.000,00 €
	20,00%	6.600.000,00 €	11.550.000,00 €	16.500.000,00 €	21.450.000,00 €
	30,00%	9.900.000,00 €	17.325.000,00 €	24.750.000,00 €	32.175.000,00 €
	40,00%	13.200.000,00 €	23.100.000,00 €	33.000.000,00 €	42.900.000,00 €

Variety B		PRICE			
		1,00 €	1,75 €	2,50 €	3,25 €
% Ha infected with Xylella	10,00%	22.000.000,00 €	38.500.000,00 €	55.000.000,00 €	71.500.000,00 €
	20,00%	44.000.000,00 €	77.000.000,00 €	110.000.000,00 €	143.000.000,00 €
	30,00%	66.000.000,00 €	115.500.000,00 €	165.000.000,00 €	214.500.000,00 €
	40,00%	88.000.000,00 €	154.000.000,00 €	220.000.000,00 €	286.000.000,00 €

TOTAL SALES REVENUES		PRICE			
		1,00 €	1,75 €	2,50 €	3,25 €
% Ha infected with Xylella	10,00%	25.300.000,00 €	44.275.000,00 €	63.250.000,00 €	82.225.000,00 €
	20,00%	50.600.000,00 €	88.550.000,00 €	126.500.000,00 €	164.450.000,00 €
	30,00%	75.900.000,00 €	132.825.000,00 €	189.750.000,00 €	246.675.000,00 €
	40,00%	101.200.000,00 €	177.100.000,00 €	253.000.000,00 €	328.900.000,00 €

Worldwide

Currently, 11.6 million hectares of the world's extension are dedicated to olive cultivation.Of which, knowing the good quality of the new varieties, we can estimate that our sales will reach 0.05% of the world market, with the following income:

Total Ha X	11.600.000	Market share	0,05%

Variety A		PRICE			
		1,50 €	2,25 €	3,00 €	3,75 €
% Market share	0,05%	1.044.000,00 €	1.566.000,00 €	2.088.000,00 €	2.610.000,00 €

Variety B		PRICE			
		1,50 €	2,25 €	3,00 €	3,75 €
% Market share	0,05%	6.960.000,00 €	10.440.000,00 €	13.920.000,00 €	17.400.000,00 €

TOTAL SALES REVENUES		PRICE			
		1,50 €	2,25 €	3,00 €	3,75 €
% Market share	0,05%	8.004.000,00 €	12.006.000,00 €	16.008.000,00 €	20.010.000,00 €

6. Results and conclusions

The market study yields very positive conclusions on the development of new varieties resistant to Xylella fastidiosa.

Despite the great economic returns that will be derived from the sale of these olive trees,it is the social benefits that make clear the importance of developing these varieties. Among them we can especially highlight:

- The provision of a range of varieties with different agronomic characteristics that will allow farmers in the infected area to generate new oils and enter new markets.
- The generation of a large number of jobs, both directly in the plantations, nurseries and plantation management, as well as indirectly in service companies,phytosanitary products, oil mills, packaging companies, those in charge of materials for the implementation... This job creation will be very important in particular for those companies that have had to close or that are at minimum levels of work.
- The revitalization of social motivation, since olive growing in Puglia is a way oflife that had been lost in recent years.
- Finally, the increase in tourism caused by the improvement of the landscape image perceived by visitors to the area. Those generated indirectly by tourism.

In the economic aspect, the commercialization of these new varieties of olive trees could generate -being conservative- a sales volume of 88.5 million euros, introducing them in three different markets: in the Apulia area, areas with the potential to be infected by the bacterium and in the world olive market. However, the economic impact would be greater, since the significant increase in jobs in the olive sector would imply, in turn, a greater spending capacity of the citizens of the area.

In addition, the benefit would be extended to the industry as a whole, thanks to the increase in sales of final products (such as olives or olive oil) or the increase in the purchase and sale of articles related to the cultivation of this species. . In the long run, not only the interest groups will benefit, but also all the inhabitants of the currently devastated area and, if applicable, of those with the potential to be devastated.

In short, as has been shown, there are multiple and varied reasons for developing and marketing new varieties resistant to the *Xylella fastidiosa* bacterium.

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