

Economic feasibility study

LIFE16-ENV-IT-000566



Life GREEN GRAPES

New approaches for protection in a modern,
sustainable viticulture: from nursery to harvesting

PROJECT LIFE16-ENV-IT-000566



Index

| | |
|---|----|
| LifeGREENGRAPES..... | 1 |
| 1. LIFE Green Grapes Project | 3 |
| 2. Results achieved | 5 |
| 3. LIFE Green Grapes Economic feasibility study | 6 |
| 4. LIFE Green Grapes protocols: validity of the solutions proposed. | 7 |
| 6. Strengths and opportunities of the solution proposed | 13 |
| 6.1 LIFE Green Grapes strengths | 13 |
| 6.2 LIFE Green Grapes Opportunities: legislative alignment of the solution proposed | 14 |
| 6.3 LIFE Green Grapes Opportunities: environmental impacts on table grape case study | 20 |
| 7. Weaknesses and Threats of the solution proposed | 25 |
| 8. Activities that will be carried out to support further project exploitation..... | 26 |

1. LIFE Green Grapes Project

The LIFE Green Grapes Project (2017-2021) was a demonstration project aimed at improving the plant protection response of grapevine and increasing the vineyard biodiversity, with the use of bio stimulant and/or resistance induction products.

The activities performed within the project were planned to evaluate and prove the effectiveness of application protocols integrated with defense forecasting models/decision support systems (DSS) and with agronomic management techniques, throughout the whole wine production chain: from nursery to wine and table grape vineyard, in Italy and Cyprus.

LIFE Green Grapes aimed to develop, test and validate protocols based on technical practices for a more sustainable vineyard and nursery management, using plant bio stimulants and biocontrol agents in order to:

- **reduce chemical inputs**, through the rationalization of the use of synthetic fungicides both in nursery propagation and in vineyard management for wine and table grape production;
- **increase soil biodiversity and preservation** thanks to a better use of agronomic management techniques in combination with a reduced use of chemicals;
- **improve the final product quality**, thanks to an optimization of timing and quantity of treatments in proximity to harvesting and, consequently, close to the use or distribution of products for consumption.

LIFE Green Grapes vineyard management system in the pilot plots has shown that **a 50% reduction in the use of pesticides along the entire production chain - from vine nurseries to vineyards - is possible, sustainable and capable to provide equal or equivalent qualitative and quantitative results in the final production in comparison with the farm IPM or organic management.**

The proposed solutions prove to have a positive impact on other relevant environmental aspects, such as increasing biodiversity, reducing water consumption, reducing greenhouse gas (GHG) emissions. The reduced quantities of residues analyzed in the final production of table and wine grapes, as well as the lower exposure to pesticides of workers throughout the whole production chain, allow to reduce the impact of wine production and table grape production on human health.

The “Green Grapes” management strategies of the vineyard have made it possible to maintain high quality levels of final productions, without modifying their commercial value. Indeed, with regard to all the parameters analysed (plant productivity, organoleptic characteristics, product commercial features and grape shelf life), there were no substantial differences between the productions obtained with the procedure followed by the company and those achieved with the “Green Grapes” procedures.

The approach proposed in this project also sought to recover and preserve the lost of microbial biodiversity at ground level but it was meant to go further. In fact, one aspect, still little explored, concerns the biodiversity of microbial communities living within plants, the so-called "endophytes". These organisms live in a more or less stable way within plant tissue and can affect directly or indirectly the physiological response of the plant to biotic and a-biotic stresses. Therefore, this project aimed to monitor the dynamics of the biodiversity of these microbial communities following the application of the proposed protocols of treatments.

The project has demonstrated the effectiveness and the environmental benefits of the proposed solutions:

- in relation and comparison with other types of products and intervention protocols;
- in relation and comparison to both the conventional production and the strictly organic one;
- in diversified geographical areas.

Demonstrative fields have been made available in the partners’ companies, such as: vineyards for wine growing in Tuscany (IT), vineyards for table grapes production in Puglia (IT), vineyards for organic table grapes production in Cyprus and vine nurseries in Tuscany (IT) both organic and conventional. These areas have been used for the implementation of project activities, for monitoring and analysis of their results and impacts.

The comparison in the same environmental conditions, as well as between different geographical areas (Italy, Cyprus), of the proposed protection protocols against the practices generally used in the companies’ conventional vine management, has resulted the optimal approach to the demonstration of the effectiveness of the proposed solutions.

2. Results achieved

LIFE Green Grapes management in the pilot vineyards has shown that **a 50% reduction in the use of pesticides** along the entire production chain - from nurseries to vineyards - **it is possible, sustainable and able to provide qualitative and quantitative results equal or equivalent in the final productions, compared to the integrated or organic management with which the new protocols have been compared.**

The proposed solutions, in particular the thesis of reducing pesticides by 50% with the use of resistance inducers, have been shown to have a positive impact on the aspects characterizing the wine production and on other relevant environmental aspects such as:

| IMPACTS OF TRIALS AT 50% reduction | Variation |
|---|----------------------------|
| Increased biodiversity | + 10% |
| Reduction of water consumption, | -15% |
| Reduction of greenhouse gas (GHG) emissions | -7.73% |
| Reduction of residues on final productions | between 27% and 71% |

Furthermore, the reduced quantities of residues analyzed in the final production of table and wine grapes, as well as the lower exposure to pesticides of workers throughout the supply chain, allow to reduce the impact of wine production on human health.

The management strategies of the "Green Grapes" vineyard have made it possible to maintain the qualitative levels of the productions high, without modifying their commercial value.

In fact, with regard to **all the parameters analyzed (productivity of the plants, organoleptic / product characteristics and shelf life of the grapes)**, there were **no substantial differences between the productions obtained with the integrated company method and those obtained with the "Green Grapes" methods.**

3. LIFE Green Grapes Economic feasibility study

The aim of this document is to analyse and highlight the economic feasibility of the Green Grapes strategies in order to support the exploitation of project results by other end users (vineyard managers, vine nurserymen, farm manager, wine growers and table grape producers) and/or stakeholders such as local/regional authorities, governmental institutions, association of entrepreneurs in the viticultural sector, research centres, active in the agricultural and viticultural sector in Italy and Cyprus, the countries involved in the Project, as well as in other regions in Europe where viticulture plays an important role.

The goal of this economic feasibility study is **to multiply the impact of the Project results reached during its implementation and to provide information about the feasibility of the strategies proposed in order to support potential new end-users to replicate and transfer the Green Grapes protection strategies after its end, and to reach a wider audience and implement its results in further sites and regions, other than the Project demo sites.**

As foreseen by the project proposal, part of the data collected and processed for the development of the socio-economic impact assessment are here used for the realization of this study.

Specifically, the study will provide details on:

- application of the protocols tested in the partner companies, with the details of further developments reached both in terms of new plants built during the project with pre-treated cuttings, as well as further extension of the project in other productive vineyards.
- Ensure medium and long-term monitoring of the impacts of the protocols on the specific supply chain (and in all the different sub-areas: vine nursery, table grape, organic table grape, wine grape and organic wine grape cultivations)
- the strategies for transferring the results of the project into a wider technical-scientific and academic context, also at the European level, also benefiting from previous national, European and international cooperation (for example, in the

context of previous and related LIFE projects and/or national/regional project; or research projects).

- the strategies to use the partners networks to promote the use of the Green Grapes application protocols in other vineyard farms in the specific production chains, if not to stimulate organic or IPM approaches in companies connected to the different networks (nurseries through MIVA, wine producers through FIVI, O.P. AGORA-Producers' Organizations).
- the monitoring of regional, national and European calls within which it is possible to develop, in various directions, further thematic, technical-scientific, academic or training initiatives, deriving from the results of this project.

4. LIFE Green Grapes protocols: validity of the solutions proposed

The viticulture world is undergoing through years of very important changes, full of technical and cultural challenges that affect both the production and marketing sectors. One of the most sensitive aspects is related to **the quantity of chemical products distributed with treatments for the pests and plant diseases control in crop protection and their eco-toxicological impact.**

The increased demand for “healthy” products by consumers pushes the large-scale retail trade to set increasingly restrictive limits, often lower than those imposed by European legislation, in relation to the chemical residues persisting on final production. Given the strength of their interlocutors on which their income depends, as well as a conscious attention to the environment in which they operate, the winegrowers are themselves forced in a position to rethinking their production choices, looking for answers in areas where product and process innovation is more advanced. The introduction of new technical means and production strategies can help winegrowers to meet the double sided demand for preservation of rural environment and of farmers' income.

Starting from this context, the LIFE Green Grapes Project was conceived and planned:

- the first project challenge was related to the development of plant protection approaches which must take into account new regulations that are limiting or completely revoking the use of many active ingredients. In Italy from 2000 to 2020 the number of synthetic active substances available for plant protection shifted from 441 to 212 (reduction of 52%). The active fungicides shifted from 107 to 72 (one third less in 20 years).
- the second challenge is related to the integration of vineyard protection with adequate agronomic practices, also based on the enhancement of soil biological activity and of the rhizosphere in particular, without which a good sustainable protection cannot be realized.

THE GREEN GRAPES MODEL



Innovation

LIFE Green Grapes has evaluated the use, for the first time "combined", of techniques and products to offer alternative solutions and support vine growers and nurserymen in the implementation of strategies to reduce chemical inputs and achieve environmental benefits

Whole production chain approach



The potential for technical application have been supported by several information actions delivered under action D2 with the participations to events and fairs/exhibitions of the sectors involved (vineyards for wine and table grapes, vine

nurseries) which allowed to reach and create awareness in a consistent number (1.318) of specific target group of end-users and stakeholders with potentially high project visibility either at local (Tuscany) and national (Italy and Cyprus) levels.

At EU level the actions carried out were mostly focused on the scientific and technical aspects of the project, thanks to participation with scientific poster and presentation in international conferences and symposia on the aspects of plant protection and biodiversity impact of the project.

During the project implementation, thanks to dissemination and training activities and events targeted either to potential beneficiaries (farmers, vine-growers and vine nurserymen) as well as to key actors for potential future implementation of the strategies and techniques proposed - such as agricultural operators/consultants/agronomists enrolled in the national professional board of Agronomists -, it was possible to implement and widen the use alternative treatments in vineyards and vine nurseries to these extents:

- **in vine nursery sector:** about 2.3 million plants treated with the proposed protocols were obtained from the nurseries participating in the project (equal to 650 ha/year of new vineyards),
- **in wine and table grape sector:** within the project areas the application of protocols have been executed on 5,36 ha + 1,6 ha (specific new vineyard in Gabbiano realized with the foreseen 10.000 plants treated in action B1, out of a total 7,5 new vineyard implemented), for a total of 6.96 ha on the whole. Moreover in the vegetative year 2020-2021 CREA has widened the use of protocols in Ente Terre Toscane Demo Farms for a total of 1,2 Ha (IPM GG = experimental field 0,2 Ha + ORG= experimental field 1 Ha) and within CREA Demo Farm for a 0,2 Ha surface. Further vineyards where the Green Grapes approaches were detected through the work of the project partners technical teams accounted for a total surface 214 Ha of private vineyard farms in Tuscany Region;
- as far as concerns the **conversion of farms to organic methods**, one of the expected results increase of farms that will implement protocols and/or undertake conversion to organic viticulture the protocols proposed by the

Green Grapes project, proved to be a valid support to more sustainable vineyard management, in line with what has been registered at national level in Organic Agriculture in general and viticulture in particular. The data processed by the SINAB (National Information System on Organic Agriculture) for Mipaaf for the year 2019 demonstrate the health of the Organic Agriculture sector: since 2010 the number of operators has grown by 69%, while the hectares of cultivated organic surface have increased 79%. According to the analyzes, in fact, in 2019 in Italy we reached almost 2 million hectares of biological surfaces, with an increase of almost 2% of UAA (Agricultural Units) compared to 2018. This translated into 35,000 hectares more in just 12 months: As for Italian agriculture, the compositional level of the surfaces remains stable and defined by the 3 production orientations which account for over 60% of the total: Pasture meadows (551,074 ha), Forage crops (396,748 ha) and Cereals (330,284 ha). These categories are followed, by extension, by the biological surfaces invested in Olive (242.708 ha) and **Vine (109.423 ha)**. From the comparison with 2018, the surface variation of the production orientations considered for vines registered a growth by 3%

- An important indirect action of **training for professional operators** aimed at the introduction of protection treatments alternative to chemical products and at the illustration of innovative recommended protocols, was performed as potential vehicle to further dissemination and to widespread the use of Green Grapes protocols in viticulture. Although it is not possible to directly connect to this training activities the results reported in terms of further application in new vineyards of the Green Grapes protocols it is important to highlight the number of professional operators reached. Only considering the events which were recognized by the National/Regional/Local Board of Agronomists (ODAF) and allowed to agronomists accredited to the professional board to have their participation recognized as training credits, we have reached:
 - 106 Agronomists during the 4 webinars realized in 2020;
 - 129 Agronomists during the 4 webinars realized in 2021;
 - 88 Agronomists during the Final Conference (72 participating on line and

16 on site)

for a total of 323 Agronomists/professional operators trained.

The project's likelihood of replication can be considered in the light of the new companies that are introducing the Green Grapes Protocols reported in Table “Companies applying the techniques developed in the Life Green Grapes Project” below

Companies applying the techniques developed in the Life Green Grapes Project

| Company's name | Province | Hectars |
|----------------------------|-----------------|----------------|
| MARYAMADO | FIRENZE | 30 |
| CARUS VINI | FIRENZE | 12 |
| TENUTA MORAIA | AREZZO | 10 |
| LECCI E BROCCHI | SIENA | 4 |
| CASCINE VALPANE | ALESSANDRIA | 5 |
| TRINGALI CASANUOVA | LIVORNO | 5 |
| SAN JACOPO | AREZZO | 20 |
| MONA VERDE | PISTOIA | 3 |
| LE THADEE | PERUGIA | 5 |
| ABBADIA ARDENGA | SIENA | 12 |
| CAMPO DEL MONTE | AREZZO | 8 |
| GAGLIOLE | SIENA | 10 |
| LA VALLETTA | FIRENZE | 10 |
| TUA RITA | LIVORNO | 20 |
| LANCIOLA E LE MASSE | FIRENZE | 30 |
| MONTECALVI | FIRENZE | 30 |
| TOTAL HA in Tuscany | | 214 |

Specific monitoring actions to quantify the project diffusion and use as crop protection practice in viticulture beyond the project end will be carried out and a database of vineyard farms and vine nurseries that have implemented the project protocols, or continuing to implement the protocols after the end of the project will be yearly kept updated.

Other important tools for further implementation and use of the Green Grapes protocols are represented by the different deliverables produced during the project

implementation, represented by:

- a. the final Operational Handbook. “**LIFE GREEN GRAPES - Operational handbook for vine nurserymen and winegrowers**” has been printed and distributed in 4.000 hard paper copies + distributed on 300 USB and on the Project website, representing, together with dissemination and training activities, another important tool for further implementation and use of the Green Grapes protocols since it can support not only professional operators/agronomists, but also vineyard managers and vine nurserymen to almost autonomously implement the protocols in their private farms.
- b. the final Guidelines related to the use of resistance inducers in vineyard protection strategies. “**LIFE Green Grapes - Guidelines for experimental protocols based on the combined use of resistance inducers**” has been distributed on 300 USB and on the Project website, representing, together with the Handbook, another important tool for further implementation and use of alternative products in crop protection strategies in viticulture, containing an analysis of products used (natural substances, resistance inducers and biostimulants), best timing for their use and effects, in order to support not only professional operators/agronomists and end-users, but also stakeholders and policy makers to support the implementation of the Green Grapes protocols in a wider context.
- c. **LIFE Green Grapes Layman’s Report**: available in Italian and English version will be used together with the project brochures for dissemination to wider general public.

6. Strengths and opportunities of the solution proposed

6.1 LIFE Green Grapes strengths

LIFE Green Grapes vineyard management system in the pilot plots has shown that a 50% reduction in the use of pesticides along the entire production chain - from vine nurseries to vineyards – is possible, sustainable and capable to provide equal or equivalent qualitative and quantitative results in the final production in comparison with the farm IPM or organic management.

The proposed solutions prove to have a positive impact on other relevant environmental aspects, such as increasing biodiversity, reducing water consumption, reducing greenhouse gas (GHG) emissions.

BENEFITS OF THE GREEN GRAPES MODEL



Benefits for final productions

Equal or equivalent qualitative results in final productions with a 50% reduction in the use of pesticides / fungicides.



Benefits for human health

Reduced exposure to toxic products for workers in the vine sector.
Reduced exposure to chemical residues for final consumers.



Benefits for the Environment

Reduced consumption of
H₂O
Reduced emissions of
CO₂

The reduced quantities of residues analyzed in the final production of table and wine grapes, as well as the lower exposure to pesticides of workers throughout the whole production chain, allow to reduce the impact of wine production and table grape production on human health. The “Green Grapes” management strategies of the vineyard have made it possible to maintain high quality levels of final productions, without modifying their commercial value. Indeed, with regard to all the parameters analyzed (plant productivity, organoleptic characteristics, product commercial features and grape shelf life), there were no substantial differences between the productions obtained with the procedure followed by the company and those achieved with the “Green Grapes” procedures.

6.2 LIFE Green Grapes Opportunities: legislative alignment of the solution proposed

The project evaluated the effectiveness and applicability of new protocols for plant protection against the main grapevine diseases, suitable for:

- proposing the combined and rational use of agronomic techniques and products to reduce chemical inputs;
- working in parallel, with the same principles, on the whole vinegrowing productive chain, from vine nursery to production of wine and table grapes, both in integrated and organic production in environments that are, in some cases, very different.

LIFE Green Grapes has proved to be a **forward- looking project proposal in terms of adaptation to the specific vine sector and the general environmental policies and regulations**, showing that it can effectively offer solutions in line with them.

- **Directive 2009/128/CE (as implemented in Italy and Cyprus)** establishing a framework for the European action for the sustainable use of pesticides. The results of the project are consistent with Article 12 (Reduction of the use or risks of

pesticides in specific areas) letter c), Article 14 (Integrated Protection) paragraphs 1 and 2 and Article 11 (Specific measures for the protection of the aquatic environment and non- drinking water) letter a).

- **EU Strategy for organic farming.** Project results are consistent with the EU strategy on the use and reduction of copper, with a view to providing a practical tool that supports Organic farmers in implementing strategies that favour the use of eco-sustainable techniques for the management of crops.
- **EU 2020 Strategy for Biodiversity.** The project implemented a strategy for the management of vineyards and vine nurseries with positive effects on biodiversity and positive results deriving from the development of sustainable protocols aimed at reducing the use of hazardous substances, for agricultural operators and the environment. Soil biodiversity is promoted in the nursery and in the vineyard, with the use of mycorrhizae to fortify the plants in the first, and green manure and cover crop in the second, where the plant protection management has also been enhanced with a reduced use of copper during plant protection treatments.
- **Regional Rural Development Programme** within which it will be possible, with the application of protocols developed by the LIFE Green Grapes PROJECT, to enhance the sustainable management of resources with more sustainable practices for the cultivated areas.
- **Regulation (EU) No 528/2012 of 22/05/ 2012 concerning the use of biocidal products and their market availability.** The aim of the project is in fact the reduction of the amount of fungicides in the protection strategies of the vineyard in a context of sustainable agriculture and therefore respectful of the environment and human health; consistently with point 3 of this regulation: “This regulation aims to improve the free circulation of biocidal products within the Union, while ensuring a high level of protection of both human and animal health and the environment”, the project has shown that it can achieve results that are perfectly in line with it.
- **Regulation (EU) No 2019/1009 of 05/06/ 2019 on fertilizers including biostimulants.** The results of the project can help to implement Reg. 2019/1009 as regard to product-specific labelling requirements (ANNEX III – Part II) where it is required to indicate for Plant Biostimulants (PFC 6) “any relevant instruction

concerning the efficacy of the product, including the soil management practices, chemical fertilization, incompatibility with plant protection products, the recommended size of spray nozzles, sprayer pressure and other anti-drift measures”.

- **Regulation (EU) No 1981/2018 which renews the approval of copper compounds active substances as candidates for substitution and which modifies the quantities of use allowed in agriculture.** When the proposal of the LIFE Green Grapes Project was presented, the use of copper was allowed up to 6 kg/ha/year (Reg. 473/2002), which then passed to 28 kg/ha of copper over seven years (i.e., on average, 4 kg/ha/ year) from 2019 (EC Reg. 1981/2018). In the implementation phase of the project, the goal remained the initial one of halving the quantities used (therefore on average, 3 kg/ha/year) compared to current legislation.
- **Directive EU 2031/2017:** in Italy, the new legislation on the organization and role of European phytosanitary services came into force in mid-December 2019, also containing the new control methods on the vine nursery sector. The directive is based on the concept of producer responsibility, aware and responsible for its role at the basis of the economic performance of the various production chains. One of the most important aspects is the training of personnel within the vine nursery companies who must be ready to identify any new alien species (harmful insect or pathogenic microorganism) or quarantine species. The controls of the phytosanitary services are divided into mandatory or precautionary ones according to the phytosanitary risk of the different vine nursery structures. This risk can be mitigated through the establishment in the company of a risk plan that analyzes the production phases and describes how the entrepreneur intervenes in them in managing the risk of infection. Our project analyzes the various production phases and inserts disinfectant or precautionary interventions in the most delicate ones in order to reduce risks as much as possible. We can, therefore, say that the project is capable of defining a roadmap that, in the wine, table grape and vine nursery sector, could be used as a backbone in the structuring of these plans, which will then be defined individually with the approval of the various Italian and European

phytosanitary services.

- **The package of recent European regulatory strategies and guidelines represented by the Green Deal, the “Farm to Fork” Strategy and the new post-2020 CAP** focuses on issues widely addressed by the project such as: environmental protection and biodiversity, human health protection and quality of food products, a 50% reduction in the use of chemical pesticides by 2030, the use of plant protection products on agricultural surfaces, plant protection with low input of products and/or integrated pest management and organic agriculture.

The Green Grapes management in the pilot vineyards has helped to demonstrate that the integration of both plant protection products with a favorable eco-toxicological profile, and products which, although not having a direct effect against pathogens, induce conditions in the plant such as to reduce damage and preserving production, can represent a valid solution for a more eco-sustainable management of the vineyard, and helps to support the spread of the use of bio-stimulating and resistance inducing products in viticulture, remaining in line with national and European guidelines that , over time have contributed to confirming the farsightedness of the project in terms of adherence to policies and regulations - general and sectoral environmental - which between 2017 (project start-up year) and 2021 confirmed the validity of the design theses.

The project has helped to demonstrate that, regardless of classification and nomenclature issues, biostimulants and resistance inducers can be used depending on what they are able to bring to the vineyard.

This was particularly relevant in conjunction with the enactment of the new European regulation on fertilising products.

The plant biostimulants and resistance inducers used in the project contain substances and / or microorganisms whose function, when applied to plants or soil, is able to stimulate natural processes to improve or promote the absorption of nutrients, the efficiency of nutrients, tolerance to abiotic stress and the quality of crops, but above all, in the case of the Green Grapes project , defense in the vineyard. This result is in line with the definition provided by the EBIC - European Council of the Biostimulants

Industry - particularly significant as it offers an official consensus definition of what a biostimulant product is and how it can contribute to crop production.

This is one of the innovations also contained in the new regulation on fertilizers (Regulation on fertilizers (EC) No 2019/1009, 05/06/2019).

The importance of this regulation is linked to the changes that the new regulatory framework will bring to the agricultural sector in general.

First of all, the regulation highlights the perceived need at European level to regulate the biostimulants market, and to decree the official inclusion of biostimulants in the regulatory framework on fertilising products in consideration of the similarity between these two products compared to other products for agricultural use, such as for example plant protection products. The inclusion of biostimulants in the new law was agreed to harmonize an excessively broad and widespread regulatory framework that has characterized the agricultural product market in recent years.

It is important to remember that up to this new legislation, the 2003/2003 regulation had to coexist with the national laws of each Member State, implying 28 different scenarios in which the definition of biostimulant functions varies from one country to another.

The diversity of existing national laws until the new regulation created uncertainty:

- both among producers, who had to position biostimulants on the markets according to their functions since these were not clearly defined within any of the existing legal frameworks.
- and among farmers, unsure which products were best suited to their needs.

The entry into force of the new European regulation on fertilising products allows all fertilizers available on the market to fall within the scope of these new rules with a single authorization valid for all European Union countries, removing the barriers created by diversity of national regulations.

The new European regulation on fertilising products establishes a new procedure for the authorization of biostimulants in agriculture, which now have to undergo a conformity assessment process by accredited bodies in each member state. This conformity assessment will ensure that the biostimulants marked with the CE marking

that are placed on the market do so in full compliance with all legal requirements, thus offering farmers greater safety and peace of mind in effective use in the field.

The regulation also provides for stricter rules regarding the labeling of biostimulant products. Manufacturers can only claim those benefits derived from their products that have been scientifically proven; that is to say, the labels will only mention the advantages related to better efficiency in the use of nutrients, greater tolerance to abiotic stress, better crop quality characteristics or better availability of nutrients confined in the soil and rhizosphere giving greater transparency and confidence in defining the limits of the efficacy of biostimulants.

Although the innovation that the new European regulation brings to the sector is undoubted, there are also some limitations in the approved text. The most important of these refers to the so-called positive lists of permitted materials which limits the choice of operating exclusively to those. If on the one hand it is particularly in line with the protocols applied by the project, the inclusion in the list of the CM2 category, referred to below.

CMC 2: PLANTS, PLANT PARTS OR PLANT EXTRACTS

An EU fertilising product may contain plants, parts of plants or plant extracts that have not undergone processing processes other than cutting, grinding, milling, sieving, sieving, centrifuging, pressing, drying, by freezing treatment, freeze drying or water extraction or extraction of Supercritical CO₂.

For the purposes of this point, plants include fungi and algae, but exclude blue algae (cyanobacteria).

On the other hand, for example, under the heading “plant biostimulants” the regulation contemplates a list of only 4 microorganisms allowed. This means that only 4 types of microorganisms (those with a widespread historical use) will actually be regulated, while the most innovative products will be omitted and manufacturers will not be able to market them.

The closure of the lists in the medium and long term could limit the innovation capacities of companies and not be in line with the research sector which is moving at a much faster pace than the legislation.

This mismatch between legislation and research and development may generate new

problems in the future, particularly in the case of biostimulants developed by microorganisms, as development and innovation in biotechnology is growing at a very significant pace.

From the date of publication of the new regulation, another three years will be necessary for its entry into force, further prolonging the aforementioned climate of uncertainty for producers and farmers in terms of actions to be taken or resources necessary to adapt to this new scenario.

The Project has helped to give further evidence on the potential of biostimulants and resistance inducers in the wine sector in particular, helping to provide evidence and data to support the choices of the winemaker.

6.3 LIFE Green Grapes Opportunities: environmental impacts on table grape case study

Three disease control strategies (farm-run, 50% inducers, and 100% inducers) were compared at the company F.lli Tagliente, on two different varieties (Crimson seedless and Thompson seedless). The Green Grapes protocol referred to an integrated pest management with reduction (or strong reduction) of PPP treatments replaced by substances with resistance inducing mechanism. The table below summarises the total production recorded during the three years of the duration of the project and the sustainability scores obtained by each Crop Unit per year.

Table: Total production recorded during the three years of the duration of the project and the sustainability scores obtained by each Crop Unit per year.

| FT1 - CS | 2018 | 2019 | 2020 |
|--------------------------|----------------|----------------|----------------|
| Total production/Surface | 5.2 t / 0.2 ha | 4.3 t / 0.2 ha | 4 t / 0.2 ha |
| Sustainability Score | 2.1, Good | 1.7, Good | 2, Good |
| FT2 - CS | 2018 | 2019 | 2020 |
| Total production/Surface | 5 t / 0.2 ha | 4.5 t / 0.2 ha | 5.4 t / 0.2 ha |
| Sustainability Score | 1.9, Good | 1.4, Excellent | 1.6, Good |
| FT3 - CS | 2018 | 2019 | 2020 |

| | | | |
|--------------------------|----------------|----------------|----------------|
| Total production/Surface | 4.6 t / 0.2 ha | 4 t / 0.2 ha | 3 t / 0.2 ha |
| Sustainability Score | 1.7, Good | 1.2, Excellent | 1.5, Excellent |
| FT1 - TS | 2018 | 2019 | 2020 |
| Total production/Surface | 7 t / 0.2 ha | 3.4 t / 0.2 ha | 8 t / 0.2 ha |
| Sustainability Score | 1.9, Good | 1.7, Good | 1.9, Good |
| FT2 - TS | 2018 | 2019 | 2020 |
| Total production/Surface | 5.8 t / 0.2 ha | 3.3 t / 0.2 ha | 8 t / 0.2 ha |
| Sustainability Score | 1.8, Good | 1.4, Excellent | 1.4, Excellent |
| FT3 - TS | 2018 | 2019 | 2020 |
| Total production/Surface | 5.2 t / 0.2 ha | 3.3 t / 0.2 ha | 8 t / 0.2 ha |
| Sustainability Score | 1.6, Good | 1.3, Excellent | 1.1, Excellent |

The radar chart in Figure 11 shows the average scores over the three years obtained for the Health, Air, Water, Soil, Biodiversity and Energy compartments. While no major differences were observed in the Air, Water, Energy and Soil compartments, during the three-years project impacts on the Biodiversity and Health compartments were on average reduced with the FT2 and FT3 management strategies

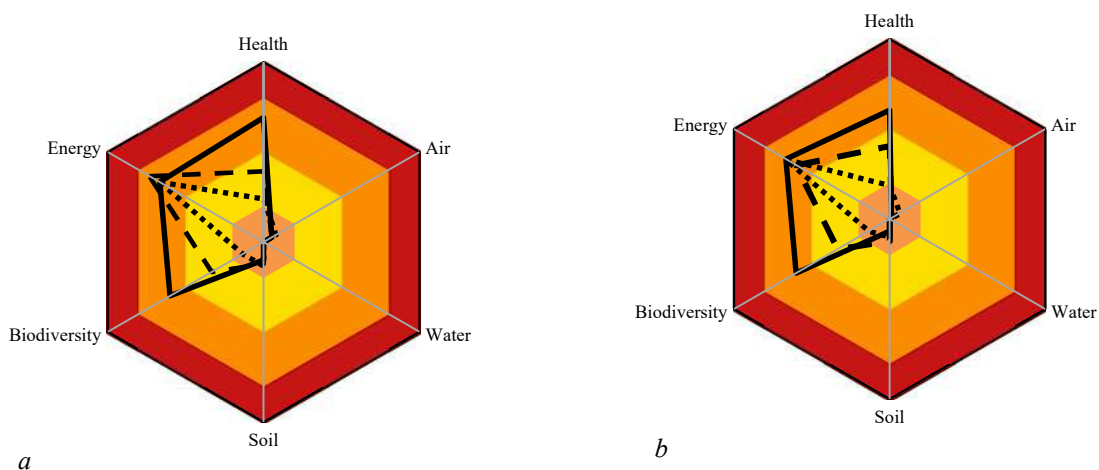
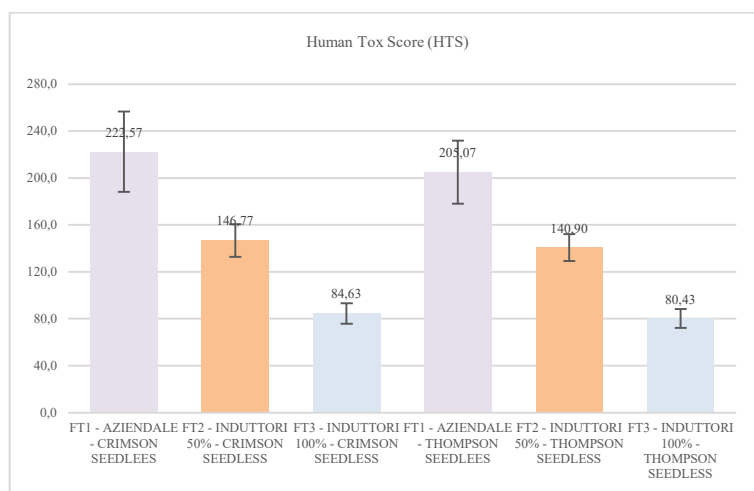
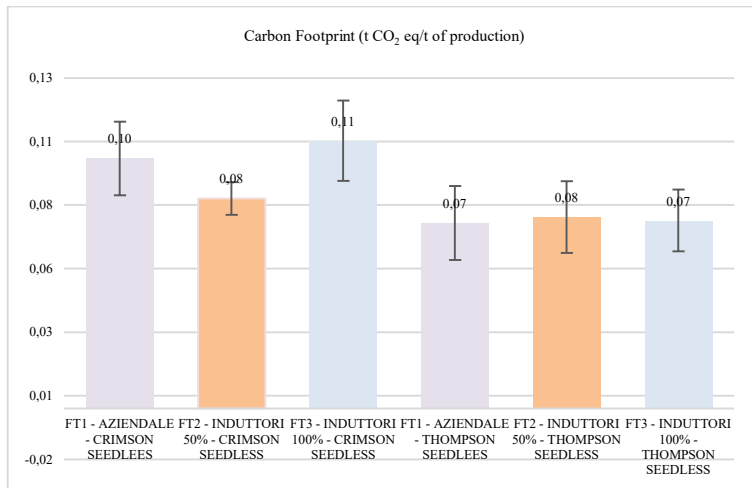
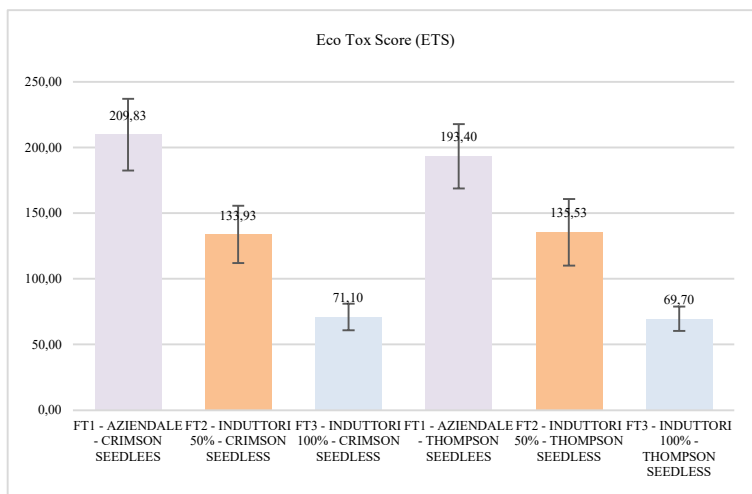
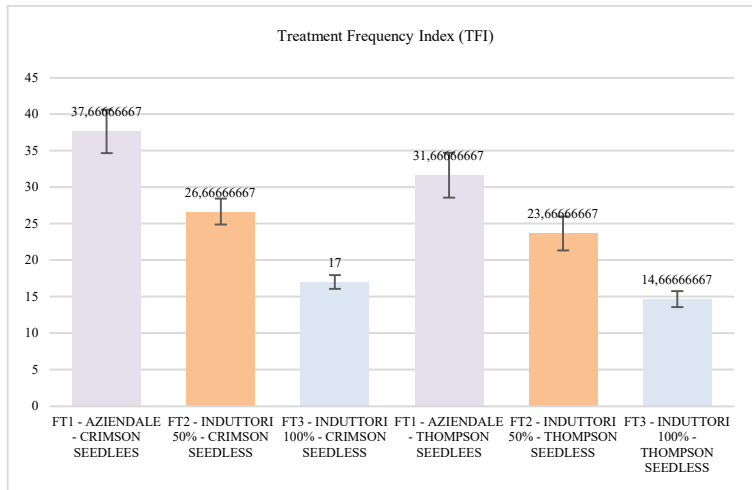


Figure 1: The radar chart shows the compartments Human Health, Air, Water, Soil, Biodiversity and Energy. *11a* shows results for Crimson Seedless. *11b* shows results for Thomson Seedless. The solid line shows the average results of the three-year project for the Crop Units FT1. The dashed line shows the average results of the three-years project for the CUs FT2. The dotted line shows the average results of the three-year project for the CUs FT3. The scores were calculated considering only those indicators that are impacted by the strategies in place.

Figure 12 shows histograms reporting the average values over the three-years of some specifically selected indicators. Human Tox Score and Eco Tox Score were proportionally reduced, starting with the farm-run strategy, and then moving to the 50% and finally to the 100% inducer strategy, for both varieties. Plant protection treatments have been replaced with substances with resistance inducing mechanisms, thus reducing impacts on the Health and Biodiversity compartments. Accordingly, also the TFI decreased. The Carbon Footprint is overall very low in all the CUs, with values between 0.07 and 0.11 t CO₂ eq/t of production. When higher values are reported for the Green Grapes strategies CUs (such as in the case of FT3-Crimson Seedless), it depends on the lower yields recorded in these CUs compared to the farm-run strategy. The CF per hectare is actually reduced. The same reasoning applies to the Ecological Footprint results, which are actually lower, per hectare, in the Green Grapes CUs. Carbon Sequestration was higher for the Thompson Seedless cultivar compared to Crimson Seedless. The quantification of carbon sequestration of a growing crop takes into account the total yield, relationship between plant biomass above the soil derived from stems, branches, leaves and harvested biomass, percentage of root biomass in relation to the whole plant biomass above the soil and percentage of carbon content into plant biomass. The lower yield recorded for Crimson Seedless both in 2018 and 2020 might explain the differences in the Carbon Sequestration results. No major differences can be observed for the Water Footprint, with slightly higher values recorded for the Crimson Seedless variety, which might be again the results of the lower yield recorded in some CUs, particularly in 2020.





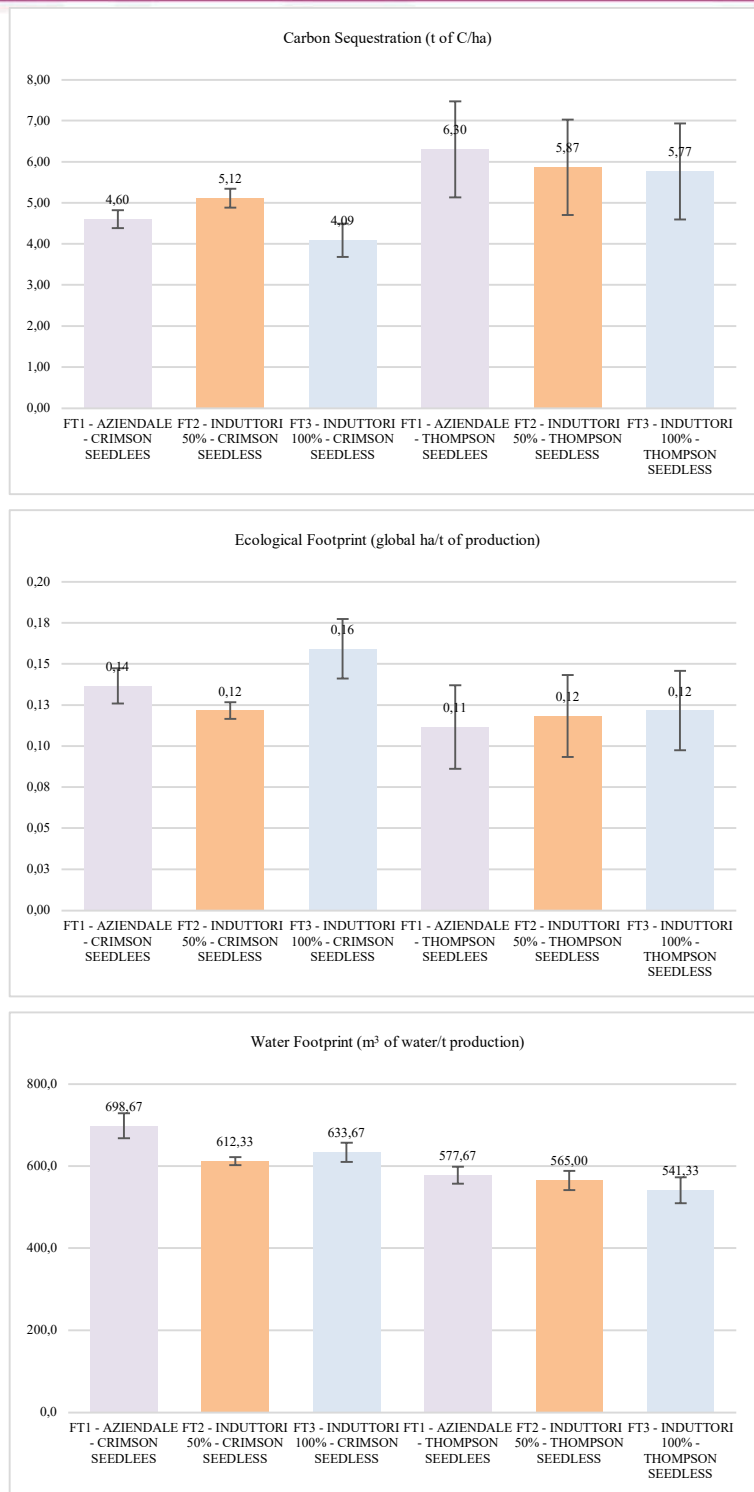


Figure 2: histograms reporting the average values over the three-years of some specifically selected indicators. Bars show standard error. Please, note the different indicators report different units on the y-axis

7. Weaknesses and Threats of the solution proposed

During project implementation a survey on the development of costs to evaluate the economic sustainability of the Green Grapes protocols has been carried out with specific focus on the table grape productive chain, for which it was also possible to compare the costs incurred for the application of alternative products in comparison with the qualitative results in terms of strong reduction of residues in final production.

Three disease control strategies (farm-run, 50% inducers, and 100% inducers) were compared at the company F.lli Tagliente, on two different varieties (Crimson seedless and Thompson seedless). The Green Grapes protocol referred to an integrated pest management with reduction (or strong reduction) of PPP treatments replaced by substances with resistance inducing mechanism.

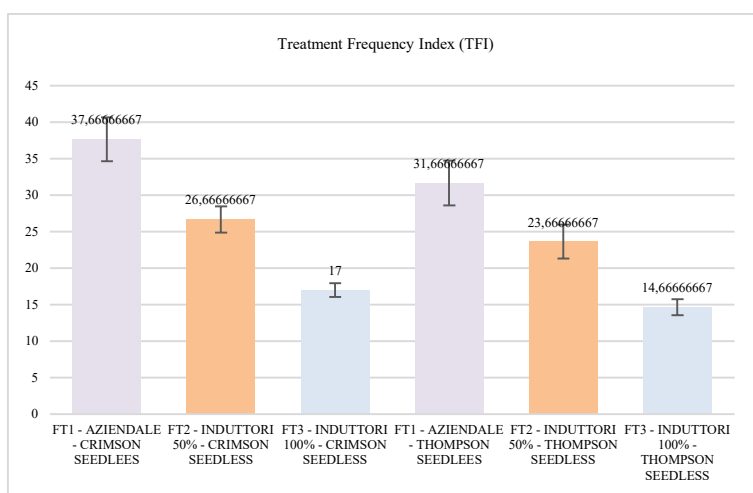
The economic analysis carried out for the 3 years of application (2018-2019-2020) have highlighted the higher costs that the viticultural operator have to bear for the application of the protocols, which is assessed for the 50% reduction solution between the 16 and 26 %of higher costs compared to IPM Company management. The table below summarize the average results for each treatment and cultivar considered in the trials on a yearly base.

Table: Average results for each treatment and cultivar considered in the trials on a yearly base.

| TREATMENT | CULTIVAR | COSTS/ha (€) | YIELD (t/ha) | N. of PLANTS/ha | PRODUCTION per PLANT | YIELD (t/ha) | Differences with Company IPM | Differences in % |
|----------------|----------|--------------|--------------|-----------------|----------------------|--------------|------------------------------|------------------|
| Company IPM | CRIMSON | 1562,4 | 26,0 | 1754,4 | 15,9 | 27,9 | | |
| 50% Reduction | CRIMSON | 1811,3 | 25,0 | 1754,4 | 11,0 | 19,4 | 248,9 | 15,93% |
| 100% Reduction | CRIMSON | 1719,7 | 23,0 | 1754,4 | 10,8 | 19,0 | 157,3 | 10,07% |
| Company IPM | THOMPSON | 1436,7 | 35,0 | 1754,4 | 17,0 | 29,9 | | |
| 50% Reduction | THOMPSON | 1819,6 | 29,0 | 1754,4 | 10,8 | 18,9 | 382,9 | 26,65% |
| 100% Reduction | THOMPSON | 1700,3 | 26,0 | 1754,4 | 11,4 | 20,0 | 263,6 | 18,35% |

The issue of higher costs, which is crucial for the vineyard management choices of the viticultural operator, should be also considered in the framework of the legislative orientation which, in the long term, will push the end-users to move towards more sustainable practices.

Moreover, the higher costs for the substitution of traditional products with bio-stimulants and resistance inducers should be also considered in the light of the reduce treatment frequency, which can have a significative impact on labour cost for field work.



8. Activities that will be carried out to support further project exploitation

Training, communication and dissemination activities demonstrated to have a transversal function and important role in enhancing the replicability and transferability strategy by enabling to reach a wider audience and by providing long-term dissemination and technical tools.

On the basis of the experience matured during the project, the activities identified by the partnership and that are intended to be carried out after the conclusion of

the project in order to support the project replicability are:

- a. **Participation in annual meetings** of the associations involved in the project as support partners and added during its implementation such as:
 - 1) MIVA Moltiplicatori Italiani Viticoli Associati in Italy
 - 2) IRV CIP Federal Institute and Research Center of Viticulture and Pomology at wider EU level accounting for 110 associated vine nurseries
 - 3) FIVI Federazione Italiana Vignaioli Indipendenti accounting for 800 wine growers
 - 4) OP Agora Organizzazione di Produttori Agricoli Basilicata, Puglia, Calabria including 50 farms of the fruit and vegetables farms in southern regions of Italy
 - 5) C.U.T. Commissione Uva da Tavola with 62 table grape farms throughout Italy members
 - 6) ODAF Ordine dei Dottori Agronomi e Dottori Forestali which is the National Board of Agronomists which have recognized accredited training to webinars and events organized by the partnership, and has renewed interest in being informed about project applications
 - 7) AIPP - Associazione Italiana Protezione delle Piante
 - 8) Tuscany Regional administration
 - 9) MITE – Ministry of Ecological Transition
 - 10) Mipaaf - Ministero delle politiche agricole alimentari e forestali and Ministry of Agriculture – Environment Department in Cyprus
- b. **Delivery of further training for professional operators and agronomists** thanks to the fruitful collaboration with ODAF Ordine dei Dottori Agronomi e Dottori Forestali, which has expressed its interest in continuing the promotion of accredited training for its associated members
- c. **Dissemination of project results to vineyard farms and vine nurseries**, thanks to the ordinary activities carried out by project staff of CREA, UNIFI, CUT, P.Ri.Ma. Forma, Vititalia with vineyard farms and vine nurseries that can be a powerful vehicle to continue the monitoring of extension of project

protocols to other areas

- d. **Participation in annual technical and sector related events**, such as Vinitaly, EXPO RIVE, MIVA National Congresses of vine nurseries; Nova Agricoltura in Vigneto; FIVI FAIR; FruitLogistica; etc... which have demonstrated to be relevant occasions to meet potential end users and furtherly disseminate the use of the project strategies
- e. **Participation in annual / periodical scientific events organized by academic/research institutions**, such as Italian Plant Pathology Society Annual Meeting; ISME - International Symposium on Microbial Ecology; European Society of Nematologist (ESN) Conference; EnoforumWeb Conference; International Organization for Biological and Integrated Control - IOBC Event; AIPP events, etc...which have demonstrated to be relevant occasions to meet the scientific community working on the same topics and sector and furtherly disseminate the use of the project strategies
- f. **Project presentation and insertion into thematic platforms, such as, for example, the “Piattaforma delle Conoscenze” managed by the Italian MITE – Ministry of Ecological Transition-**
<https://www.mite.gov.it/pagina/lqs-piattaforma-delle-conoscenze-capitalizzazione-delle-esperienze-e-disseminazione-dei>

The activities will be addressed to the following targets:

Potential end users: wine-growers, vineyard managers, vine nurserymen, table and wine grape farms managers

Professional operators: experts of the wine and vine nursery sector and agronomists

Scientific communities: researchers, students, scientific research groups and associations, academic institutions;

Technical communities: sector related technical groups and associations, environmental and agricultural associations, sector-related social parties such as associations of producers, trade unions, association representative of the

viticultural sector;

Stakeholders: policy makers, local and regional authorities, National authorities

in the

General Public

