



LIFE Project Number

LIFE13 ENV/HR/000580

FINAL Report

Covering the project activities from 16/06/2014 to 16/12/2017

Reporting Date

15/06/2018

LIFE+ PROJECT NAME or Acronym

Low pesticide IPM in sustainable and safe fruit production

Project Data

| | |
|---|-------------------|
| Project location | Croatia and Italy |
| Project start date: | 16/06/2014 |
| Project end date: | 16/12/2017 |
| Total Project duration (in months) | 42 months |
| Total budget | € 1,839,378 |
| Total eligible budget | € |
| EU contribution: | € 901,938 |
| (%) of total costs | 49.03 % |
| (%) of eligible costs | 50 % |

Beneficiary Data

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1. Executive Summary

The LIFE.SU.SA.FRUIT Three main innovative technologies have been tested and demonstrated: 1) photo- selective anti- insect nets; 2) Innovative control strategies against *Venturia inaequalis*; and 3) thermotherapy as method of control postharvest diseases and fruit quality maintenance.

The project showed that technology of photosensitive anti- insect was able to save € 535 per ha per year, with 20% increase of class in peaches and 19 % in apples. Additionally, increased added value (10 % for apples and 4-15 % for peaches) of produced fruits was achieved. At least 3 - 9 insecticide treatments were avoided by using photosensitive nets, meaning at least 70 % reduction of use of insecticides. Lower treatment costs (130-300 €/ha for peaches and 350-400 €/ha for apples) were achieved with the use of photo selective anti- insect nets. Due to the reduced use of pesticides, photosensitive anti- insect net technology significantly contributed to the maintenance of high biological diversity in orchards. Lower pesticide residues in fruits from orchards covered with nets was recorded with. Commercial yield of apple (share of first class fruits) is significantly increased under the red net than in control, as well significantly lower incidence of sunburn. Furthermore, fruit weight was increased in both apples and peaches. Better quality and lower pesticide residues enabled to create potentially higher demand from internal and external markets. Project results were actively disseminated through workshops, training activities, conferences, TV broadcasts and through project website to more than 500.000 people. Photosensitive nets tested within the project showed high potential for commercial application (10 ha of apples and peaches in Croatia will be covered with red net). This technology enables savings of production costs of € 500 annually through reduced number of sprays against insects together with preserved biodiversity, lower pesticides residues on the fruit and safer working environment for producers.

Thermotherapy showed significant potential for commercial use, especially in apple. There are two main benefits of prototype usage: 1) better fruit quality preservation and reduction of fungal spores on the fruit, and preventing fruit from decay, thus lowering postharvest loss (PHL); and 2) reduces residues of pesticides on the fruit, having benefit for human health.

This final report (FR) covers the project activities from June 16th, 2014 to December 16th, 2017. The most important tasks developed within each of the project actions are described. All related documentation related is included in Annexes.

2. Introduction

2.1. Background

Plant pests and diseases cause important yield and quality losses in fruit crops. Due to the hazardous effects of agrochemicals on both humans and the environment, there is a growing trend towards agro-ecosystems based on the management of ecological interactions and the use of integrated pest management (IPM).

An adequate and reliable food supply cannot be guaranteed without pest and disease control measures. Due to the hazardous effects of agrochemicals on both humans and environment, there is a growing trend towards agro-ecosystems based on the management of ecological interactions and the use of IPM. IPM has become an accepted model for plant protection in the EU to maintain food security while addressing environmental considerations.

The fruit sector is a key element in EU agriculture, weighting 6.8 % of EU agricultural output. In 2016, the total fruit production in the EU was 36.4 million tonnes. Spain (29.1 %), Italy (23.9 %) and Poland (12.2 %) were the most important producers. The most important fruits, in terms of the volume of harvested products, are apples (12.6 million tonnes), oranges (6.4 million tonnes) and peaches (2.7 million tonnes). (EUROSTAT, 2017).

According to the 2013 farm structure survey, 1.55 million holdings in Europe managed fruit orchards. This figure represents 14.6 % of all European farms with 'utilised agricultural area'. In 2015, orchards occupied a little more than 3.2 million hectares, 1.8 % of all utilised agricultural land in the EU. Nuts accounted for almost a third (30.6 %) of the fruit area, pome fruits (mainly apples and pears) came second (23.0 %), followed by stone fruits (peaches, nectarines, apricots, plums and cherries) (18.3 %), while citrus trees were cultivated on 16.5 % of the total area of fruits. Two thirds (66.6 %) of the area devoted to fruit was located in just three Member States. Spain (38.8 %) was first in the ranking, followed by Italy (17.3 %) and Poland (10.4 %). (EUROSTAT, 2016).

Fruit and vegetables (F&V) represent a key sector in the EU agriculture: in 2015 the value of its production was 64.6 billion euros, with a share of 15.8% of the value of total EU-28 agricultural production. Vegetables account for 10.7% (43.7 billion of euros) and fruit for the remaining 5.1% (20.9 billion of euros). The F&V production is highly geographically concentrated in the EU. The first five producing countries (Spain, Italy, Germany, France and Poland) account for about two thirds of the value of total EU-28 F&V production. For fruit, instead, Italy (16%) ranks first in pears, peaches, apricots and table grapes harvest. (EU Parliament, 2017).

Italy is the largest peach and nectarine producer in the EU and ranks 2nd in the world after China. Stone fruit production plays a key role in the agricultural sector of several Italian regions, both in the North (Emilia-Romagna and Piedmont) and in the South (Campania). Peach and nectarine orchards occupy about 90,000 ha.

Freshness and perishability of F&V produce, as well as the fairly wide variety of products offered by EU countries, make intra-EU trade a very significant share of the F&V total trade. In 2015 intra-EU trade covered more than 80% of the total value.

Apple and peach are thus important fruit crops for European agricultural economy with a production of 12.6 M t and 2.7 M t, respectively.

Apple is the first Croatian fruit crop (112,931 t on 6,553 ha in 2011), and peach and nectarine are the third fruit crop (11,824 t on 1,615 ha in 2012). Therefore, they play the key role for Croatian fruit production sector. Worldwide, Italy ranks 6th with an apple production of 2 M t on 60,000 ha, mainly localized in the regions Trentino Alto Adige, Piedmont, Emilia Romagna, and Campania. The Italian exports of apples have been constantly growing in the last 10 years, in terms of both quantities and reached destinations (especially to North Africa and Mid-East countries). Italy is the largest peach and nectarine producer in the EU and ranks 2nd in the world after China.

Apple, peach and nectarine suffer from huge crop losses if their pests and pathogens are not effectively controlled. Beside pre- harvest losses, post- harvest losses, which can be as high as 80% on peaches and nectarines if pathogens such as *Monilinia* spp. are not effectively controlled deserve special attention. Therefore, apple, peach and nectarine are among fruit crops the ones with the highest pesticide inputs per ha, with consequent high ecotoxicological side effects towards aquatic and terrestrial systems.

2.2. Environmental problem addressed

The main problem addressed within the framework of LIFE.SUSAFRUIT project was to decrease high use of pesticides in apple and peach production and still reduction of fruit losses (at least 20%) derived by pest and fungal diseases. In the post- harvest phase, project intended to reduce of pesticide residues and consequently increase of food safety and decrease of risks for consumers and environmental health (lower pollution of water, soil and air).

Sustainable fruit production (according to the 3 E: economic, environmental and ethical) is a top priority for European producers to safeguard not only human health, protecting the farmer's health while handling agrochemicals and providing healthy fruits of high quality with a minimal occurrence of pesticide residues, but also the environment. Sustainable fruit production allows to minimise pollution of water, soil and air, to preserve and promote long-term soil fertility and to preserve biodiversity in agroecosystems avoiding side effects against useful insects such as predators, parasitoid and pollinators.

Apples in Italy receive, on average, 17 sprays (13 fungicide sprays, 5 growth regulators, 5 insecticide sprays, and 2 herbicides with the possibility to apply more than one active ingredient at the same time). In NW Italy, chemical control against apple codling moth require at least 4-6 treatments, with a rough cost of treatments per ha of € 300-500 per ha. Chemical control against oriental fruit moth (OFM) and peach twig borer (PTB) require at least 4-5 treatments with a rough cost of treatments per ha of € 300-450. The adoption of the mating disruption strategy with a rough cost per ha of € 250 on apple and of € 360 on peach successfully reduced treatments to 1-3 on apple (1 against eggs and eventually other 2 against larvae with a rough cost of € 70-230) and to 1 against eggs and larvae on peach with a rough cost of € 90.

Total number of pesticide treatments on apples in Croatia is about 20 sprays per year (11 fungicide sprays, 5 growth regulators and 10 insecticides, 3 herbicides). The average number of sprays against apple codling moth (CM) apple is 8-10, and 5-6 sprays against OFM and PTB on peach and nectarine. About 400 g of neonicotinoid insecticides per ha per treatment are used (with approx. price of € 100 per ha per treatment). Therefore, the use of insecticides in Croatia against these pests reaches 26.2 t for apple, and 3.2 t for peach and nectarine.

The costs associated with food waste for EU-28 in 2012 were estimated at around 143 billion €, or 20 % of total produced food (FUSIONS, 2016). Postharvest decay caused by

phytopathogenic fungi is one of the main causes of PHL. PHL in Fruits & Vegetable sector is 56%, and 33% of loss occurs in postharvest handling and storage, processing and packaging and distribution stages of value chain. Except in few cases such as citrus fruits, no fungicide applications are allowed in postharvest phase. Therefore sustainable non-pesticide solutions must be found to decrease PHL. Postharvest heat treatments (thermotherapy) shows potential in decreasing PHL.

These data show high use of pesticides in current production technology in apple, peach and nectarine, which present significant environmental and food safety risk. PHL is another problem which cause both economic and food security risk.

Therefore, the main hypothesis of the LIFE.SUSAFRUIT project was that it is possible to achieve both high-quality and sustainable apple, peach and nectarine fruit production with a significantly reduced use of pesticides if photosensitive anti-insect exclusion nets in pre-harvest and thermotherapy using hot water in post-harvest phase are applied.

2.3. Project objectives

Having the above mentioned main hypothesis in mind, overall objective of the LIFE.SU.SA.FRUIT project was to develop, apply and demonstrate an economically viable strategic plan to implement integrated pest management (IPM), by promoting the use of low-chemical approaches in orchards and post-harvest fruit production in typical Croatian and Italian agro-ecosystems. The project aimed to create an environmentally friendly fruit production and storage management system by making more efficient resource use and by ensuring food safety is not compromised.

The specific objectives of the proposal were the following:

1. to set up and validate the best practices for IPM fruit production with regards to the key pathogens and pests selected for Croatia and Italy;
2. to encourage the development and application of IPM in order to reduce dependency on pesticides;
3. to promote a large-scale adoption of more sustainable crop protection strategies for pre- and postharvest diseases and pests in fruit growing areas;
4. to contribute to the implementation of the environmental EU policy for sustainable development (Dir. 2009/128/CE);
5. to achieve a sustainable use of pesticides by reducing the risks and impacts on the environment and human health;
6. to secure a sustainable production of healthy apples and peaches of high quality with a minimal occurrence of pesticide residues;
7. to reduce the pesticide residues in fruit, thanks to less pesticide treatments in the field (i.e. exclusion nets) and during storage (i.e. hot water treatments), and also to the secondary effect of hot water treatments (pesticide residue elimination);
8. to protect the health of farmers and packinghouse operators by reducing the agrochemical handling;
9. to promote and maintain a high biological diversity in the orchard agroecosystems;
10. to minimise water, soil and air pollution;
11. to maintain the competitiveness of European agriculture in a globalized market, and of the Croatian and Italian productions in particular;

12. to improve the effectiveness of research on the sustainable use of pesticides, and to promote the awareness of growers, packinghouses, technicians, advisors, policy makers and general public on sustainable crop protection strategies.

2.4. Description of technical/methodological solution

The project considers IPM as a key challenge in intensive fruit production with the problems related to the impact of pesticide use on human health and environment. Non-chemical pre- and post-harvest fruit production practices will be developed, applied, demonstrated and disseminated in order to promote the sustainable use of pesticides in typical Croatian and Italian agro-ecosystems in typical Croatian and Italian agro-ecosystems.

Preharvest production practices were concentrated on testing and demonstrating photoselective insect exclusion nets (Fig. 1) and new apple scab (*Venturia inaequalis*) control measures as tools for effective reduction of pesticide use in apple production.

In this project, four colours of photoselective insect exclusion nets were tested (pearl white, red, yellow and white) (Fig. 1), and two mesh sizes aimed to prevent entrance of CM, PTB, PFM and *Drosophila suzukii* into orchard. Before net closure, one insecticide spray was used to control pest populations of pest already present in the orchard.



Fig. 1 – Photoselective exclusion nets in an Italian peach orchard (left) and Croatian apple orchard (right).

Photo-selective anti-insect exclusion nets were installed in total of 17 orchards (4 apple, 2 peach and 1 nectarine orchard in Croatia and 5 apple and 5 peach orchards in Italy). It means that we tested 5 more orchards than planned in the project since we wanted to increase reliability and reproducibility of the results.

Innovative control strategies against *Venturia inaequalis* were aimed to significantly reduce extensive use of fungicides in apple orchards. This objective was pursued by adoption of the low impact control means (principally sulphur) compared to that of the synthetic plant protection products against both primary and secondary infections.

Postharvest practices were concentrated on testing and demonstrating thermotherapy using hot water. This technology was tested and demonstrated in one packinghouse in Croatia and two packinghouses in Italy using two machine prototypes specially developed within LIFE SUSAFRUIT by project partner XEDA (Fig. 2). It was not possible to move either prototype from Emilia-Romagna to Piedmont, due to transport costs, but fruit (peaches and apples)

freshly harvested in Piedmont were moved on the same day in the packinghouses in Emilia-Romagna for hot water treatment. Therefore, the prototype machines were also tested with fruit produced in Piedmont. Moreover, instead of a single prototype, two machines were produced by XEDA and placed in two packinghouses at Apofruit



Fig. 2. Prototypes of thermotherapy machines developed by project partner XEDA

2.5. Expected results and environmental benefits

Based on the described methodological approach and specific objectives, the following expected results of the project have been outlined in the project application:

- Increase of the competitiveness of European agriculture in a globalized market, and of the Croatian and Italian productions in particular.
- Promotion and maintenance of high biological diversity in the ecosystem of the orchard.
- Promotion of the awareness of growers, packinghouses, technicians, advisors, policy makers and general public on sustainable crop protection strategies.
- Reduction of chemical pressure and of risks for growers (e.g. reduction of about 50% of insecticides, and of about 25% of fungicides), consumers and environment
- The decrease of pesticide use for 70 – 90 % in apple and 40 – 81 % in peach and nectarine
- Reduction of agricultural costs and increase in growers' profits, in terms of money and energy saved due to the use of exclusion netting systems (e.g. saving of about €300-500/ha for the control of insects).
- Reduction of pesticide residues for at least 60%, due to less insecticide and fungicide treatments, and to the hot water treatment to remove residue)
- Reduction of fruit losses (at least 20%) from pest and fungal diseases;
- Increase of fruit quality due to the effects of nets, on the basis of quality parameters such as firmness, colour, acidity, RSR (e.g. increase of sugar content of 1-1.5° Brix in apples)

- Reduction of chemical pressure and of risks for growers (e.g., reduction of about 50% of insecticides, and of about 25% of chemicals used against diseases and pests).

From above mentioned expected results, the following environmental benefits can be outlined:

- The maintenance of high biological diversity in the European orchard ecosystems noticed in pilot orchards during the experiments
- Reduction of chemical pressure in European fruit production sector and decreased risks for growers, consumers and environment
- Reduction of pesticide residues in fruits
- The increase of food safety and decrease of risks for consumers and environmental health (e.g. lower pollution of water, soil and air).
- Reduction of chemical pressure and of risks for growers (e.g., reduction of about 50% of insecticides, and of about 25% of chemicals used against diseases and pests).

2.6. Expected longer term results

The proposal aimed to contribute to the sustainable development in the agricultural sector through to the implementation of the Thematic strategy on the sustainable use of pesticides, mainly in its objective to encourage fruit farming with low-input of pesticides.

In 2006, the European Commission proposed a strategy to improve the way pesticides are used across the EU. The European Thematic Strategy on the Sustainable Use of Pesticides has been forwarded through several legal provisions: the Reg. 1107/2009 on the marketing of plant protection products, the Machinery Directive 2009/127/EC, the Reg. 1185/2009 on statistics on pesticides and the Dir. 2009/128/EC establishing a framework for community action to achieve the sustainable use of pesticides.

All these provisions cover pesticides' full life-cycle in an attempt to reduce their impacts on human health and the environment. They identify and analyze a number of objectives and possible solutions that include, among others: minimizing the hazards and risks to health and environment from the use of pesticides; improved controls on the use and distribution of pesticides; encouraging low-input or pesticide-free crop farming systems as the IPM.

In accordance with Article 14 of Dir. 2009/128/EC, the Member States must implement the principles of integrated protection by 1 January 2014. The strategies for integrated protection must be based on techniques with low environmental impact, non-chemical methods must be preferred, and the pesticides applied shall have the least side effects on non-target organisms and the environment.

In addition, as laid down in Dir. 91/414/EEC, in 1993 the EU Commission launched the review programme for all active substances used in plant protection products within the European Union. In this review process, completed in 2009, each substance has been evaluated as to whether it could be used safely with respect to human health (consumers, farmers, local residents and passers-by) and the environment. This strict system for placing on the market has led to an approximate 50% reduction in the number of approved active substances. Controls on the marketing and use of pesticides aim to ensure that authorised pesticides are marketed and used according to these conditions. Plants treated with authorised

pesticides in line with the product label can be marketed and consumed as safe food, with pesticide residues within the EU maximum residue levels (MRLs). (EU Commission, 2017)

Directive 2009/128/EC of the European Parliament and of the Council on the sustainable use of pesticides provides for a range of actions to achieve a sustainable use of pesticides in the European Union by reducing the risks and impacts of pesticide use on human health and the environment and promoting the use of Integrated Pest Management (IPM) and of alternative approaches or techniques, such as non-chemical alternatives to pesticides (DG SANCO, 2017). Art. 4 requires MSs to develop National Action Plans designed to reduce risks related to the use of pesticides and to reduce their use wherever possible. Art. 14 requires MSs to take all necessary measures to promote low pesticide-input pest management, giving priority to nonchemical methods. Art. 5 requires MSs to ensure that all professional users, distributors and advisors have access to appropriate training

In **Italy**, there are three levels of IPM implementation; statutory IPM, Integrated Production as a specific agri-environmental measure funded by EU Rural Development funds under the CAP, and the National Quality Integrated Production System. For statutory IPM, the relevant Competent Authority should check to what extent growers are aware of general IPM principles during routine inspections, but there is no element of monitoring or verification that IPM general principles are applied in practice. Italy make extensive use of Rural Development Funds under the CAP to promote IPM practices which they believe that farmers would not undertake, at least to the same extent, in the absence of payments, as farmers perceive these techniques as costing them money. In Italy, growers receive these additional payments for keeping detailed additional records of crop production. In the case of integrated production, compliance with IPM general principles is checked during inspections by the Paying Agencies. The National Quality Integrated Production System is a voluntary scheme, similar to organic farming certification. Annual inspections are performed at certified operators by approved Control Bodies. In order for certification to be granted, it must be verified that IPM principles and specific IPM measures have been applied during the growing season, as well as in the post-harvest stage. (DG SANCO, 2017).

Croatia identified challenges in controlling the implementation of the eight principles of IPM at individual grower level (DG SANCO, 2017). In Croatia, fruit production since the 1970s has applied the integrated production approach, though the establishment of integrated production systems at the national level started relatively late. In 2010, the legal framework for establishing an integrated plant production system was put in place. For each production sector, the Ministry of Agriculture prepares technological instructions. In 2011, there was a marked increase in interest for this system, with an increase in the area under integrated production and an increase in the number of agricultural producers. Due to shortcomings in the integrated production system and the implementation of inspection controls for agricultural producers, a large number of producers left the existing system of integrated production of agricultural products. The Ordinance on the establishment of a framework for action to achieve the sustainable use of pesticides established the compulsory application of the general principles of integrated pest management as of 1 January 2014 (Republic of Croatia, 2013).

Sustainable cropping systems go beyond technical changes and refers to organizational and even strategic change. The strategy proposed in this project comes from the integration of economic, environmental and social goals into the design of agricultural production systems through broad multidisciplinary cooperation. The sustainable use of pesticides, as a basic IPM principle, means that the decision to apply external inputs is made locally, based on monitoring of pest incidence and is site-specific for a defined agro-ecosystem. For this reason, the Project aimed to promote the use of low-chemical approaches in orchards and post-harvest

fruit production in typical Croatian and Italian agro-ecosystems by showing alternative methods for the management of fruit pest and diseases and by demonstrating the best agricultural practices in fruit production and processing.

These goals were developed and tested, in 17 pilot sites (10 in Italy and 7 in Croatia). The demonstration trials carried out in these sites were the core activity of the project. Indeed, several other activities have been based on them: the monitoring of incidence of diseases and of agronomical parameters, the evaluation of the economic aspects connected with the different practices applied, the development of training and dissemination activities.

A recent report issued by the European Commission on Member State National Action Plans and on progress in the implementation of Directive 2009/128/EC on the sustainable use of pesticides (European Commission, 2017) underlines some critical aspects in the implementation of the Directive, and in particular referring to IPM:

- - *“Member States have not converted the IPM principles into prescriptive and assessable criteria. They see IPM mainly as an education tool for farmers, and have no methods in place to assess compliance with IPM principles. While Member States take a range of measures to promote the use of IPM, this does not necessarily ensure that the relevant IPM techniques are actually implemented by users. Farmers are economic operators, and while IPM techniques are sustainable from a long-term perspective, IPM can mean a higher economic risk in the short term. Member States highlighted the insufficient availability of low risk and non-chemical pesticides as a barrier for further IPM development. Incentives for the registration of low risk and non-chemical products are mentioned however in only a few national action plans. **Therefore, the authorisation and promotion of low-risk and non-chemical pesticides is another important measure to support low pesticide-input pest management.** In three Member States (including Italy) the proportion of non-chemical active substances contained in pesticides, compared to all active substances in authorised pesticides was high, at over 10% in 2015”*
- *“Integrated Pest Management is a cornerstone of the Directive, and it is therefore of particular concern that Member States have not yet set clear targets and ensured their implementation, including for the more widespread use of land management techniques such as crop rotation. Member States need to improve the quality of their plans, primarily by establishing specific and measurable targets and indicators for a long term strategy for the reduction of risks and impacts from pesticide use. These improvements should be included in the revised action plans, which would allow Member States to continuously monitor progress with implementation and adjust strategy as necessary”*
- *“**IPM guidelines can help growers and their advisors, but to be relevant, IPM must be tailored to local conditions.** Italy provides a good example in this area. Italy has developed IPM guidelines for over 95 % of the crops grown in the country. At national level, there are general IPM guidelines, outlining the minimum requirements with regard to IPM. These are complemented by crop-specific IPM guidelines at regional level which take into account specific regional issues”*

We may thus state that LIFE SUSAFRUIT contributes to the implementation, updating and development of European Union environmental policy and legislation also by addressing these shortcomings, and namely by taking into account economic considerations of producers,

by supporting low-input pest management and finally by tailoring IPM guidelines to local conditions

In addition, the project was also relevant to a wide range of agricultural and environmental legislation, including instruments within the Common Agricultural Policy (CAP) apparatus that regulate EU farm activity. In this respect, the outputs provided can be easily integrated within the practices used under the schemes of food quality certification such as Integrated Production and Organic Farming. These two schemes are subsidized under the Rural Development Plan and are fostered as production methods that are limiting the impact of agricultural practices to the environment. The project has delivered a series of information that are supporting IPM methods, normally used in Integrated Production. Similarly, some alternative methods (exclusion nets, thermotherapy) can be used in organic farming.

3. Administrative part

3.1 Description of the management system

LIFE.SUSAFRUIT project was organized through five distinct groups of actions: A) Preparatory actions, B) Implementation actions C) Monitoring actions, D) Communication and dissemination actions, and E) Project management and monitoring actions. With exception of A actions, all other groups of actions were conducted simultaneously as shown in project timetable (Table 5).

Preparatory actions were dedicated to preliminary activities that focused on fact findings, review of literature, choice of the demonstration sites, and preparation of detailed plans for the different activities foreseen within the project.

Implementation actions were the core of the project activities dedicated to the actual implementation of sustainable technologies (photo- selective insect exclusion nets, and thermotherapy) in apple and peach orchards and fruit packinghouses in Croatia and Italy.

Project monitoring actions were dedicated to the monitoring of environmental and socioeconomic impacts of the project actions.

Communication and dissemination actions were designed to effectively promote and disseminate project results to the farmers, consumers, scientists and other stakeholders in the form of workshops, newsletters, technical and scientific publications. Within this group of action project website was developed and maintained. This dissemination tool will remain active for 5 years after project end to achieve the maximum dissemination effect

Project management and monitoring actions were dedicated to ensure smooth progress of project actions from technical and financial point of view. They were designed to enable project implementation in accordance with LIFE Programme rules and regulations and help achieving project objectives.

Organisational scheme of project actions and subactions is shown in Fig. 5 and organisational management structure is shown in Fig. 6

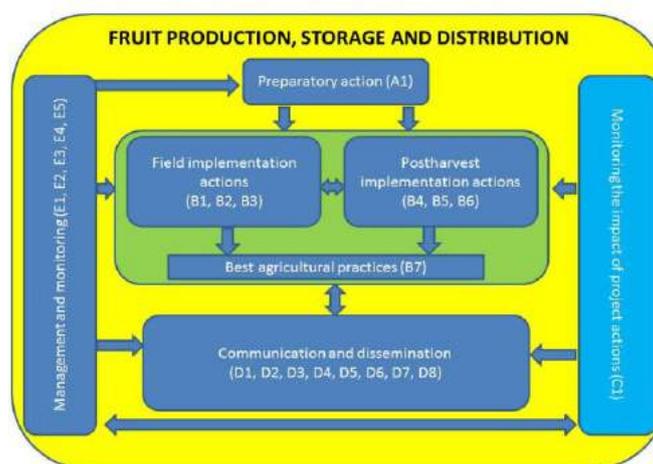


Fig. 3. Organisational scheme of project actions

The key part of management system was action E1 (Project Management: operational plan; management system; project meetings; project reports, maintenance plan). Within this action, quality assurance plan, internal communication plan and a development plan were created to ensure a successful project management and monitoring.

The management structure is shown in Fig. 6.

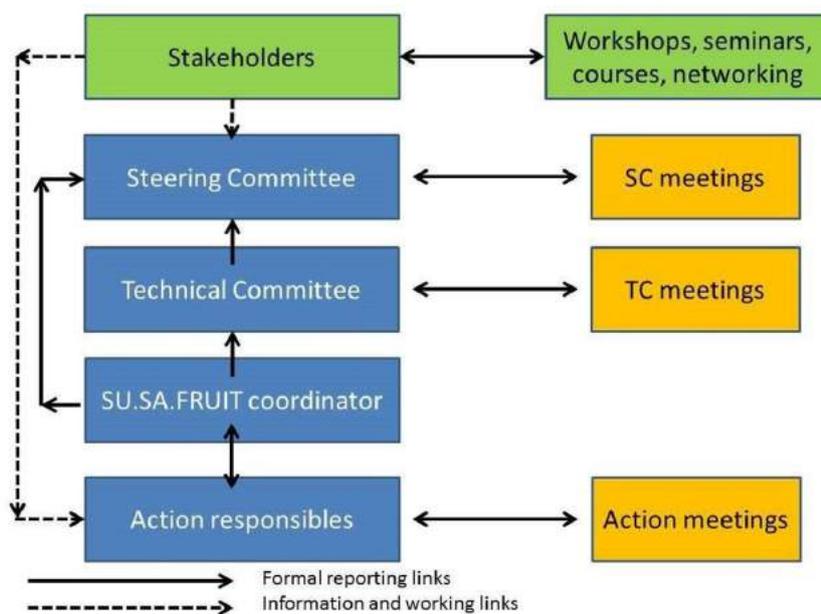


Fig. 4 Management structure of LIFE.SUSAFRUIT project

Project management structure is consisted of following important parts:

- Project teams, led by the coordinating beneficiary through the Project Coordinator (FAZ);
- Action responsible persons;
- Technical Committee (TC);
- Steering Committee (SC).

The Technical Committee (TC) led by FAZ through the Project Coordinator and included members from each project consortium organisation

The project consortium involved FAZ (coordinating beneficiary) in Croatia; the Departments of Agricultural Science and of Management of the University of Torino (UNITO), the University of Bologna (UNIBO), APOFRUIT and XEDA in Italy

FAZ, as coordinating beneficiary, was directly responsible of Actions E (Project management and monitoring of the project progress), thus ensuring the financial, administrative and operational coordination of activities held in the two Project Countries.

The management structure of the project was the following:

- **Project Coordinator:** Prof. Tomislav Jemrić (FAZ)
- **Project Manager:** Mr Mladen Fruk (FAZ)
- **Financial Manager:** Mr Josip Buhin (from 1/7/2017 to 16/12/2017) (FAZ)
- **Action responsible:** In general terms the action responsible coordinated the work foreseen in each action, collecting results of all teams in the 2 Countries and transferring them to the coordinator.
- **Technical Committee (TC):** lead by the project coordinator, it was the decision-making body for daily matters and of communication action with third parties. It approved the work plan. It was composed by 7 members: Tomislav Jemrić (FAZ, chair), Davide Spadaro and Rosemarie Tedeschi (UNITO), Marta Mari (UNIBO) Zoran Lovrek (AGRA) Gianni Ceredi (APOFRUIT) Gil Bompeix (XEDA).
- **Steering Committee:** it was the body responsible for the contingency planning, internal evaluation system, and met once a year to discuss about project development and assess the mid-term and final report. It was established at Kick-off meeting on 16/6/2014. The Steering Committee (SC), included the following members: Neven Voća (Croatian Environmental Agency), Karmen Mrakovčić (Tutti-Frutti), Graziano Vittone (CreSo, now Agrion), Luisa Ricci (Piedmont Region)

Partnership Agreements (PAs) were submitted with the IR, and PAs with changes requested by the EC were resubmitted in September 2015.

3.2. Description of the Project Consortium

Coordinating Beneficiary: University of Zagreb – Faculty of Agriculture (FAZ)

FAZ is the leading higher education and science institution in the field of agriculture and related sciences in the Republic of Croatia. During the past 90 years, more than 12,000 students have received graduate, postgraduate and doctoral degrees from FAZ. Within Faculty departments there are 28 laboratories and 6 experimental stations intended for teaching, and scientific and technical activities.

As coordinating beneficiary, FAZ participated in all project actions.

Partner organisations

The partners involved in LIFE.SUSAFRUIT project are Agra d.o.o., Apofruit Italia Soc. Coop. Agricola, Alma Mater Studiorum – Università di Bologna, Università degli Studi di Torino and Xeda International S.A.

AGRA is founded in 1990, as small and dynamic family company. Main businesses of this company are fruit production (8 hectares of apple and 9 hectares of peach) and selling of anti-hail protection nets, measuring and other equipment for agriculture.

AGRA participated in the implementation of the following actions: A1, B1, B3, D3, D4, D5 and E1.

Apofruit Italia (APOFRUIT) is a cooperative enterprise that has been operating on the international market for more than 50 years with its own structures and producer-members from the north to the south of Italy. Apofruit Italia is a leader production organization in fruit and vegetable sector with about 4.000 member farmers, 12 production plants and 6 reception

and storage centres. Apofruit manages about 200.000 tonnes of fruit and vegetables of which more than half is exported in EU.

APOFRUIT participated in the implementation of the following actions: A1, B3, B5, B7, D3, D4, D5, and E1.

Alma Mater Studiorum – Università di Bologna (UNIBO) is one of the most important institution of higher education across Europe and one of the most active Italian universities in research and technology transfer. At the European level, UNIBO successfully participated in FP6 and FP7 programs. At the UNIBO, research activities are promoted and coordinated by Departments autonomously. UNIBO participating Department in the project is Department of Agricultural Science (DipSA), in particular the scientific area of Plant Pathology and Phytoiatry and CRIOF (research centre of DipSA) having over 40 years of experience in the plant pathology in pre and post-harvest field.

UNIBO participated in the implementation of the following actions: B1, B3, B5, B6, B7, C1, D5, and E1

UNITO – DISAFA has a long tradition of research in the field of biological control and Integrated Pest Management (IPM). Over the years, investigators from the DISAFA have set up and applied large-scale inoculative and inundative biological control programmes. DISAFA carries out basic and applied research, teaching, knowledge and technology transfer, life-long learning and communication on up-to-date topics in the agro-environmental and agro-food sectors. It has several national and international collaborations and possesses extensive facilities including molecular, microbiological and chemical laboratories, experimental fields and greenhouses.

UNITO participated in the implementation of the following actions: B1, B2, B3, B5, B6, B7, C1, C2, D2, D4, D5 and E1.

XEDA international is a French company with a capitalization of 1 071 000 Euro and incorporated in 1976. Headquarters are at Zone Artisanale la Crau RD 7 13670 Saint Andiol, France. XEDA offers the most complete and innovative range of post-harvest chemicals. Our products and technology are patented worldwide. XEDA manufactures and markets packing machinery, equipment for the individual labelling of fruit and vegetables and chemical application equipment. XEDA is committed to sustainable agriculture and every year invests approximately 18% of its turnover in Research & Development and in registrations to bring new and efficient technology and chemicals to the market that respect both people and the environment.

XEDA participated in the implementation of the following actions: B4, D5 and E1.

4. Technical part

4.1. Dissemination actions

Action D.1 Building and updating the project website

Actual starting date: 16/6/2014

Ending date: 16/12/2022

State of the Action: completed

Website is the main communication tool for exchanging information with consumers, stakeholders and other interested people. Partners sent all information, documents, pictures, to the project manager who forwards them to person that is responsible for website updating.

Project website is fully operational since October 2014. Web site is multilingual (Croatian, Italian, English, French and Spanish. As shown in Fig. 12, a total of 14440 visitors visited the web site, of which 9160 (63.5%) were unique visitors, meaning that each visitor viewed the average of 1.57 pages of the project. The number of unique visitors has increased every year, indicating that web pages have become a constant source of information for target groups, thus fulfilling their goal. There are visitors from many countries all around the world.

Starting from 2016 website is also visible on www.researchgate.net which is the biggest scientific and researcher's portal. LIFE.SUSAFRUIT project is also visible on Facebook(Link: <https://www.facebook.com/pg/su.sa.fruit/>) as well as Youtube channel: (Link: <https://www.youtube.com/channel/UC2IB64ZuBNJ3LFqHDK5gENQ>).

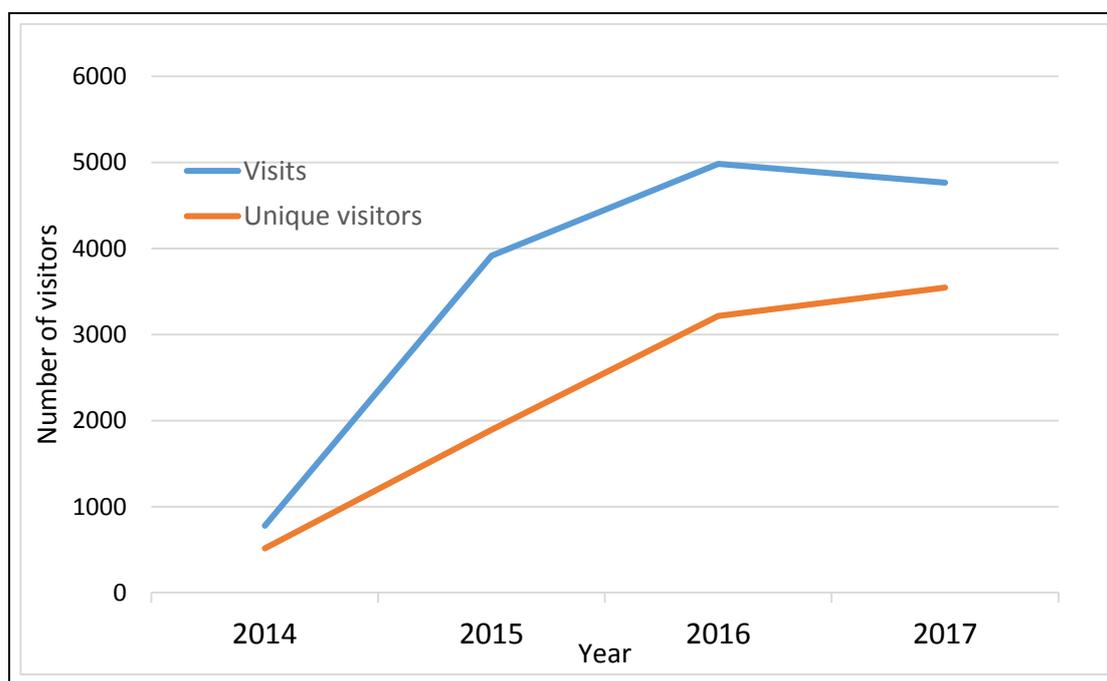


Fig. 5. Number of visitors to website of LIFE.SUSAFRUIT project

Action D.2 Production of communication and dissemination materials

Action starting date: 16/6/2014

Ending date: 16/12/2017

State of the Action: completed

Action D.2.1 : Developing general project brochure

Brochures are finished (Annex 29 sent with MR). They are trilingual, Italian, Croatian and English. In brochures we briefly described project (contribution, partners involved, eSC.). LIFE logo that is provided from the Commission is included. We distributed the brochures during all the activities in which we promoted the project and disseminated the results. Moreover, we established strong collaboration link with Croatian Extension Service who delivered project brochures through their own events. For that purpose we increased total number of project brochures on 8000.

Action D.2.2 Developing general project poster

Two types of general project posters have been made; one is a typical poster A0 size printed on paper (Annex 17 and 18 sent with IR) and the other is in a form of roll-up that makes it easier to transport it to events, and they are more durable as well (Annex 16 sent with IR). They have general information about the project, partners, duration, budget, LIFE logo, eSC. They are made in three languages (Croatian/English and Italian/English).

Each partner has received posters and was using them at conferences (D5), seminars (D3), workshops (D4) and during networking activities (E5).

Action D.2.3 Production of guidelines booklets

Guideline booklets were produced after the project partners collected and analyzed data about application of nets and its effectiveness in pest control. In total 500 copies of booklets were produced (Annex 14) and they were distributed during final conference of the project held in Zagreb (Action D2.5) and they are distributed by project partners within their regular activity. Due to the established strong collaboration with Croatian Extension Service, guidelines booklets were distributed on their events.

Action D.2.4 Set up the SUSAFRUIT press office

SUSAFRUIT press office is formed. The press office, coordinated by UNITO, organized press conferences and releases, and wrote press reviews for local and national printed and web thematic and general press media. Facebook account was activated with uploaded news and materials.

SUSAFRUIT press office is formed. The press office is at UNITO and they are collecting all the news about the project. Project was presented in “Gospodarski list” and “Apofruit Notizie”. The project Kick off meeting was published in “Gospodarski list” which has more than 25 000 subscribers in Croatia.

The project Kick-off meeting was covered in “Gospodarski list” which is specialized magazine that reaches targeted audience (Annex 19, sent with IR). Total of 13 press releases and 3 press conferences were organized as described in Report on Action D2 (Annex 6).

Action D.2.5 Press conferences

Three press conferences were held, as follows:

- 1) In March 2016, during the “International symposium on sustainable fruit production”, there was press conference. Croatian national television (HRT) was able to broadcast that event. The Croatian national television (HRT) broadcasted that event in one TV show named “Plodovi zemlje” that is a weekly show specialized in agriculture. It is visible on the SU.SA.FRUIT website under the section “news” (www.life-susafruit.eu/news.html).
- 2) In June 2016 a second press conference was held, for that occasion Tomislav Jemrić as project coordinator participated in TV show “Guide to the EU funds” at the Croatian Radio-Television. (<http://www.life-susafruit.eu/news.html>)
- 3) In November 2017, during the final conference of the LIFE SU.SA.FRUIT project "Low pesticide IPM in sustainable and safe fruit production" (LIFE.SU.SA.FRUIT)" held at the University of Zagreb, Faculty of Agriculture, Zagreb, Croatia. It was also attended by press. (<http://www.life-susafruit.eu/news.html>)

Concerning the indicators of progress:

- 8,000 project brochures were delivered
- 500 guideline booklets were delivered
- 13 press releases were done
- 112 people participated to the press conferences

Action D.3 Communication actions towards farmers (4 seminars on BAPs)

Actual starting date: 1/06/2015

Ending date: 16/12/2017

State of the Action: completed

Action D.3.1 Seminars and technical visits reserved to growers

This dissemination activity designed for growers consisted in seminars on new sustainable strategies to control pests and diseases of apple and peach and in technical visits in some orchards involved in the project. Eight seminars (4 in Croatia and 4 in Italy) and 6 technical visits (4 in Croatia and 2 in Italy, associated to 4 seminars) were expected.

The following seminars and technical visits were organized:

In Croatia:

- 1) September 2015. A group of faculty members and growers from Nitra (Slovakia) visited our project (Annex 8 and 29, sent with MR). FAZ organized one **seminar** for them and a

technical visit to an orchard in Krapina where the project was implemented. We informed them about the principles of exclusion nets.

2) 8 June 2016. AGRA and FAZ organized one **seminar for growers** (Annex 6, sent with PR). Twelve of them were present. When the seminar ended, there was a **technical visit** to one orchard involved in the activity of the project.

3) 20 September 2016. Within the meeting of Croatian chamber of economy, AGRA and FAZ organized a **seminar** for scientists and relevant experts from fields of agriculture and economy (Annex 7, sent with PR).

4) On 7 December 2017 in Vratišinec, Croatia, seminar for growers was organized by AGRA. 15 Growers were present (Annex 16).

In Italy:

- 1- July 2015. **Seminar** in APOFRUIT packinghouse on preliminary results from the project (Annex 6 and 30 sent with MR) + **technical visit** to the nearby orchards where the nets were installed.
- 2- February 2016. UNITO organized a **seminar for fruit growers** in AGRION (Manta, CN) (Annex 7 and 31, sent with MR). Ten growers were present. Project partners have presented results from the first year of experiments.
- 3- 12 February 2016, one seminar on Best Agricultural Practices in IPM in Fruit Production was held by UNITO at AGRION, Manta (CN), Italy (Annex 63 sent with PR).
- 4- 12 July 2016. During the 5th project meeting of LIFE SUSAFRUIT in Emilia Romagna Region (Ferrara - Italy), UNIBO has organized a **seminar for growers** on apple scab control strategies with low chemical inputs. After the seminar growers there was **technical visit** to one orchard involved in the project activities (Annex 27, sent with PR).
- 5- 26 August 2016. UNITO organized a **technical visit** for technicians and operators (Annex 28 sent with PR) in Revello (CN), in one of the LIFE+ SU.SA.FRUIT demonstrative orchard. The promising results obtained, in the second year of field trials within the "LIFE + SU.SA.FRUIT Project were presented. The effectiveness of anti-insect nets against the Brown marmorated stink bug (BMSB), *Halyomorpha halys* was highlighted. 24 people were present.
- 6- 7 November 2016. In the frame of a technician coordination organized by the Regione Piemonte, in Cavour (TO) (Annex 29, sent with PR), UNITO presented preliminary results from Action B3 on the effectiveness of anti-insect nets against the Brown marmorated stink bug *Halyomorpha halys*: "Uso di reti anti-insetto su melo e pesco in Piemonte: buone prospettive per il contenimento del danno da *Halyomorpha halys* (Use of the anti-insect nets on apple and peach in Piedmont: promising perspectives for the control of damage by *Halyomorpha halys*). 34 people were present.
- 7- 9 June 2017. A technical visit with growers was held on June 9th, 2017 in Cervignasco (CN, Italy), in one of the LIFE+ SU.SA.FRUIT demonstrative apple orchard. The promising results obtained, in the second year of field trials within the "LIFE + SU.SA.FRUIT Project were presented. In particular the effectiveness of anti-

insect nets against the Brown marmorated stink bug (BMSB), *Halyomorpha halys* was highlighted. 92 participants attended the event. (Annex 63)

- 8- On November 30th, 2017, the results of the LIFE SU.SA.FRUIT project were presented to the growers and to packinghouses at Agrion, Moretta (Italy)

Moreover, UNITO organized technical visits for students of the courses “Plant Pathology” and “General and Applied Entomology” of the Agriculture Science and Technology degree course (University of Torino):

1. 3 June 2015. Technical visit to the experimental orchards in Cervignasco, Revello and Savigliano (Annex 26 sent with PR). 115 students were present. The use of anti-insect net prototypes (2015, Action B2)
2. 8 June 2016, Technical visit to the experimental orchards in Cervignasco, Revello and Savigliano (Annex 25 sent with PR). 86 students were present.

During and the experiments in the demonstrative apple orchards (2016, Action B3) were showed and explained to the students in the frame of a seminar on innovative and sustainable pest and disease control strategies.

Action D.3.2 Technical workshops reserved to packinghouse technicians

This dissemination activity designed for packinghouse technicians consisted in technical workshops on the use of hot water for the treatments of apples and peaches against post-harvest diseases. Six workshops (4 in Italy and 2 in Croatia) were expected. The technical workshops were organized:

In Italy:

1. In the frame of the project meeting held in Bologna and Cesena in July 2015 APOFRUIT organized 1 workshop for packinghouse technicians (Annex 32 sent with MR) in which the functioning of the two different machines adopted by APFRUIT was explained.
2. Bologna 26 May 2016. In the frame of a technician and grower’s coordination organized by the Regione Emilia, a workshop titled ‘Incontro tecnico post-raccolta 2016’ was organized (Annex 30, sent with PR). 50 people attended the workshop. Marina Collina presented "LIFE + SU.SA.FRUIT Project", Marta Mari presented preliminary results from Action B5 on the strategies to control bull’s eye rot (Difesa integrata dal marciume lenticellare delle mele – Integrated control of bull’s eye rot of apple) and Gianni Ceredi presented preliminary results from Action B5 on the alternative control means to brown rot of peaches (Nuove specie di Monilinia e nuovi approcci di difesa – New species of Monilinia and new control approaches).
3. Lagnasco, 9 June 2017. After the technical visit to one of the LIFE+ SU.SA.FRUIT demonstrative apple orchard a workshop on the preliminary results of packinghouse trials was organized.

4. Manta, 30 November 2017. UNITO organized a workshop and seminars reserved to growers and packinghouse technicians on new strategies for the control of fruit pests and diseases in the field and in post-harvest.

In Croatia:

- 1 In the frame of the International Symposium on sustainable fruit production held in Donja Stubica (22 March 2016) FAZ organized a workshop on “Sustainable postharvest technologies”. 25 people attended the workshop (Annex 8 sent with PR).
- 2 On 17 November 2017 in Kašić, Croatia, seminar for packinghouse technicians was organized by FAZ. 21 grower was present (Annex 4).
- 3 On 8 December 2017 in Kašić, Croatia, seminar for packinghouse technicians was organized by AGRA. 21 grower was present (Annex 19).

Concerning the indicators of progress:

107 farmers participated to the technical visits

106 people participated to the workshops and seminars

Action D.4 Communication actions towards consumers (4 workshops)

Actual starting date: 1/10/2014

Ending date: 16/12/2017

State of the Action: completed

Action D.4.1 Articles on magazines and online magazines to be published on Italian and Croatian generalist and specialized journal

The results of this action are described in Report on action D4 „Report on communications towards consumers and survey results“ (Annex 57). The project exceeded the target of 10 articles foreseen in the grant agreement, as in total 13 articles have been published already.

Action D.4.2 Consumer-oriented workshops

Consumer-oriented workshops were organized in order to inform consumers about the advantages of the fruits produced with reduced chemical inputs. Panel tests and short workshops on the project topics and main results were combined. In total, 8 consumer-oriented workshops (6 in Italy and 2 in Croatia) were expected.

The following workshops were organized:

In Italy:

1. On 12 November 2016, in the frame of the Tuttomele Fair in Cavour (TO) the workshop “Dove va l’agricoltura? L’Evolution dell’agricoltura locale” (Where is agriculture going? The evolution of local agriculture) was held. Rosemarie Tedeschi presented the LIFE+ SU.SA.FRUIT Project and the promising results of anti-insect nets in apple and nectarine orchards against *Halyomorpha halys* damage (Annex 34 of the PR). Title of the presentation “Reti escludi-insetto: nuova strategia per contenere il danno da cimice asiatica nei frutteti piemontesi” (Anti insect nets: a new control strategy against the brown marmorated stink bug damage in fruit orchards in Piedmont).
2. The LIFE+ SU.SA.FRUIT Project has been presented at consumers during the weekly market managed by local farmers in Via Segantini (Bologna, Italy) (www.pabp.it) (Annex 35, sent with PR). Consumers were informed on the main objectives of project and invited to taste the ‘Crips Pink’ apple. Thirty people tasted the apple treated by hot water (sample 2) or not (sample 1), and expressed their opinion in a satisfaction test.

In Croatia:

1. On 6 of March 2017, AGRA in cooperation with Kaufland organized one consumer orientated workshop (Annex 62, sent with PR). Panel test on apple was included.

Concerning the panel tests, the following were organized:

1. On 18 March 2017 the LIFE+ SU.SA.FRUIT Project has been presented at consumers during the weekly market managed by local farmers in Via Morazzo, 3, Villa Bernaroli (Bologna, Italy) (www.pabp.it). Consumers were informed on the main objectives of project and invited to taste the ‘Crips Pink’ apple. Sixty-five people tasted the apple treated by hot water (sample 2) or not (sample 1), and expressed their opinion in a satisfaction test.
2. On July 28th, 2017, the LIFE + SUSAFRUIT Project has been presented at consumers in Grugliasco (TO) village. Consumers were informed on the main objectives of the project in particular on the use of exclusion nets against fruit pests
3. On September 13th, 2017, the LIFE + SUSAFRUIT Project has been presented at consumers in the frame of the VII National Meeting on Phytoplasmas and Phytoplasmas diseases

This event gave also visibility to the LIFE + SUSAFRUIT Project towards the Italian scientific community working on phytoplasmas and phytoplasma diseases.

Concerning the indicators of progress:

- 13 of specialized/general public press articles were published
- 117 of consumers participated to the surveys about awareness and perception on integrated fruit production

Action D.5 Participating in dissemination events (conferences, workshops, seminars) presenting technical communication of project experience

Starting date: 1/7/2015 action started earlier (16/2/2015)

Ending date: 16/12/2017

State of the Action: completed

Action D.5.1 Participation to fairs and exhibitio

The project and its main results were presented during national and international fairs/exhibitions.

The participation to 5 fairs and exhibition was expected and the followings were done:

1. Ministry of Environmental and Nature Protection on May 20, 2015, organized LIFE Programme Info Day in Zagreb. During this Info Day Life SU.SA.FRUIT project was presented (Annex 41 sent with MR).
2. The Ministry of Environmental and Nature Protection held on 17 June 2015 a Workshop on the LIFE program project. In this workshop SU.SA.FRUIT Life project was presented as an example of a successful application to the call of the LIFE program (Annex 42 sent with MR).
3. Gianni Ceredi (APOFRUIT) presented the topics of the project at SANA 2014, an international exhibition of organic and natural products held from 6th to 9th September 2014 in Bologna (Bologna Fair).
4. On 4th and 5th September 2015 we participated in 10th International fruit fair in Donji Kraljevec (Croatia) (Annex 38, 39 and 40 sent with MR). There we have presented project and some preliminary results from the project experimental phase.
5. European and Mediterranean Plant Protection Organization (EPPO) in its database of plant pests has published photos of *Xestia c-nigrum*, *Cydia pomonella*, *Habrosyne pyritoides*, *Ematurga atomaria*, *Grapholita molesta*, *Pseudoips prasinana*, *Pyrrhia umbra*, *Rhagoxycha fulva*, and *Synanthedon myopaeformis* found in Croatian orchards where Life SU.SA.FRUIT project is implemented (Annex 43, sent with MR).

6. A PhD student studying at the University of Zagreb Faculty of Agriculture and Scholar Erasmus Mundus program Experts4Asia under Prof. Tomislav Jemric supervision, Mr. Mushtaque Ahmed Jatoi on 9 December 2015, presented the Life SU.SA.FRUIT project at the Shah Abdul Latif University (Khairpur, Pakistan) to faculty members and the postgraduate students of the Department of Botany (Annex 44, sent with MR).
7. For all the duration of the Tuttomele Fair in Cavour (TO) there was a stand from UNITO with a poster (Annex 36 sent with PR) on LIFE + SU.SA.FRUIT Project and the promising preliminary results obtained with the anti-insect nets in the management of the brown marmorated stink bug *Halyomorpha halys* in apple orchards. Moreover, a photographic poster on damage caused by *Halyomorpha halys* in Piedmont as well as a cage containing alive *H. halys* specimens were provided. Title of the poster: “LIFE+ SU.SA.FRUIT: strategie innovative per una frutticoltura più sostenibile” [LIFE+ SU.SA.FRUIT: innovative strategies for a more sustainable fruit production].
8. From 24 to 26 September 2014, the Macfrut, an international trade fair for the fruit and vegetable supply, in Cesena (Italy). In that year, 24,800 registered visitors and exhibitors from more than 35 countries were present, which contributed to the success increasing the focus of the event finding all the useful elements to set up strong businesses in the global market. APOFRUIT was present in MACFRUT with a stand. Gianni Ceredi and Marta Mari presented a poster on LIFE + SU.SA.FRUIT Project remained in the APOFRUIT stand for the whole duration of exposure. The title of poster was: ‘Riduzione degli agro-farmaci per una produzione frutticola sostenibile: un progetto LIFE+’ (Annex 37 sent with IR?)
9. On 23 February 2015, during an open day of Department of Agricultural Science of University of Bologna, Marta Mari presented the LIFE + SU.SA.FRUIT Project (Annex 38 sent with IR). Over than 120 visitors attended to the event, including students, researchers and R&D responsible of enterprises.

The target number of presentations at fairs (5) was exceeded by four more events, so total participation was 9 exhibitions and fairs.

Action D.5.2 Participation to congresses

The participation to several national and international scientific congresses increased the knowledge of the project and allowed to disseminate the project results to the scientific community. Four oral presentations (power point) in national and international congresses were expected. In addition, the project partners presented several posters to national and international scientific congresses as follows:

1. Prof. Marta Mari delivered a **plenary lecture** at the 50th Croatian and the 10th International Symposium on Agriculture” (Annex 24 sent with IR). Prof. Tomislav Jemrić also participated in that symposium and **presented** Life+SU.SA.FRUIT project (Annex 25 sent with IR).

2. Prof. Božena Barić attended the 10th Symposium of fruit growers in Čakovec. She had an **oral presentation** about the influence of anti-hail and other types of nets on pest control (see Annex 26, in Croatian only, sent with IR).
3. On 22-24 September 2014 was held in Pisa (Italy) the annual conference of Italian Society of Plant Pathology titled: Environmentally loyal plant protection: from nano- to field-scale'. The scientific program included invited lectures, contributed oral and poster presentations covering several thematic sessions. Over 120 delegates attended to the conference. In the poster session Davide Spadaro presented a **poster** on LIFE+SU.SA.FRUIT Project (Annex 39, sent with PR). In the proceeding of conference published in a special issue of the Journal of Plant Pathology at page 72 is reported the abstract of poster. The title of poster was 'Low pesticide IPM in sustainable and safe fruit production: a Life+project'.
4. On 7-11 June 2015 in Bari was held the III International Symposium on Postharvest Pathology. Over 160 delegates from 41 countries in 5 continents attended to the congress. The scientific program included invited lectures, contributed oral and poster presentations, and commercial exhibitions covering seven thematic session. In the poster session, Davide Spadaro and Marta Mari presented a **poster** on LIFE+SU.SA.FRUIT Project (Annex 40, sent with PR). The title of poster was 'Low pesticide IPM in sustainable and safe fruit production: a Life+project'
5. On 2 July 2015, the LIFE+ SU.SA.FRUIT Project was presented at the DipSA Innova 2015 conference, held in Bologna, Italy. Sponsored by Bologna University's Department of Agricultural Sciences, DipSA Innova highlights innovations in the Agricultural Sciences. DipSA Innova brings together companies and organizations involved in the financing and support research in the agriculture and food industries. Over than 200 people attended to the conference. Gianni Ceredi had an **oral presentation** on the experience of APOFRUIT in the frame of the SUSAFRUIT Project (Annex 41 sent with PR).
6. The LIFE+ SU.SA.FRUIT Project was presented at the 'International workshop in Monilinia' Lleida-FruisCentre 25-26 November 2015. Over 30 people from Europe attended to Workshop. Italian partners (Prof. Davide Spadaro, Prof. Marta Mari and Dott. Gianni Ceredi) had **oral presentations** (Annex 42, sent with PR). The title of presentations was: Spadaro D. '*Sensitivity of Monilinia laxa and M. fructicola isolated in northern Italy to fungicides*'; Mari M. '*Old and new approaches in brown rot control of stone fruits*'; Ceredi G. '*Evolution of the pre harvest chemical prophylaxis and problems related to the use of fungicides*'. (Annex 43, sent with PR)
7. The LIFE+ SU.SA.FRUIT Project was presented at the 6th Annual Meeting of the European PhD Network in "Insect Science" and SEI-SIPaV Joint Workshop (Firenze, 11th – 13th November 2015). The PhD student Valentina Candian presented preliminary project results with a **poster** entitled "Exclusion nets for the control of fruit pests in NW Italy (Annex 44, sent with PR).
8. The LIFE+ SU.SA.FRUIT Project was presented at 'Working group Apple Lenticel Rots' Paris, 16-17 December 2015. Over 40 people attended to meeting from different countries (New Zealand, South Africa, Chile, Argentina, Europe). Italian partners (Prof. Marta Mari and Dott. Gianni Ceredi) participated to the working group with

oral presentations (Annex 45). The titles of presentations were: Mari Marta.: ‘New approach in lenticel rot control’; Ceredi Gianni.: ‘Lenticel rot: Prospectives for the prevention in the field and the management in post – harvest’ (Annex 64 sent with PR).

9. At the “International symposium on sustainable fruit production” in Donja Stubica (21-24 March 2016) Rosemarie Tedeschi, Valentina Candian, Davide Spadaro, Karin Santoro presented the latest results of the LIFE+ SU.SA.FRUIT Project with **oral presentations**. The titles of presentations were: Rosemarie Tedeschi: “*Halyomorpha halys*, a new threat to crops in Europe: distribution, damage and control perspectives”; Valentina Candian: “Exclusion nets for the control of fruit pests in NW Italy”; Davide Spadaro: “Use of biocontrol agents and essential oils for postharvest disease control”; Karin Santoro: “Effect of fumigation with essential oils on postharvest quality and health of stone fruit”.
10. During the poster session, results on “The ground beetle fauna (*Coleoptera*) in apple orchard in Croatia” were presented with a **poster**.
11. The LIFE+ SU.SA.FRUIT Project was presented at the Italian National Congress of Entomology held in Padova, 20-24 June 2016) with a **poster** on the use of insect-exclusion nets against pests in fruit orchards presented by Rosemarie Tedeschi (UNITO) (Annex 46, sent with PR).
12. From 21-23 September 2016 in Nitra (Slovakia) was held 5th International Scientific Horticulture Conference. Croatian partners (prof. Tomislav Jemrić and prof. Goran Fruk) have participated to the Congress with the **oral presentation** (Annex 11, sent with PR). The name of the paper was “Influence of different coloured anti-hail nets on fruit colouration apple ‘Braeburn’” was presented (results of LIFE.SU.SA.FRUIT).
13. On 1 December 2016, a Pink Lady Technical Meeting was held in Bologna (Italy) sponsored by Pink Lady Consortium. Over 100 people attended to the meeting representing technicians and growers of Pink Lady® of France, Spain, Italy. During the meeting Marta Mari, Marina Collina and Gianni Ceredi presented **oral presentations** on some results obtained in the trails performed within LIFE SUSAFRUIT Project. The title of presentation was: Mari, M. ‘Neofabraea spp. causal agent of apple lenticel rot’(Annex 47, sent with PR); Collina M. ‘Innovative control strategies against *Venturia inaequalis* (Annex 65 sent with PR).

Concerning the indicators of progress:

- More than 700 researchers attended the national and international congresses where the project results were presented
- 17 oral presentations were given by project partners in national and international congresses

Action D.6 Production of technical and scientific publications

Action starting date: 1/10/2014

Ending date: 16/12/2017

State of the Action: completed

Action D6.1 Production of technical publications

This technical meeting held in Bologna prepared of joint report which that served as base for preparation Sustainable fruit production method manual. At this meeting editorial board for manual was established to prepare manual. Final preparation of manual was postponed till the end of peroproject since we wanted to obtain maximum reliability of information.

Action D6.2 Production of scientific publications

Within this sub- action, following was done:

1. Preparatory workshop about sustainable pre-harvest and post-harvest practices in fruit production (Annex 27, sent with IR) was held in Zagreb on 5th and 6th November 2014. The first part of the workshop consisted of field survey, including visits to orchards and a packinghouse. Problems observed in these sites were discussed scientifically. All project partners participated and had presentations about the topic of the workshop. Those presentation are on the website in form of publications and also as video material (Annex 28, 29, 30, 31, 32, 33 and 34, sent with IR).
2. Scientific symposium about sustainable fruit production (Annex 9, 10 and 11, sent with MR, Annex 12, sent with PR) was held from 21th – 24th March 2016 in Terme Jezerčica, Donja Stubica, Croatia (<http://www.life-susafruit.eu/symposium.html>). Symposium has been attended not only by project partners but also by all other interested scientists, fruit producers and people from agricultural industry. In total, there waere 80 people with 31 oral presentations and 21 poster presentations. All abstracts have been published in Book of abstracts (Annex 13, sent with PR). The purpose of symposium was a broad dissemination of project results. Symposium had three sections: (1) Sustainable pre-harvest technology, (2) Sustainable post-harvest technology, and (3) IPM in sustainable fruit production. Each section lasted for one day and consisted of oral and poster presentations. Separate professional tour to AGRA orchard where SUSAFRUIT project is implemented has been organized.
3. Special issue of Agricultural Conspectus Scientificus dedicated papers presented on the symposium was published online: (http://www.agr.unizg.hr/smotra/acs81_2/index_c.htm) in 2017 (Annex 48, sent with PR).

Action D6.3 Production of other technical and scientific publication

Inm total, 22 technical publications has been produced so far. Results are described in Report on action D6 Production of technical and scientific publications (Annex 21). Researchers,

technicians and other personnel involved in project so far have produced 44 scientific publications, including 7 abstract on Congress, 2 presentations, 2 seminars, 2 posters, 2 bulletins and 27 scientific papers) and one plenary lecture at scientific symposium and organization of project .project symposium “International symposium on sustainable fruit production”. Results are described in Report on action D6 Production of technical and scientific publications (Annex 21).

It was expected to produce at least 3 articles in Italian and 3 articles in Croatian for technicians and farmers and at least 3 articles in in peer-reviewed journals. In total 11 articles were published (6 technical articles in Italian, 5 technical articles in Croatian, and 27 scientific articles in peer reviewed journals, beside many presentations on congresses and other scientific publications).

Together with abovementioned material, two special issues of *Agriculturae Conspectus Scientificus* were produced. One special issue was devoted to Scientific symposium about sustainable fruit production described in sub-action 6.2, and another one was dedicated to sustainable fruit production (<https://acs.agr.hr/acs/index.php/acs/issue/view/78>).

Action D.7 Preparing LIFE+ information boards

Actual starting date: 1/10/2014

Ending date: 31/3/2015

State of the Action: completed

Information boards, which include the LIFE logo and acknowledge EU support, have been made (Annex 4 sent with IR). They are in two languages, Croatian/English and Italian/English. Boards contain general information about the project and they are placed in prominent places at the CB premises. The boards will be installed at the pilot orchards until the end of April, before the experiments start.

Information boards are made. They are in two languages, Croatian/English and Italian/English. Boards contain general information about the project. They are installed in each experimental orchard and on selected packinghouses (Annex 49, sent with MR). We have installed 32 information boards.

4.2. Analysis of long-term benefits

Environmental benefits

Reduction of chemical pressure and of risks for growers are the main environmental benefits. We plan to reduce about 50% of insecticides, and about 25% of chemicals used against diseases and pests with implementing netting system and with usage of hot water machines. Reduction of the agricultural costs and increase of grower's profit in terms of money and energy saved in the exclusion netting system with saving of about 300-500 €/ha for the control of insects. Reduction of at least 60% of pesticide residues due to less insecticide and fungicide treatments, and to the residue removal action of hot water treatment, and

consequently increase of food safety and decrease of risks for consumers and environmental health (lower pollution of water, soil and air).

Promotion and maintenance of high biological diversity in the ecosystem of the orchard. Promotion of the awareness of growers, packinghouses, technicians, advisors, policy makers and general public on sustainable crop protection strategies.

As shown in the results of experiments with anti-insect nets an all experimental sites, as well in postharvest experiments, the project helped to increase fruit quality of both apples and peaches, fruit crops that were targeted by the project, with simultaneous reduction of pesticide usage. Moreover, it become evident from the very beginning of experimental trials in the field, especially in Croatia, that project will have beneficial effect for important predatory insect species, such as ladybugs, which were recorded in abundant number thorough the whole experimental period. These species were photo-documented and shown in picture gallery at the project website (<http://life-susafruit.eu/gallery11.html>). Especially high diversity of *Lepidoptera* (63 species) were recorded in Čakovec experimental site (Annex 8). Some species were photo-documented and shown in picture gallery at the project website (<http://life-susafruit.eu/gallery12.html>).

This undoubtedly proves that implementation of the LIFE.SUSAFRUIT project significantly contributes not only the overall productivity performance of fruit production but also helps in preserving biodiversity in fruit orchards. Decreased pesticide usage achieved using photoselective anti-insect nets, besides helping in biodiversity maintenance, helps in preserving healthy and safe working environment for workers in fruit industry and also increase nutritious value and safety of produced fruit

Directive 128/2009/CE establishes a framework to achieve a sustainable use of pesticides by reducing the risks and impacts of pesticide application on human and environment health, and promoting the use of IPM and alternative approaches to pesticides. Art. 4 requires MSs to develop NAPs designed to reduce risks related to the use of pesticides and to reduce their use wherever possible. Art. 14 requires Member States to take all necessary measures to promote low pesticide-input pest management, giving priority to nonchemical methods. Art. 5 requires Member States to ensure that all professional users, distributors and advisors have access to appropriate training.

Photoselective nets tested and hot water prototype developed in scope of the project significantly reduce pesticide use, thatway contributing to implementation of this Directive and National action plan to achieve sustainable use of pesticides.

Moreover, sustainable fruit production is a top priority for European producers. With the new Regulation on Plant Protection Products (1107/2009) and the Directive for the Sustainable Use of Pesticides (2009/128), many chemical products have disappeared from the European market, creating new challenges for pest and disease control. The promotion of low-pesticide input management, notably IPM and organic farming, has achieved a significant reduction in pesticide use, but the sustainable use of pesticides requires additional efforts to ensure technology transfer.

LIFE:SUSAFRUIT project results showed that photoselective anti-insect exclusiuon net technology and thermotherapy significantly reduce production costs, preserve environment, human health and food safety. At least 3 - 9 insecticide treatments were avoided by using photoselective nets, meaning at least 70 % reduction of use of insecticides.

Pesticide residues were higher in most cases in control orchard than in orchards covered with nets. This directly contributes to the regulation EC No 396/2005 on maximum residue limits of pesticides in food and feed.

Furthermore, LIFE.SUSAFRUIT project results significantly contribute to Directive on Health and safety of workers (Directive 98/24/EC) since reduced pesticide usage, and reduced pesticide residue have a positive influence to the health of farmers, packinghouse operators and retailers and consumers. Decreased use of pesticides directly contribute to decreased pollution of water, soil and air due to lower pesticide usage, which is in line with Water Framework Directive (Directive 2000/60/EC) and Waste Framework Directive (Directive 2006/12/EC).

Long-term benefits and sustainability

Continuation of project activities is described in After LIFE communication plan (Annex 9). Beside planned installation of photo-selective nets on 10 ha of apples and peaches in Croatia, further prototype testing in lose to market (C2M) conditions as well as dissemination to students, growers, technicians, scientific community and extension service workers.

FAZ applied one project proposal with application of photo-selective net technology in strawberry production to call funded by European fund for regional development and managed by Ministry of Science and Education of _Republic of Croatia. Unfortunately, the results of this call should be announced in February or March 2008, but they are still unknown. Total project value is about € 379.000.

LIFE.SU.SA.FRUIT underlines the importance of sustainable fruit production methods both pre-harvest and postharvest phase to ensure protection of environment and increase fruit quality. Sustainable fruit production is a powerful tool to produce safe products and, at same time, it protects and improves the natural environment. Another important aspect is the safety of workers and other personnel involved in fruit production since sustainable fruit production methods significantly contribute to reduced use of pesticide and other agrochemicals.

The project is performing in Croatia and Italy in a total of 17 demonstration orchard sites and 3 packinghouses where sustainable technologies are demonstrated and applied.

According to our results, nets and hot water machines are efficient and it could be used in other countries and for other crops.

Photoselective nets tested within the project showed high potential for commercial application (10 ha of apples and peaches in Croatia will be covered with red net). During project activities four types of photoselective nets were tested, but only on peach, nectarine and apple. However, possibility to apply them on other crops is high, but requires further testing. FAZ has applied one project proposal photo-selective net technology in strawberry production to call funded by European fund for regional development and managed by Ministry of Science and Education of _Republic of Croatia. If project proposal would be approved it

Price of photoselective nets (0,45 €/m²) is a higher than that of standard anti-hail nets (0,25 €/m²). Additional cost also represents covering of the lateral sides, but this practice requires less pesticide treatment (500 €/ha/year savings). When adding higher yield, better fruit quality and environmental benefits of the potoselective nets, in long term view photoselective nets are far better solution, not only in term od production, but also from financial aspect.

Due to the promising results, in Italy there are now Regions that support growers for the implementation of the netting system. Piedmont Region is an example of that.




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| Aperto | Finanziamento |
| Materia: <u>Agricoltura e Sviluppo rurale</u> | <u>PSR 2014/2020 operazione 5.1.1 - BANDO n° 3</u> <u>"Prevenzione dei danni da calamità naturali di tipo biotico causati da Halyomorpha halys (Cimice asiatica)"</u> Il sostegno è rivolto ad investimenti legati alla copertura laterale con reti anti insetto di colture arbustive ed arboree da frutto, a chiusura dell'impianto antigrandine (o reti poggiali preesistente o ammesso a finanziamento sul bando n. 1/2016 dell'Operazione 5.1.2. |

Due to our good results, there is now a big interest for the use of the nets on other crops such as kiwifruit, that, at the moment, in Italy, is seriously damaged by *H. halys*. For instance we are asked by the Zespri enterprise to disseminate our experience to their growers.

Hot water prototype also showed significant potential for commercial use. There are two main benefits of prototype usage: 1) hot water treatment enables longer fruit preservation i.e. it reduces number of funghi spores on the fruit, thatway preventing fruit from decay. In long term view, using hot water treatment could singnificantly lower PHL; and 2) HWT reduces residues of pesticides on the fruit, having benefit for human health.

Well established productive collaboration with Croatian Extension Service will enable long-term dissemination of project results into wide practice. Extension service workers cover entire territory of Croatia and are in contact with farmers on every-day basis. This is guarantee of continuous and direct implementation of project reults in practice.

The LIFE.SU.SA.FRUIT project introduced in Croatian and Italian orchards a new technologies for insect control, the photoselective anti- insect exclusion nets, which can be a reliable alternative to chemical insecticides and also to mating disruption pheromones. The net exclusion technology should be adapted to different agro ecological conditions present in different regions of Europe. The new elements of the projects are represented by the optimization of the colors and mesh of the net exclusion available. Experimental fields are established to demonstrate the control efficacy of exclusion nets.

Against postharvest pathogens on apple and peach, hot water treatments showed efficacy but they are not yet practically used because they need to be improved further for consistency of results.