

Technical actions:

The following was done and achieved:

A1. Scoping of the fruit production area and fruit selection: After having received a proposal from Finca Valleluz, Zerya identified five groups of plots planted with different crops (Peach, Nectarine, Apricot, Flat peach and Cherry) to be used for trials. Plots have an extension of approximately 5ha and are located in the province of Zaragoza. The main selection criteria was the commercial interest of each variety. Two experimental plots to test phytosanitary products and fertilizers and generate a scale of degradation curves indispensable to improve the ZR protocol were also identified. Those plots belong to Seipasa and are located in the l'Alcudia Municipality, Valencia. The production area was then characterized by collecting information on previous management practices and conducting multi-residue and general soil analysis. Action was concluded in early February 2014.

A2. Methodology development of the Zero Residues fruit production: The step by step guide for Zero Residues production was drafted as scheduled by January 2014. It included: the analysis of potential pests and diseases; the recommended phytosanitary protocol; the list of allowed fertilisers; and a preliminary list of the global regulations and standards for the ZR methodology. With the results of the 2014 season, new measures were adopted in 2015, aiming to avoid the persistent substances and reinforce all the preventive treatments and practices. To this end, action A2 progressed in parallel with Action B2 until March 2015.

A3. Characterization of required quality aspects of the fruits. Preliminary shelf-life studies: Internal procedures to be applied by PCTAD, Unizar and TOP in order to evaluate quality aspects and conservation of stone fruits produced under the ZR methodology were defined, including: a) protocol for sampling and laboratory procedures; b) set of protocols to evaluate quality of stone fruits; and c) protocol to evaluate shelf life of stone fruits. A list of available and accredited laboratories to perform the different analysis was also drafted.

A4. Planning the post-harvest technologies to be applied: The planning of the post-harvest technologies to be applied involved several tasks, namely: storage, shelf-life analysis, fruit quality assessment; panel tests; pulping of fruit. Steps and responsibilities for the post harvest process were defined by the partners involved: Unizar, PCTAD, Top and Lafuente. The calendar of the post harvest process with a schedule of the analysis to be implemented in the 2014 campaign was prepared and delivered with the IR. The same approach, adjusted to real harvesting dates, was adopted in the following campaigns. The protocol to evaluate the respiration rate of stone fruit, as well as the procedure to wash, de-stone, pulp and pascalise the discarded product was defined.

A5. Market research stone fruits: The market research consisted of a theoretical (online) part and an interactive (field research) part. Interviews were conducted, either in person or by telephone, following questionnaires specifically tailored to each target group. The interviewed sample includes: 5 experts in the agricultural and commercial fruit sector; 4 important purchasers; 1 cooperative of fruit producers; 450 consumers; 5 supermarkets; 1 baby food company. Results were gathered in a report and confirmed that panels are significantly positive towards “healthy” stone fruits and supermarkets are interested for testing the market potential in their facilities (under Action B7).

B1. Application of Zero Residues methodology for stone fruit production: The application of the ZR methodology for stone fruit production involved several tasks:

- Training: in January 2014 Zerya and Seipasa delivered the course “Basic Concepts of Zero Residues in Stone Fruit Production”, addressed to project participants. Training course materials were then updated to cover the evolution of the pests and diseases.
- Land and trees preparation. It consisted essentially in soil management and fertilization. Organic fertilizers and botanicals were applied according to the different stages of the different fruit trees, based on Seipasa’s advice and soil analysis results. Technical support to

fertilization decisions was also provided by an external company (AGQ) by means of sensors determining the concentration of nutrients available. Further sensors, installed by subcontractor Savesa in March 2014, measured the moisture of the soil, as to optimize irrigation and water consumption. Trees preparation (pruning, pricking, etc.) was done before the start of the season, as to ensure optimal growth during the campaign.

- Growth development. Within this task, Zerya developed a software application in order to monitor the environmental factors at Finca Valleluz and support technical decisions during production. The application became fully operational in October 2014. As of the fitosanitary treatments, during the season 2014-2015, SEIPASA designed and performed a trial to compare conventional fitosanitary treatment with a ZR treatment, as well as other comparative trials aimed at assessing the different management practices. During the campaign 2015-2016, the application of the ZR methodology continued both in Finca Valleluz and in the replica run by SEIPASA. Due to changes to the phytosanitary legislation, during the last season the applied methodology had to be updated.
- Fruit quality and multi residue analysis. The evolution of the growth and quality of the production were assessed by PCTAD against commercial, physiological (respiratory activity and ethylene production), microbiological and nutritional parameters. Likewise, in order to verify the presence or absence of chemical residues, as well as compliance with the criteria required in the ZR protocol (<0.01 ppm), PCTAD conducted the multi-residue analysis of the 6 fruits selected at the time harvest. In addition, samplings to allow for soil conventional and multi-residues analysis (C1) were performed.

B2. Certification process: According to Zerya's General Regulations, one year of conversion and control is required before starting the auditing process to obtain the ZR certification. This process started with the 2014-15 campaign, incorporating to the operative procedures of Finca and Lafuente the recommendations provided by Zerya. At the same time, the ZR certification protocol was revised and upgraded for stone fruit production, with the support of an external specialized certification company. Finca Valleluz (as production company) and LaFuente Tomey (as handling site) were successfully audited and obtained certification, with validity 27/10/2015 to 26/10/2016, then extended until 26/10/2017.

B3. Harvest, pre-selection and first storage: Harvest, preselection, transport and first storage activities were conducted in close collaboration by Lafuente and Finca Valleluz. Firstly, the criteria to determine optimum harvest dates for the various species were defined. Fruit was harvested between May and September each year by harvesters trained on the correct picking and preselection of fruits, as well as on food industry regulations. Products were transported from the plots to Lafuente's facilities, where they were identified as to ensure traceability, underwent a process of rapid cooling and were stored in refrigerated chambers. Unizar and PCTAD were constantly kept informed about harvesting dates, as to arrange the pick-up of fruit to be analysed. Of the fruit harvested during the first campaign, only cherry and peaches met ZR standards, while during the second and third campaigns all the harvest met ZR standards. Due to unfavourable weather conditions, a decrease of harvested quantities was registered in 2015 and 2016.

B4. Application and optimization of post-harvest technologies: The application and optimization of post-harvest technologies involved several tasks, including:

- Long term storage, started in May of 2014. In addition to the low temperature storage, the effect of controlled atmosphere was assessed. To have an overview of the state of the art on this issue, TOP performed extended literature studies. Results of first experiments showed the need to make adjustments to the Palliflex prototype system, which was modified and calibrated until steady measurements were possible. In the first half of 2016 TOP performed several test trials, including quality evaluation in collaboration with Unizar, PCTAD and La Fuente. All the assays were performed under refrigeration during at least 21 days, keeping a control batch. After this, fruits were kept at room temperature during 2 or 3 days to simulate the commercialization period.

- Shelf-life studies. The respiratory rates of all the fruit varieties were determined during the 2014 and 2015 campaigns in order to select the appropriate microperforated packaging. Trials simulating transport and commercialization conditions of packaged stone fruits were then performed, as to assess shelf-life and quality features. The gas concentration (O₂ and CO₂) within the packaging was measured twice a day by Unizar/PCTAD.
- Fruit quality. In order to determine the postharvest life several fruit quality analysis were carried out. These analyses were performed by UNIZAR on day 0 and periodically after harvest. A sensorial analysis was also carried out and the nutritional value of each fruit was determined by PCTAD.

The effectiveness of the post-harvest technologies varied according to the product type. The microperforated films positively influenced the cherry shelf life when exposed to room temperature. The controlled atmospheres (CA) with cold temperature (4°C) with moderate O₂ and high CO₂ favoured nectarine and apricot preservation, increasing shelf life by 7 and 5 days, respectively. Palliflex allowed an increase in shelf life of up to 2 days for apricot and 1 day for peach when stored at room temperature.

B5. Test of washing method, pulp production and High Pressure Processing (HPP) for baby food producer: During the first campaign various preliminary tests were conducted on cherry, nectarine 603 and peach GC-58, to evaluate the effectiveness of different washing conditions to sanitize and remove any residue present in fruit. During the 2015 campaign, two different washing methods were then optimized: electrolyzed water and chlorine dioxide. Furthermore, PCTAD, UNIZAR and LAFUENTE performed preliminary assays of the high pressure treatment for pulp production on nectarines, peaches and flat peaches. These activities allowed to design all the steps for fruit preparation (washing, peeling, stone removal and pulping), to select the proper packaging (suitable for HPP treatment) and format (200g of pulp) and define the most effective HPP treatment conditions (600MPa/3min). In the following campaign, the designed process was validated at industrial level and a shelf life study under refrigeration was performed. For each of the developed products, a technical product sheet was then drafted and sent to different companies of the sector to evaluate their acceptance, with positive results. Finally, the fruit pulp was offered for tasting to children of 3 to 6 years. Notwithstanding the bankruptcy of the partner Chez Pascal, who was supposed to play a significant role in this action, results were achieved: the combination of the washing method and the HPP treatment effectively allowed to eliminate waste of discarded fruit by 80%. In all cases, fruit pulp presented < 0,01 ppm of any residue.

B6. Verify (perceived) quality aspects of fruit by consumers (test panels): The quality of the fruit perceived by consumers was assessed through a set of test panels to carry out the organoleptic assessment of the fruits. After an assessment of the individual sensory aptitudes, determined through acuity tests based on aroma recognition and identification of basic tastes, a group of 11 members from PCTAD and UNIZAR was created in early 2014. Each year, from January to mid-May, the panel of tasters was trained as to be prepared for the measurements done during the summer session. For each attribute (visual aspect, aroma, taste and texture) as well as hedonic preference, data were compiled and the average scores by assessor and fruit replicate were calculated. This data was represented in the form of spider-type charts. As a general conclusion it can be said that fruits delivered under the described ZR methodology and postharvest technologies, showed a remarkable sensory quality during a longer period, which is translated in an improved sensory shelf life.

B7. Market evaluation and commercial testing in supermarkets: The market evaluation and commercial testing organized by Transfer were divided in two parts: Part I consisted of a series of in-depth interviews carried out with retailers from the supermarkets in The Netherlands (Rotterdam) and in Spain (Zaragoza). Part II of the market research consisted on product tests carried out in the 2 Dutch and 1 Spanish supermarket, respectively in May 2015 and September 2016. In the campaign in The Netherlands, two pallets of cherry were entirely sold, while in the Spanish campaigns peaches were offered for tastings to the consumers who had bought any fruit

or vegetable. POS materials were developed for both campaigns to maximise visibility. The formulation of the market objectives and of the market strategy was concluded after evaluating the consumer and retailers reactions.

C1. Maintenance, control, technical monitoring: The technical monitoring of the tasks throughout the project was done by regular contact (meetings, email, telephone, videoconference, etc.) with and among the different partners involved within an action, focusing on three main strands of actions: 1) land preparation and maintenance; 2) controlling and monitoring of the ZR methodology development and implementation; 3) fruit sampling for laboratory analysis and post-harvest trials. In coordinating the activities, UNIZAR particularly veiled for: having a global view on the project and on the main problems raised; managing the different priorities and ensuring the smooth completion of each task; maintaining effective communication and flow. Expected concerning compliance with ZR standards and decrease of residues chemicals in the soil were achieved. The progress of activities was summarized by UNIZAR in 2 interim monitoring reports, issued respectively in May 2015 and November 2016.

C2. Final technical evaluation and Monitoring of socio-economic impact of the project: The socio-economic study, draft by UNIZAR's subcontractor Geadvance, screened several variables related to the geographic, demographic, social and economic situation of the area concerned by the project (Zaragoza neighbourhoods). The work also includes the surveys conducted on agro-food retailers, farmers, confectionary industries and local population. Results highlighted the two strongest aspects regarding the perception of the ZR Project: human health and environmental sustainability. Findings of the socio-economic report, together with the technical information produced throughout the project, were integrated and analysed in a Final Technical Evaluation Report, draft by Zerya.

C3. Conclusions & Guidelines: A "Conclusions & Guidelines" report has been prepared. For this purpose: goals and targets set in the project have been compared with experimental results; a stakeholder consultation based on enquiries to all involved partners was performed; results from the market evaluation were taken into account. The report addresses the answer to 16 main questions divided into two parts:

- PART 1. Conclusions regarding the implementation of the ZR protocol in stone fruit and the application of post-harvest technologies for shelf-life improvement.
- PART II. Conclusions regarding the consultation of agents from the production and distribution chain of certified ZR fruit and consumers' perceptions.

TRANSFER has sent the conclusions report together with the layman's report to almost 1.000 emails.

D1. Project website: The project websites were launched in the second week of October 2013, one in English and one in Spanish. A project summary in Dutch was uploaded onto both sites under News/Downloads. Website traffic was significant during the execution of this project (15/10/2013-15/06/2017), reaching a total of 15,534 unique visitor and 23,998 sessions. Furthermore a Facebook subpage, managed in Spanish, and a you tube channel were created. 18 videos on the project were uploaded. We are also active on Twitter and Google+.

D2. LIFE+ information boards: Notice boards were placed at partners' offices by mid-November 2013. The 2 bigger notice boards for the demonstration sites were placed as soon as there was some project activity going on (i.e. at the end of December).

D3. Layman's Report: A bilingual Layman's report was produced in 500 paper copies and presented in occasion of the final conference, where 100 were distributed. Remaining copies were divided among partners. It contains a description of the objectives of the project, of what has been done, and of the main technical results and conclusions. The report also gives contacts to allow people interested in replication of the ZR agricultural method to reach project partners. It was draft by Transfer, who shared the draft with the partners and implemented proposals for improvements.

D4. General Dissemination: Several activities were conducted to disseminate project activities and results including:

activities were conducted

- the organization of one inauguration event, one technical seminar and one final European conference. The latter was held in Zaragoza and included a visit to the test location. 100 participants attended;
- the presentation at international seminars of 5 Posters
- 11 presentations on national / international congresses with an estimated public of 3.565 attendees
- 12 presentation to interest groups, with an estimated public of 15.660 attendees
- 5 participations in other events
- 56 publications in written press or television or radio
- the production and distribution of leaflets and brochures in English and Spanish (3.000 in total)
- 1 mobile application (QR code)

D5. Local Awareness: Dissemination activities were also complemented by a set of actions specifically aimed at raising awareness on project activities and aims at local level. Those include:

- 1 Special invite visits for local farmers' organizations and regional environment groups
- 1 presentation to a regional interest group, the vegetal sector of Aragón
- 2 nights of the researchers
- 6 educational visits targeting University students
- 2 sweepstakes competitions, with travels to Spain/Holland to visit project partners offered as a price
- 2 Special invite visits at Lafuente for local fruit producers

E13. Networking: The Consortium presented the project in different events, which resulted in significant networking among diverse stakeholders interested in food quality, sustainable food production and supply chain. The project has had contacts with in total 20 other LIFE projects. Cooperation activities have focused on dissemination of the project objectives and results (like with SaveCrops) but also in seeking synergies and actions that can benefit diverse stakeholders, going in several cases beyond just the transfer of knowledge: technologies developed in a project have been or will be implemented in another, contributing to the achievement of the latter project's objectives and finding meanwhile new test environments or future exploitation opportunities for the first. This was especially the case with the collaborations with Crops for better Soil, Freshbox, Rewind and Laser Fence.

E14. After LIFE: The development of the AFTER LIFE communication plan was coordinated by Transfer with inputs from the partners. The plan outlines how project partners will disseminate and communicate the results of Zero Residues during the following 5 years.