Preventing HLB epidemics for ensuring citrus survival in Europe

[D2.1] Technical data sheets and training materials for farmers

Deliverable No.	2.1	Work Package No	2	Task/s No.	2.2
Work Package Title	DEVELOPMENT OF SHORT-TERM PREVENTIVE MEASURES				
Linked Task/s Title	Creation of an early warning system and improvement of the contingency plan at EU level				
Status	Final			(Draft/Draft Final/Final)	
Dissemination level	PUBLIC			(PU-Public, PP, RE-Restricted, CO-Confidential)	
Due date deliverable	30/08/2020	Submission date	17/12/2020		
Deliverable version	V3				

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FIGURES LIST

1 Actions related to creation of technical data sheets for farmers on the detection of the insect vectors *Trioza erytreae* and *Diaphorina citri* and symptoms of the disease.

The main objective of these actions was to create awareness about the existence of HLB in EU as widely known as possible, mainly among farmers. Different activities related to the detection of the insect vectors *Trioza erytreae* and *Diaphorina citri* and symptoms of the disease have been carried out during the first period.

The first step was to design leaflets, visual files, and stickers. Below, it is shown a diptych created in the scope of this action with images of the vectors and their symptoms to facilitate their identification (Figure 1). It is a plasticized document to make it more resistant to dust, folds, humidity, among other external agents. The idea of this material is that farmers hang it or hook it where the pin is so that they become familiar with the vector and the first symptoms of it.

These materials have been distributed among the farmers so that they always have this tool at hand. They have been written in Spanish, but translation to more languages is planned to reach Italian, French and Portuguese farmers.

Figure 1. Plastic-coated diptych

On the other hand, an open-source platform and mobile app is being developed, as an early warning system. It is an informative mobile application, by which, and through the mobile camera and with the help of artificial intelligence (AI) can convey warnings of possible symptoms or the presence of the vector (Figure 2). This mobile application will be equipped with geolocation, news, etc.

It is worth mentioning that numerous meetings have been held with mobile application companies to design the early warning application. This application, in addition to familiarizing the sector with the vector and the symptoms of the disease in the tree, allows the user to take photographs that, with the help of AI, can detect a possible vector or a leaf with similar symptoms. In case of a positive match, the application itself will send this information (location and possible threat) to a technician of the plant health department of the competent administration.

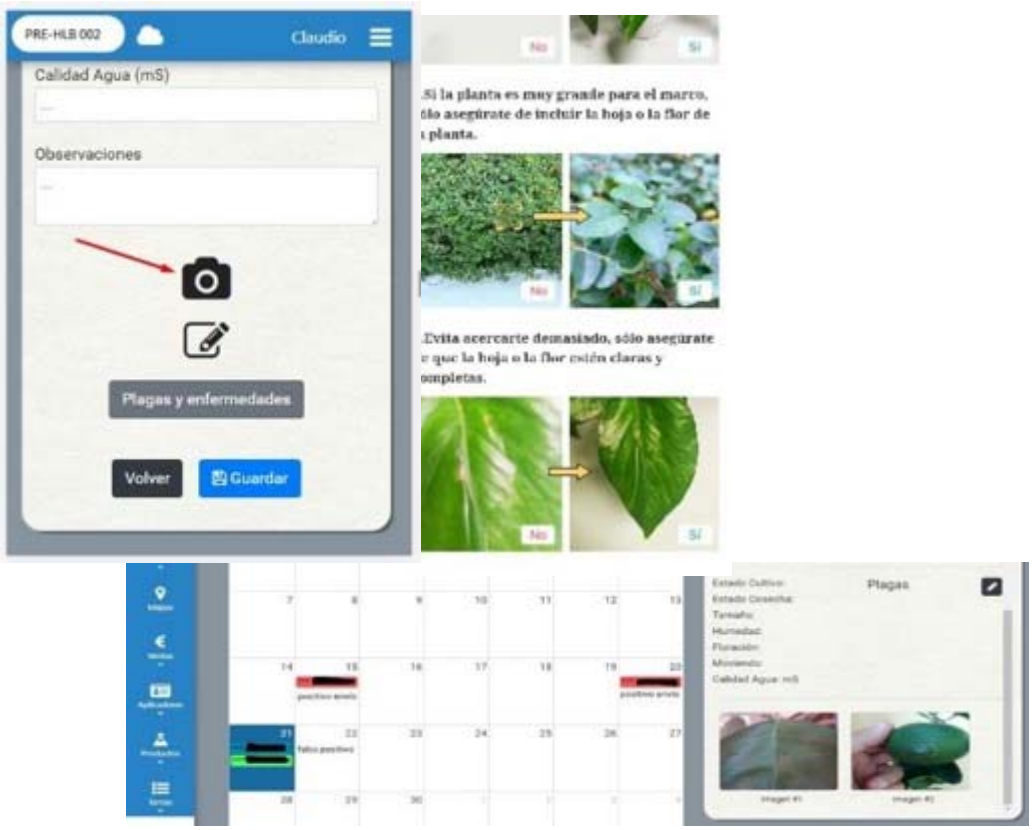


Figure 2. Mobile App

It is also important to mention in this section the creation of numerous practice abstracts, designed to embody practical information related to disease (symptoms recognition, economic consequences in affected regions, detection in the EU, etc.) and vectors (recognition, symptoms, dispersal, etc.). In addition to the above, the practice abstracts contain different recommendations aimed at knowing and recognizing the vectors and the disease itself, to prevent its appearance and to promote the knowledge of it.

On the other hand, it is necessary to include in this point, the creation of the web page of the project (https://www.prehlb.eu/), designed and updated about HLB status and regulation in EU, and to find the latest research results to fight against the disease.

2 Actions for the elaboration of training material for each specific target groups (farmers, nurseries, agronomists, local governments…).

Because the first measures proposed in the Pre-HLB project are informative, to raise awareness of the existence of HLB and its aggressiveness, as well as to train citrus growers in the identification of symptoms, the actions within this section have consisted of the design, translation and print of leaflets, posters, roll-ups, technical data sheets and training materials.

All the training material designed contains the following key items: Project Logo, H2020 logo (financing), Project name, Project partners and social networks.

In addition, efforts have been made to adapt the materials in terms of language as much as possible to the target audience, making it easier in the case of farmers, and in terms of specific topics.

Below (Figure 3) it is shown some of the designed training material:

Roll-Ups designed and printed

Figure 3. Roll-ups designed

Triptych designed and printed

Below (Figure 4) it is the triptych designed in English, which was also translated into Spanish:


OPERATIONAL OBJECTIVES
Establish short-term preventive actions to monitor vector spread and risk of HLB invasion in the EU, to establish efficient control measures and to set up an HLB information and communication network to discuss PRE-HLB results with phytosanitary authorities to facilitate the development and implementation of a new EU health policy.
Setting up medium-term mitigation actions to reduce the spread of psyllid/HLB via rapid interventions, through analysis of the insect interactions to understand the biology of the vector/disease, development of vector/bacteria detection and integrated pest management strategies, and data—and model—based risk assessment tools adjusted to the EU and associates.
Implementing long-term avoidance actions by biotechnological approaches, including exploitation of resistance to HLB-causing bacteria or to insect vectors, generation of genetic resistance to them, and development of new biocontrol agents.

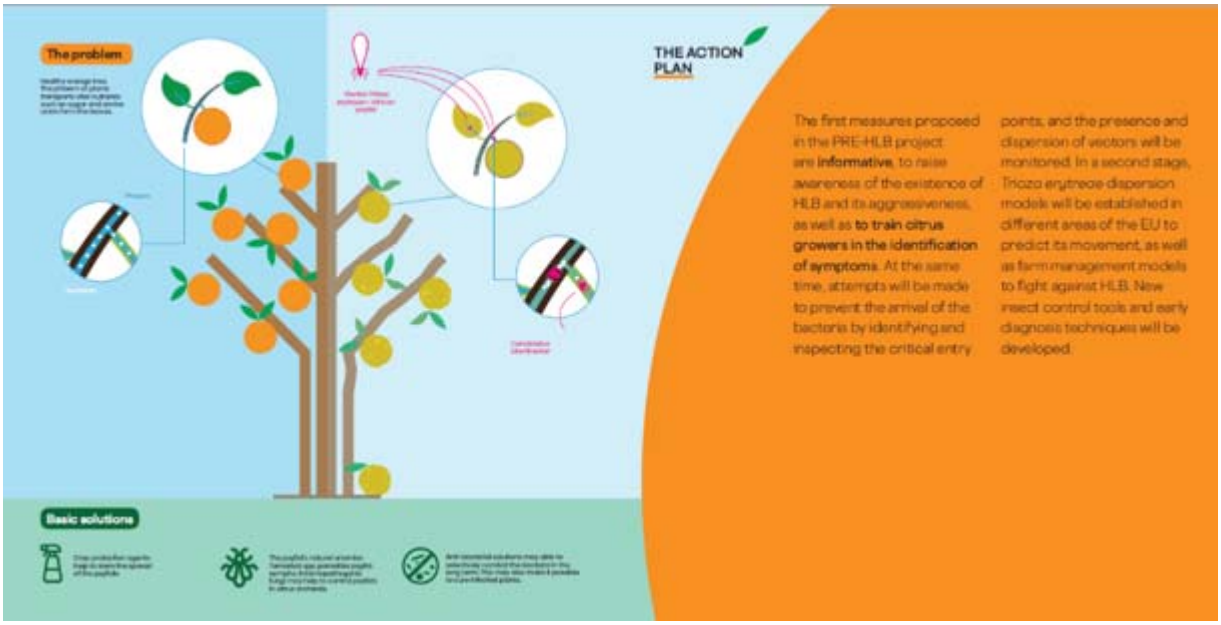

The problem
THE ACTION PLAN
The first measures proposed in the PRE-HLB project are informative, to raise awareness of the existence of HLB and its aggressiveness, as well as to train citrus growers in the identification of symptoms. At the same time, attempts will be made to prevent the arrival of the bacteria by identifying and inspecting the critical entry points, and the presence and dispersion of vectors will be monitored. In a second stage, Tricoa erytreae dispersion models will be established in different areas of the EU to predict its movement, as well as farm management models to fight against HLB. New insect control tools and early diagnosis techniques will be developed.
Basic solutions

Figure 4. Triptych designed

Design of tools for presentations

Finally, it is worth mentioning the design of the presentations used for the different events that take place. As an example see Figure 5:

Figure 5. Presentations designed

Project Website and Social Media

The project website is as follows: https://www.prehlb.eu/

This open web data platform is designed to share the most relevant milestones related to research publications, fact sheets, protocols, crop management strategies, disease database, bibliography and legislation available worldwide.

This website is continuously updated, and the different news and relevant facts within the project are published.

Below (Figure 6) you will find a screenshot of the “news” section of the website:

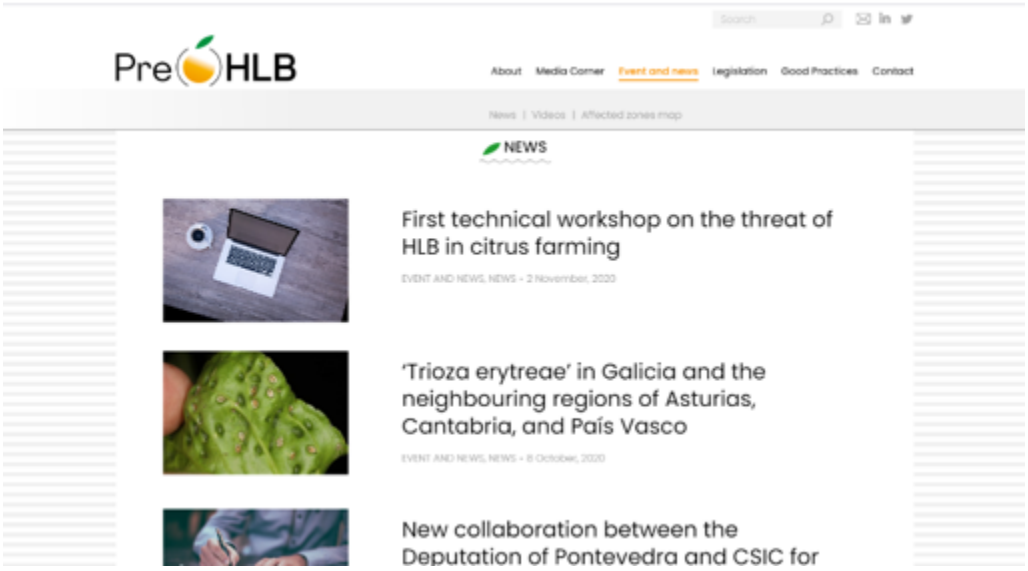


Figure 6. Project Website

In addition, the group disseminates the project and the different activities carried in social networks, such as twitter (https://twitter.com/PreHLB, Figure 7):

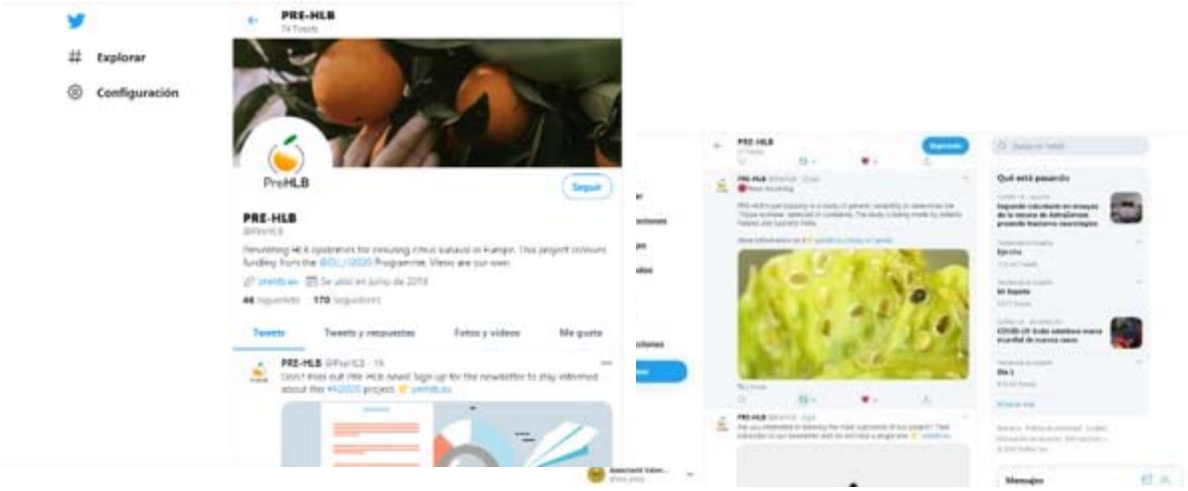


Figure 7. Twitter of the Project

3 Discussion with farmers and regional governments of the technical and training materials previously created.

Throughout this time, different workshops have been held to discuss with farmers, regional governments, and other relevant actors the technical and training materials previously created. Furthermore, these events served to increase the awareness about the existing issue and its challenge, and about the project being developed, PRE-HLB.

It should be noted that, both during the sessions and, mainly after their completion, feedback was collected from those attending the sessions, to validate the usefulness of the training materials and the information provided.

Some of the aspects that have been reviewed in these workshops are listed below:

- Legislation that regulates the activities, both preventive and those that are carried out in the case of the presence of the disease in the territory.
- Explanation of the symptoms produced by the disease and its causal agent. The exhibition of all the preventive measures that are already carrying out, as well as the monitoring network for the control of *Ceratitis capitata*.
- Interpretation of photos of different symptoms, emphasizing the need to recognize the symptomatology of the disease to be able to differentiate between the foliar symptoms it produces, and the symptoms caused by different nutritional deficiencies that can lead to confusion.
- The main characteristics and differences of the 2 known vectors of HLB, *Diaphorina citri* and *Trioza erytreae*, the symptomatology that they cause and their damages.
- An explanation on the management of the disease and the actions that should be done in the event that it is detected, both for the case of having vectors without HLB present, or the case of having HLB in the absence of vectors or the case of having both vectors and HLB, all of them aimed at eradication.

In this context, different sessions have been held, some of which are discussed below:

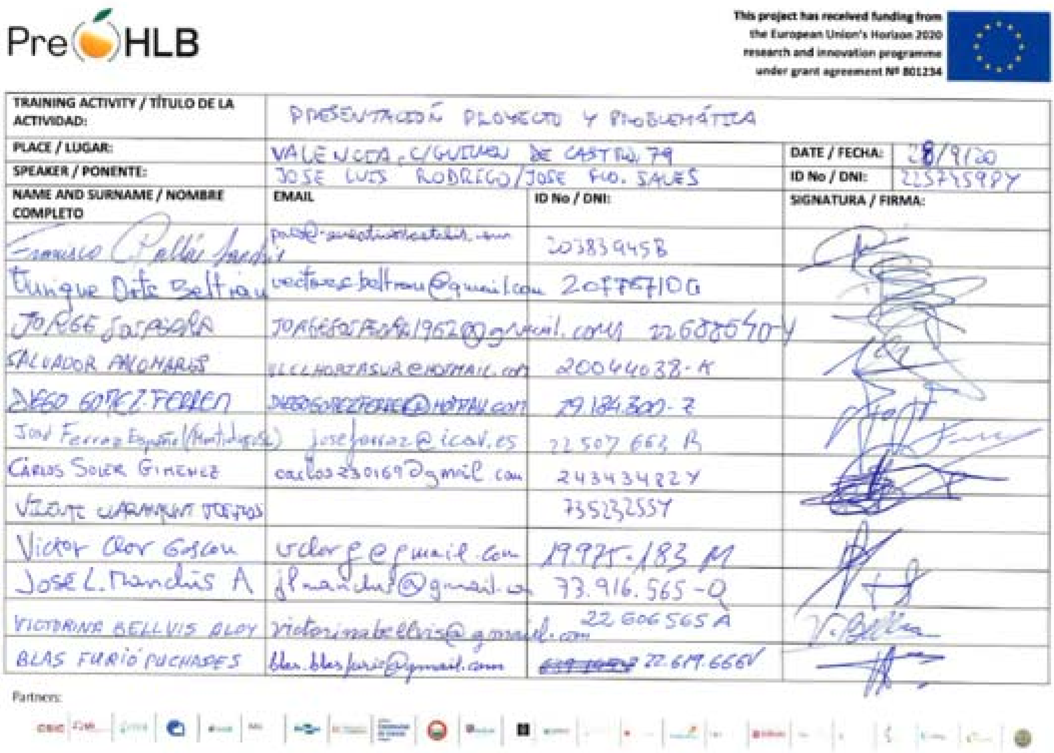
Presentation of the Project and the HLB issue in the Citrus Sector Session (28/09/2020)

Place: Asociación Valenciana de Agricultores (A.V.A.) facilities (Valencia, C/ Guillem de Castro 79, Valencia, Spain)

Date: 28/09/2020

The session that took place in A.V.A. facilities on September 28, was directed to citrus growers, among which are representatives of producers, marketers, cooperatives, industry, etc., a very relevant target audience within the scope of this project. A total of 14 people attended this session due the capacity limitations generated by the Covid-19 situation. Representative photographs (Figure 8) and signature sheets (Figure 9) are shown below.

Figure 8. Pictures taken during the session of September 28


Pre HLB

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TRAINING ACTIVITY / TÍTULO DE LA ACTIVIDAD:	PRESENTACIÓN PROYECTO Y PROBLEMÁTICA		
PLACE / LUGAR:	VALENCIA, C/GUILLEM DE CASTRO, 79	DATE / FECHA:	28/9/20
SPEAKER / PONENTE:	JOSE LUIS RODRIGO / JOSE FCO. SALES	ID No / DNI:	22575599Y

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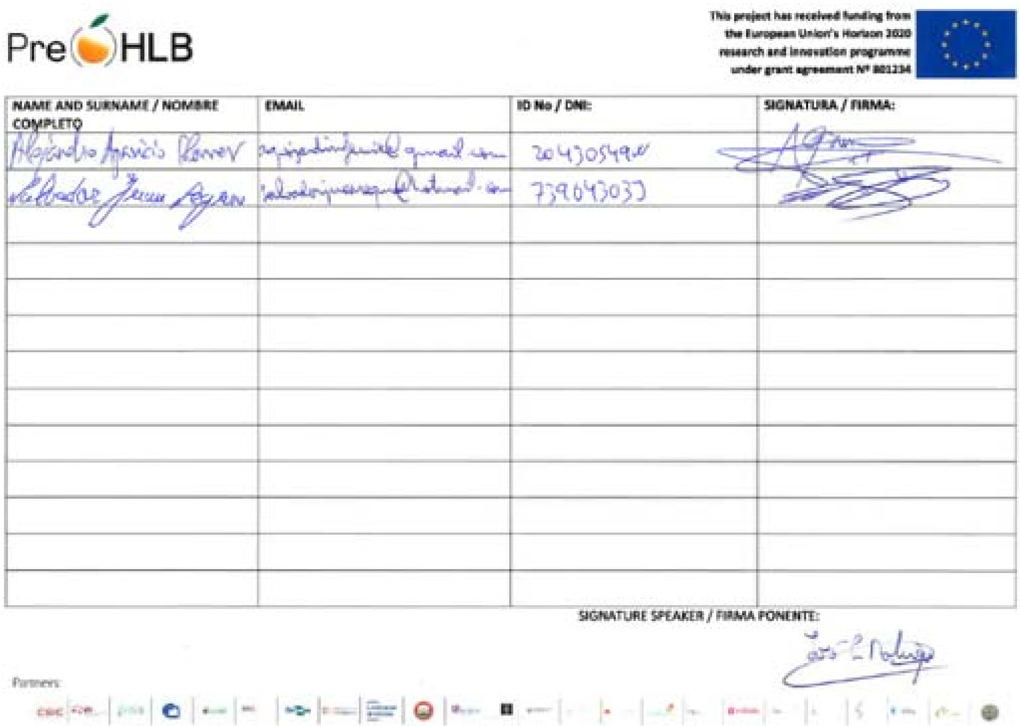
Pre HLB

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Figure 9. Signature Sheet of the session of September 28

Presentation to Citrus Growers (20/10/2020)

Place: Pego, C/ San Eloy

Date: 20/10/2020

The session that took place in Pego (Valencia, Spain) on October 20, was directed to citrus growers, a very relevant target audience within the scope of this project. The capacity was reduced due to the exceptional conditions of the Covid-19, thus a total of 8 people attended this session. Representative photographs (Figure 10) and signature sheets (Figure 11) are shown below.

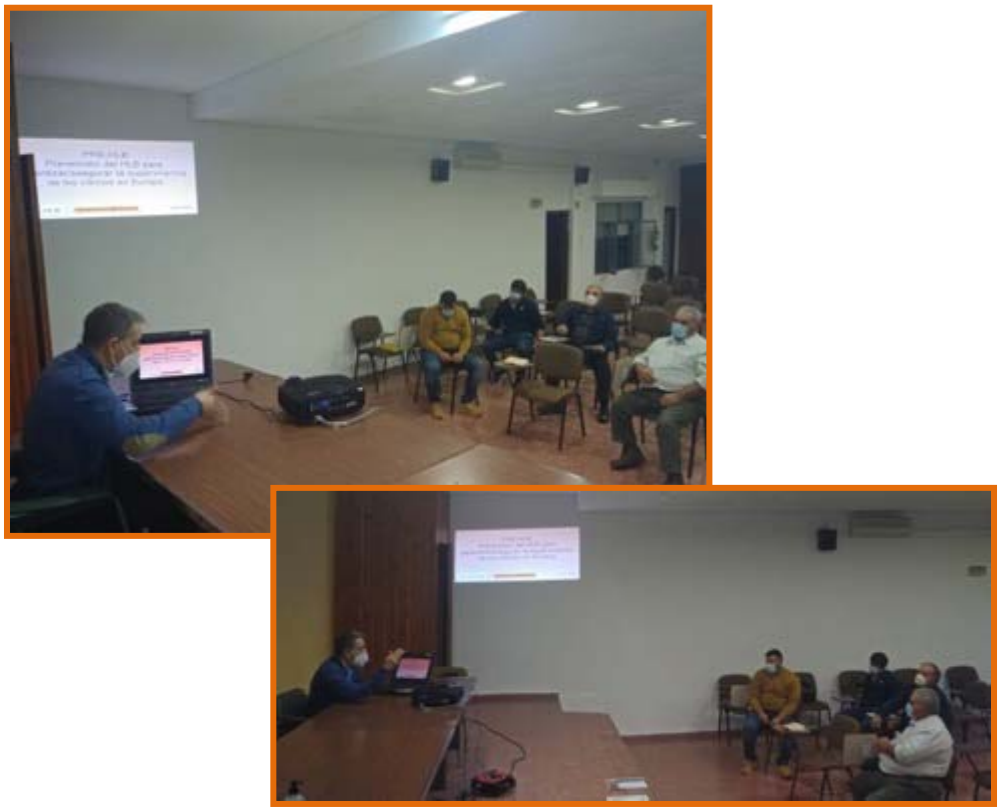
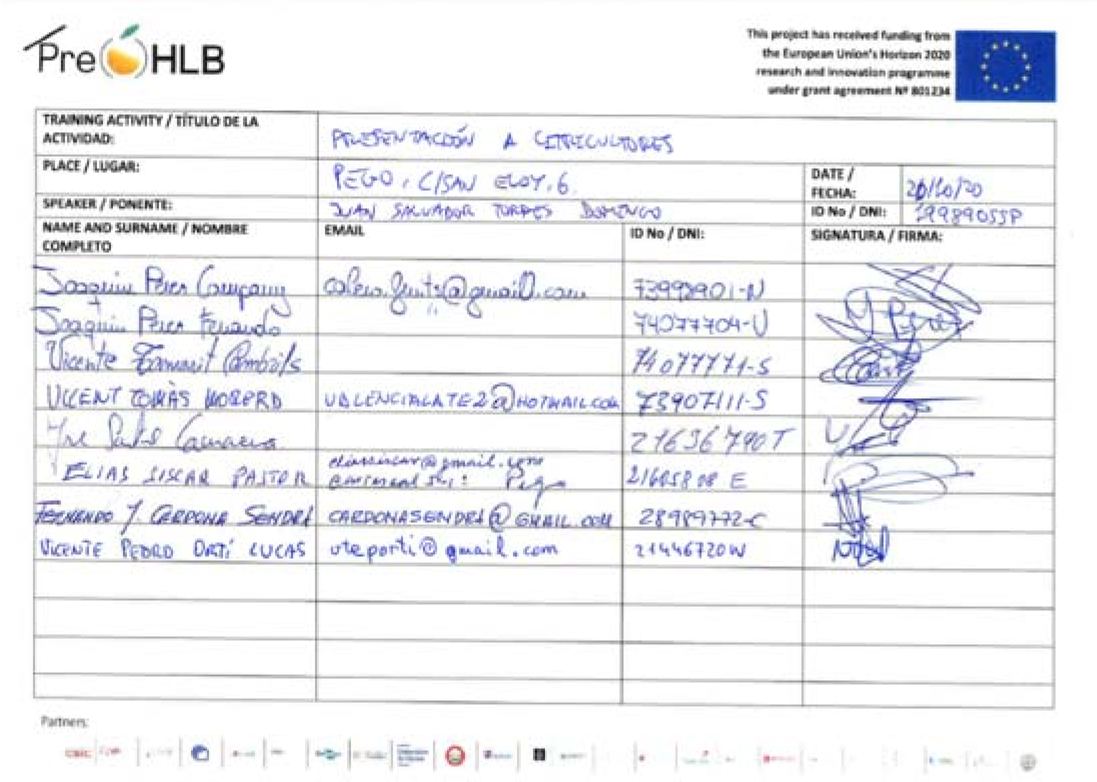


Figure 10. Pictures taken during the session of October 20



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TRAINING ACTIVITY / TÍTULO DE LA ACTIVIDAD:	PRESENTACIÓN A CITRICULTORES			
PLACE / LUGAR:	PEGO, C/SAN ELOY, 6		DATE / FECHA:	20/10/20
SPEAKER / PONENTE:	JUAN SALVADOR TORRES DOMINGO		ID No / DNI:	29989055P

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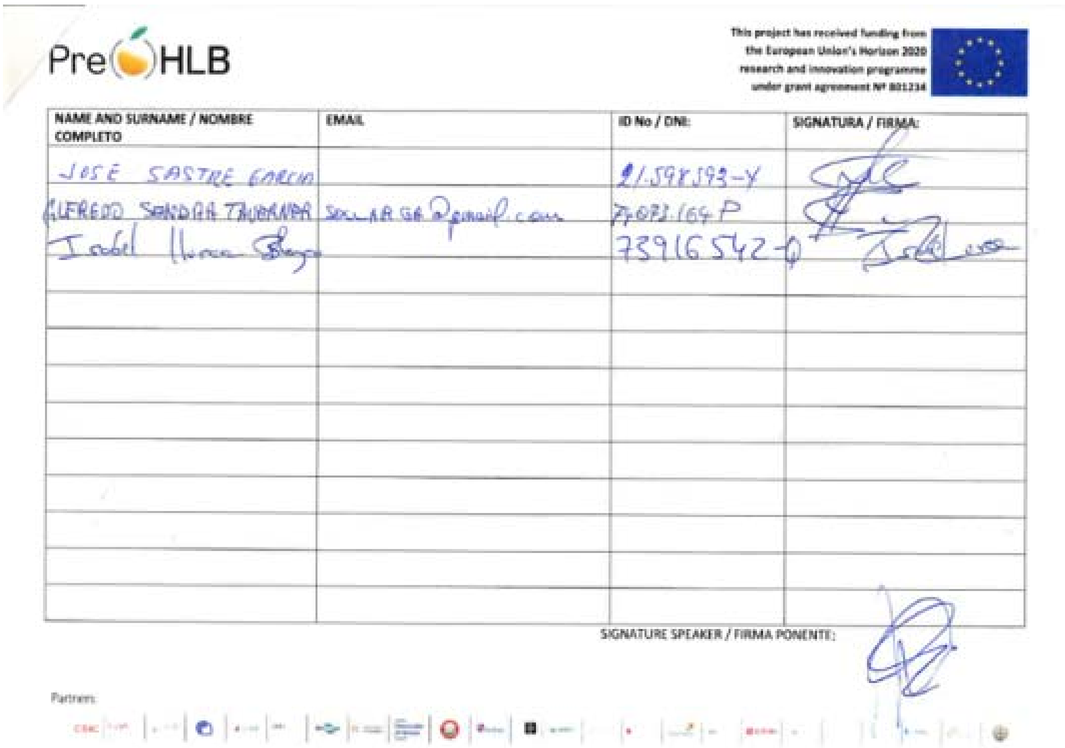

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Figure 11. Signature Sheet of the session of October 20

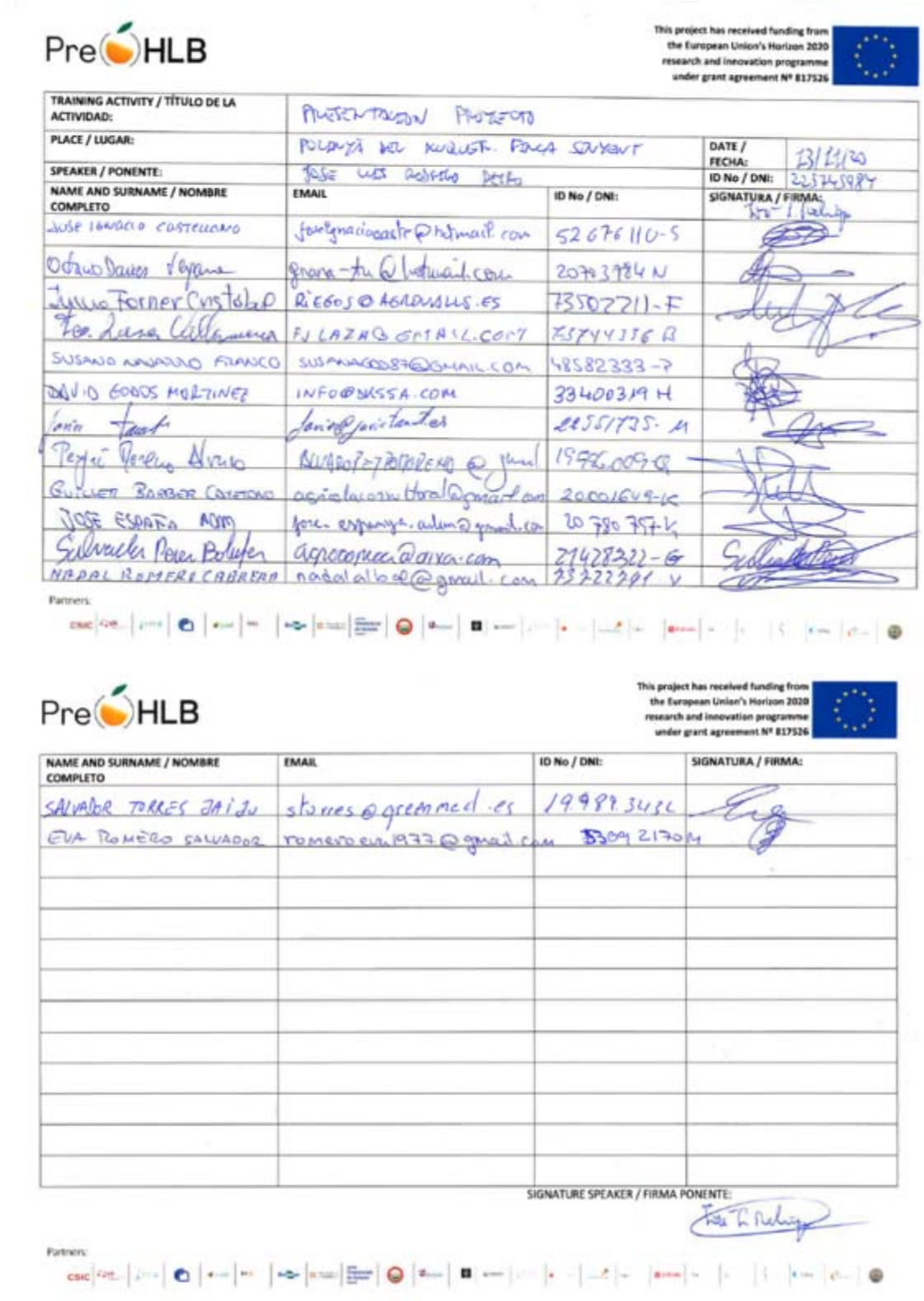
Presentation to Actors of the Insurance Area (12/11/2020)

Place: Finca Sinyent

Date: 12/11/2020

The session that took place in Finca Sinyent (Valencia, Spain) on November 12, was directed to actors of the insurance area. A total of 14 people attended this session due the capacity limitations generated by the Covid-19 situation. Representative photographs (Figure 12) and signature sheets (Figure 13) are shown below.

Figure 12. Pictures taken during the session of November 12



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TRAINING ACTIVITY / TÍTULO DE LA ACTIVIDAD:	PRESENTACION PROYECTO		
PLACE / LUGAR:	POLIGONO DEL KUBOTE PARCELA SOLVENT	DATE / FECHA:	13/11/20
SPEAKER / PONENTE:	JOSE LUIS ROSTRO PEREZ	ID No / DNI:	22374598Y

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PreHLB

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Figure 13. Signature Sheet of the session of November 12

Presentation of the Project to Citrus Growers of Castellón (13/11/2020)

Place: Vilavella

Date: 13/11/2020

The session that took place in Vilavella (Castellón, Spain) on November 13, was directed to citrus growers in the area of Castellón, a very relevant target audience within the scope of this project The capacity was reduced due to the exceptional conditions of the Covid-19, thus a total of 12 people attended this session. Representative photographs (Figure 14) and signature sheets (Figure 15) are shown below.

Figure 14. Pictures taken during the session of November 13

Pre HLB

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TRAINING ACTIVITY / TÍTULO DE LA ACTIVIDAD:	Presentación proyecto		
PLACE / LUGAR:	CA VILAVELLA (CASTELLÓN)	DATE / FECHA:	13/11/2020
SPEAKER / PONENTE:	Adrián Lobo Salvador	ID No / DNI:	20485648-R

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Partners:

Figure 15. Signature Sheet of the session of November 13

1st WEBINAR ON "THE HLB. TECHNIQUES AND CONTROL OF PLANT MATERIAL" (AGROAMBIENT)

Figure 16. Poster for the dissemination of events

The Ministry of Agriculture, Rural Development, Climate Emergency and Ecological Transition, within the PRE-HLB Project, "PREVENTING HLB EPIDEMICS FOR ENSURING CITRUS SURVIVAL IN EUROPE" framed within the HORIZON 2020 program, held on November 10 and 11, 2020 the first technical workshop, with webinar format, on "THE HLB. TECHNIQUES AND CONTROL OF PLANT MATERIAL". This course has been aimed mainly at technical personnel related to the production and handling of plant material and in it we have had the participation of qualified professionals.

The attendance on November 10, 2020 was 74 people connected and on November 11, 69 attendees. Each of the speakers and a review of the content of their presentations are detailed below (Figures 17-22).

November 10 courses

The first presentation on November 10, 2020 was given by PhD. Ester Marco, Researcher at the Center for Plant Protection and Biotechnology of the Valencian Institute of Agricultural Research (IVIA). The doctor made a presentation on the "Generalities of the disease and its current situation", and explained its most characteristic symptoms, the current situation in Spain and in other countries

where it is already present, the diagnosis and detection techniques and control strategies, both against the bacteria and against the vector.

Figure 17. PhD. Esther Marco course

The second presentation was given by Mari Carmen Vives, PhD in Biological Sciences from the University of Valencia. She is currently responsible for the Citrus Sanitation, Quarantine and Certification Programs of the Valencian Institute of Agrarian Research (IVIA). Ms. Vives gave her presentation on “Sanitation, Quarantine and Certification of plant material”, exposing the prevention measures against HLB, the Sanitary Improvement Program for citrus varieties established since 1975 and the entire process of quarantine and sanitation of citrus fruits that it is currently carried out at the IVIA facilities, as well as the current citrus certification process.

Figure 18. PhD Mari Carmen Vices course

César Graf, Agronomist and Executive Director (CEO) of Citrograf, taught the third presentation. They are a citrus plant nursery company with nurseries located in the states of São Paulo and Bahia, as well as Director of a company of new varieties of citrus, RBC - Royal Buds Citricos. In his presentation, entitled "Organization and control of plant material in nurseries", he explained the situation of citrus in Brazil and the adaptations made in the citrus production nurseries to the appearance of HLB, such as the characteristics in terms of substrates used, distances with other plantations, coverage and security antechambers, controlled origin of the genetic material, etc. Finally, he showed the progress and benefits achieved with the measures adopted.

Figure 19. Citrograf presentation

November 11 courses

The first presentation on November 11, 2020 was given by PhD. Estrella Hernández, entomologist, and Principal Investigator at the Plant Protection Unit of the Canarian Institute of Agrarian Research. The presentation dealt with "Potential Vectors": She gave a detailed description of the main psyllids that spread HLB, their hosts and their current distribution in the world. Later, she showed very interesting photos and videos of field recognition of *Trioza erytreae*, symptoms, mating, its life cycle, and spawning. She showed the sampling methods used and explained the *Trioza erytreae* containment plan through vector control and the experience carried out in the Canary Islands with the introduction of *Tamarixia dryi*.

Figure 20. Presentation from plant Protection Unit of the Canarian Institute of Agrarian Research

The second presentation of the afternoon was made by Antonio Juliano Ayres, Bachelor of Agronomy and Master of Phytotechnics from the University of São Paulo and Master of Citrus from the Polytechnic University of Valencia. He is currently THE DIRECTOR OF FUNDECITRUS, an association maintained by citrus producers and juice manufacturers in the State of São Paulo (Brazil) to promote the sustainable development of the citrus industry. His presentation "Control of the disease on farms and current situation" began with a presentation of citrus production in Brazil and

the evolution of its decline after the appearance of HLB in 2004. He went on to describe the methods of fighting HLB and its vector *Diaphorina citri*, as well as the biological control by *Tamarixia radiata*. Finally, he presented the HLB management conditions and the long-term solutions.

Figure 21. Fundecitrus presentation

Finally, the last speaker on this day was PhD. José Cuenca, Agricultural Engineer and Agricultural Technical Engineer from the Polytechnic University of Valencia and current Technical Director of AVASA (Agrupación de Viveristas de Agrios, S.A.). His presentation, entitled "Organization and control of plant material in nurseries" was focused on presenting the Certification System that is currently being carried out and the role of AVASA in the production of base plant. He reviewed the regulatory change regarding disease controls in citrus. He exposed the new threat of HLB in citrus fruits and ended with an explanation of the effect of the Contingency Plan in nurseries.

Figure 22. AVASA presentation

It was also important the collaboration of José Forcadell, Director of the Professional Association of Flowers, Plants and Horticultural Technology of the Valencian Community (ASFPLANT), as moderator of the event. José answered all the doubts that citrus growers raised to the panellists each day regarding the nursery health measurements and risk management procedures to avoid young plant infection.

2nd WEBINAR ON "STRATEGIES FOR PREVENTION AND CONTROL OF HLB Y SPAIN AND CALIFORNIA" (IVIA).

Figure 23. Poster of the session

The first presentation was given by PhD. Ester Marco, Researcher at the Center for Plant Protection and Biotechnology of the Valencian Institute of Agricultural Research (IVIA). The doctor made a presentation on the "Current situation of HLB".

The second presentation was given by PhD. Alberto Urbaneja, entomologist, and Principal Investigator at the Plant Protection Unit of IVIA. He explained the current situation of the vector and gave a detailed description of Trioza.

María Angeles Forner explained plant material tolerance and resistance to HLB.

Finally, Vicente Dalmau closed the session explaining the control measures of the government to avoid Trioza on the fields and Sara Garcia explained the measures to control HLB and the psyllids in California.

The webinar was held online, and more than 500 people have seen it.

In the following link you can access the web space where the session and its recording appear: http://www.ivia.gva.es/es/actualidad/-/asset_publisher/PAJ314FDohUZ/content/ya-esta-disponible-en-nuestra-videoteca-el-coloquio-sobre-la-prevencion-y-el-control-de-hlb-en-espana-y-california

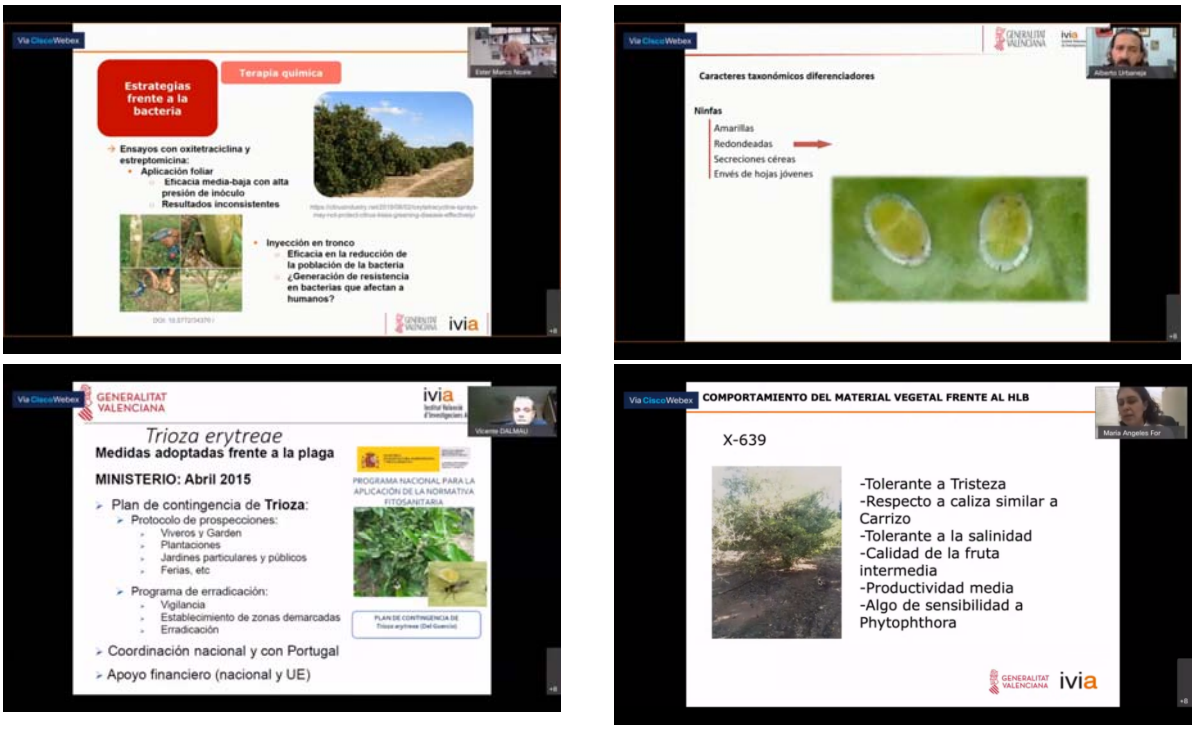

Figure 24. IVIA presentation

4 Conclusions

In the current context of the Covid-19 outbreak all the presential activities considered in the initial plan were greatly affected, mainly at the beginning of the pandemic. The limitation of movement and the risk of face-to-face activities have resulted in the postponement of different events due to the lack of attendees. We have even had weeks of closed offices of the different partners.

During this period of uncertainty, when most of the on-site activities were suspended or postponed, numerous internal meetings and internal working groups sessions were held to design an alternative.

Figure 25. Working groups to design materials

AVA has led other actions to disseminate the training materials designed and to increase awareness of HLB. For instance, we are using the mailing to citrus growers and to ASAJAs associated entities in the Mediterranean, Balearic, and northern Spain.

We hope to make up for some of the lost time with webinars and sessions with ASAJAs and cooperatives during the first semester in 2021.

In any case, it is important to remark that we have started the open discussion forums with farmers and regional governments to deploy the new HLB health policy. All the above in order to convey concerns and discuss the project and the problem with the administration.

Figure 26. Discussion with farmers and regional governments