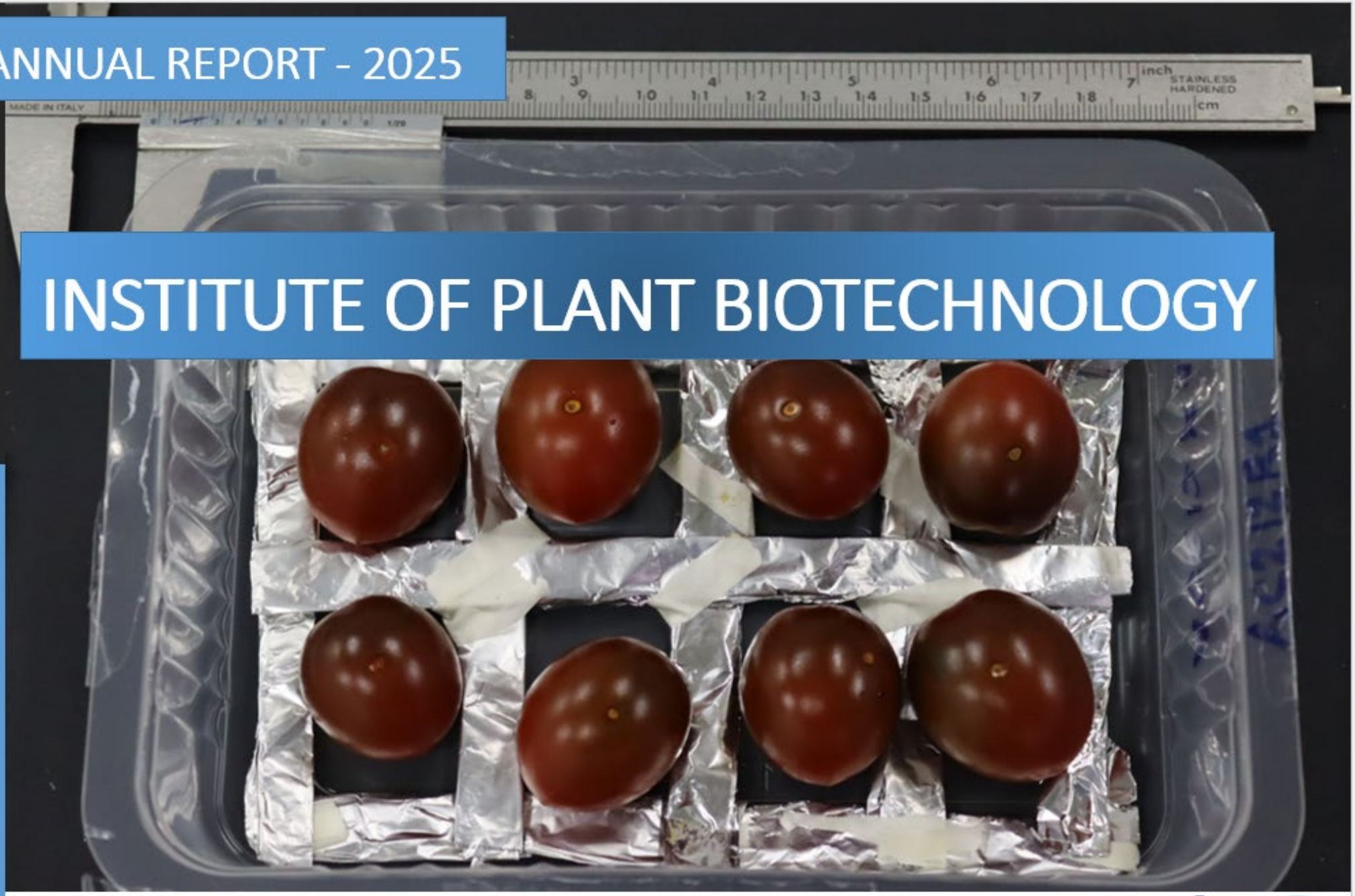
ANNUAL REPORT - 2025

INSTITUTE OF PLANT BIOTECHNOLOGY



Universidad Politécnica de Cartagena

MEMBER OF EUT+ EUROPEAN UNIVERSITY OF TECHNOLOGY

Human Resources Strategy for Researchers (HRS4R)

Instituto de Biotecnología Vegetal
Universidad Politécnica de Cartagena

INDEX

FROM THE VICE-RECTOR FOR RESEARCH, INNOVATION AND TECHNOLOGY TRANSFER

It is a real pleasure to introduce the 2025 Annual Report of the Institute of Plant Biotechnology, a document that reflects not only a year of scientific activity, projects, publications and achievements, but also the strength of a human and academic community that continues to grow within the Universidad Politécnica de Cartagena.

The IBV has long been a place where excellent science is carried out with commitment, creativity and a clear vocation to serve society. Its research groups work in fields that are essential for our future: sustainable agriculture, food safety and quality, plant biotechnology, soil ecology, biological control, genetic resources and the development of new biotechnological processes. Each of these areas shows the value of specialised knowledge and the importance of individual scientific excellence.

But 2025 has also reminded us of something equally important: science moves forward not only through individual talent, but also through the ability to connect ideas, disciplines and people. In this sense, the launch of Synapsis-IBV has been one of the most meaningful new initiatives of the year. Inspired by the idea of a synapse as a point of connection and transmission, Synapsis-IBV has created a space for researchers to meet, explain their work, listen to one another and discover unexpected links between different lines of research.

This initiative captures very well what a research institute should be: not just a sum of excellent groups, but a living network of knowledge. When researchers share questions, methods and challenges, new possibilities appear. A conversation after a seminar, a common problem seen from another perspective, or a simple exchange between colleagues can become the seed of a new collaboration. That is why Synapsis-IBV is much more than a seminar programme; it is a way of strengthening the scientific culture of the Institute and making its collective intelligence more visible.

I would like to warmly congratulate Prof. Dr. Catalina Egea Gilabert, Director of the IBV, for her leadership, vision and dedication throughout this year. I also want to express my sincere thanks to the technical team, especially Mariano and Perla, whose daily work is essential to the smooth running of the Institute, to supporting research activity and to making ambitious projects possible. Their contribution is often discreet, but it is fundamental.

Finally, I would like to thank all the researchers, technical staff, students and collaborators who form part of the IBV. Each of you contributes, in your own way, to making the Institute stronger, more open and more connected. Your work not only makes the IBV grow but also strengthens the UPCT as a university committed to knowledge, innovation and social impact.

With my warmest congratulations and gratitude,

Prof. Dr. Roque Torres Sánchez

FROM THE DIRECTOR OF IBV

In recent years, the Institute of Plant Biotechnology (IBV) has continued to consolidate its position as a multidisciplinary research centre capable of addressing some of the major challenges facing agriculture, food systems, biotechnology and environmental sustainability. Our achievements in scientific production, competitive funding, technology transfer and international collaboration are the result of the dedication, talent and commitment of all the researchers, technical staff and students who form part of the Institute.

However, beyond individual achievements, one of the greatest strengths of the IBV lies in the diversity of expertise represented within its research units. From molecular genetics to food technology, from soil ecology to integrated pest management, from plant genetic resources to secondary metabolites, our researchers contribute complementary perspectives that enrich our scientific capacity and broaden our impact on society.

Today, scientific progress increasingly depends on the ability to integrate knowledge across disciplines. The complexity of current global challenges, including climate change, food security, sustainable production systems and human health, requires collaborative approaches that transcend traditional research boundaries. In this context, fostering interaction among researchers is not only desirable but essential.

With this vision in mind, we launched in 2025 the initiative **"Synapsis-IBV: Activating Scientific Connections"**, a seminar series designed to strengthen communication among the different research units of the Institute and promote new synergies with other research groups across the Universidad Politécnica de Cartagena. Through monthly outreach-oriented seminars, our researchers have shared their work, explored common interests and identified new opportunities for collaboration.

The concept of a synapse is particularly meaningful for our Institute. Just as neural connections allow information to flow and generate new capabilities, scientific connections enable ideas, methodologies and expertise to interact, giving rise to innovative solutions and new research opportunities. Every collaboration established, every interdisciplinary project initiated and every new partnership formed contributes to strengthening the collective intelligence of the IBV.

This annual report reflects not only the scientific achievements of the Institute during the past year, but also the growing network of interactions that supports them. It showcases an Institute that is increasingly connected, open and collaborative, committed to generating knowledge with impact and to contributing actively to the scientific, technological and socio-economic development of our region and beyond.

I would like to express my sincere gratitude to all members of the IBV for their enthusiasm, professionalism and commitment. Their work continues to demonstrate that excellence in research is not only measured by individual accomplishments, but also by our capacity to work together, share knowledge and build a stronger scientific community.

The future of science belongs to those who connect ideas, disciplines and people. At the IBV, we are proud to be building those connections every day.

Prof. Dr. Catalina Egea Gilabert

SYNAPSIS-IBV: BUILDING THE FUTURE THROUGH SCIENTIFIC CONNECTIONS

THE BIRTH OF SYNAPSIS-IBV

Scientific excellence is built on knowledge, but innovation emerges through connections. Inspired by the concept of neural synapsis, the specialized junctions that allow information to flow between neurons and generate complex responses, the Institute of Plant Biotechnology launched in 2025 the initiative **"Synapsis-IBV: Activating Scientific Connections."**

The programme was conceived to strengthen interaction among researchers from the different IBV units and to create an environment where ideas, methodologies and expertise can circulate more freely across disciplinary boundaries. Although the institute brings together specialists in diverse areas ranging from molecular genetics and plant biotechnology to food science, soil ecology and pest management, opportunities for regular scientific exchange are often limited by the increasing specialization of modern research.

Synapsis-IBV was created to bridge these internal gaps and to reinforce a culture of collaboration within the institute. Through a series of monthly seminars, researchers are invited to present their work in an accessible and engaging format, highlighting not only scientific achievements but also the challenges, opportunities and future perspectives of their research. The initiative encourages dialogue among colleagues, promotes mutual learning and facilitates the identification of complementary expertise that may lead to future collaborative projects.

Beyond fostering internal scientific interaction, Synapsis-IBV also represents an important step towards increasing the visibility of the institute. Scientific knowledge generates greater impact when it is communicated beyond disciplinary boundaries and shared with broader audiences. For this reason, all seminars are organised in a hybrid format, allowing both in-person and online participation through Microsoft Teams and facilitating access for researchers, staff and students across the Universidad Politécnica de Cartagena.

The initiative is currently evolving beyond the seminar format. New communication activities are being developed to increase the visibility of IBV research through interviews, short videos, podcasts and social media content aimed at presenting science in a more accessible and attractive way. In this sense, Synapsis-IBV is becoming not only a platform for scientific exchange, but also a vehicle for scientific communication and institutional outreach.

Throughout 2025, seven seminars showcased the diversity, creativity and societal relevance of the research conducted across the institute. Together, they illustrate the richness of the scientific ecosystem that defines the IBV and the growing network of connections that will shape its future.

Like neural synapsis connect neurons to create intelligence, scientific connections link researchers to create innovation

Synapsis 1. Systematic Identification of *Arabidopsis* mutants affected in cell culture growth.
Researcher: Marcos Egea Gutiérrez-Cortines.
Unit: Developmental and Metabolic Genetic Engineering.
Date: February 6, 2025.

The presentation was framed within the gene validation project for biotechnological applications (PID2021-127933OB-C21), led by Marcos Egea Gutiérrez-Cortines and Julia Weiss focused on identifying genetic determinants that regulate plant cell growth under controlled in vitro conditions.

The main objective of the research is the systematic identification and characterization of *Arabidopsis thaliana* mutants that exhibit altered growth dynamics in cell culture systems. *Arabidopsis* is widely used as a model organism in plant biology due to its s
mall genome, short life cycle, and well-annotated genetics, making it particularly suitable for functional gene analysis. In this context, the study of mutants allows researchers to link specific genes with cellular processes that control proliferation, differentiation, and metabolic activity. A central application of this research is the improvement of plant cell-based bioproduction systems. The team investigates mutations that enhance the growth rate of plant stem cells when cultivated in bioreactors, with the goal of increasing biomass productivity and process efficiency. Faster-growing cell lines could significantly reduce production times and increase scalability in industrial biotechnology platforms.

This approach has broad implications across multiple sectors. Plant cell cultures can be used as sustainable biofactories to produce high-value compounds relevant to healthcare, pharmaceuticals, agri-food industries, cosmetics, textiles, and environmental applications. Examples include the synthesis of therapeutic proteins, natural pigments, enzymes, and other bioactive molecules. The researcher highlighted that improved cell proliferation could enable rapid and scalable production systems capable of manufacturing products ranging from vaccines to industrial dyes.

Beyond applied outcomes, the project also contributes to fundamental plant biology by improving understanding of gene function in cell growth regulation and metabolic control. Identifying key genetic pathways involved in cell proliferation may also provide insights into plant development and stress responses.

Overall, this research integrates functional genomics, plant biotechnology, and bioprocess engineering to advance the development of efficient and sustainable plant-based production systems for future biotechnological applications.

Synapsis 2. Hyaluronic acid production: challenges and perspectives.

Researcher: Dr. Ginés Benito Martínez Hernández.

Unit: Biotechnology Process Technology and Engineering.

Date: March 6, 2025.

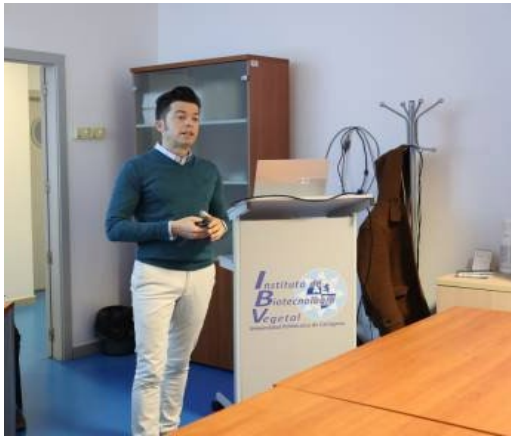
Hyaluronic acid (HA) is a natural polysaccharide with exceptional biocompatibility, water-retention capacity, and viscoelastic properties, making it one of the most valuable biomolecules in modern biotechnology. It is widely used in medicine, cosmetics, tissue engineering, ophthalmology, and regenerative therapies. Current scientific research has increasingly focused on improving its production efficiency, purity, and sustainability while expanding its biomedical applications.

The work associated with the Unit addresses the growing industrial interest in optimizing HA production through advanced biotechnological strategies. Traditionally, hyaluronic acid was extracted from animal tissues, but this approach raised concerns related to contamination risks, purification costs, and ethical issues. For this reason, microbial fermentation has become the preferred alternative for industrial production. Some bacterial species can synthesize HA naturally, although their pathogenic potential has motivated the search for safer engineered microorganisms.

One of the major challenges in HA biotechnology is achieving high yields while maintaining precise control over molecular weight. This parameter is critical because the biological and commercial applications of HA depend strongly on its size.

Recent advances in metabolic engineering, synthetic biology, and bioprocess optimization are enabling the development of more efficient microbial cell factories. Researchers are also exploring the use of renewable substrates and circular bioeconomy approaches to reduce production costs and environmental impact. Beyond technical challenges, HA production faces regulatory and scalability issues. Industrial processes must guarantee reproducibility, sterility, and quality standards compatible with pharmaceutical applications. Consequently, interdisciplinary collaboration among microbiologists, engineers, material scientists, and clinicians is becoming increasingly important.

Dr, Martínez-Hernández emphasizes that current research on hyaluronic acid production reflects the broader transformation of industrial biotechnology toward safer, more sustainable, and highly specialized biomaterials capable of supporting future advances in bioengineering.



Synapsis 3. What we know about *Listeria*, what we are learning, and what we do not know.
Researcher: Dr. Alberto Garre Pérez.
Unit: Microbiology and Food Safety.
Date: Thursday, April 3, 2025.

Listeria monocytogenes is one of the most important foodborne pathogens worldwide due to its high mortality rate and its ability to survive under conditions that inhibit many other microorganisms. Although listeriosis is relatively uncommon, it represents a major public health concern because it particularly affects vulnerable populations such as pregnant women, newborns, elderly individuals, and immunocompromised patients.

The research activity headed by Dr. Alberto Garre has focused extensively on predictive microbiology and quantitative approaches to understanding microbial behaviour in food systems. His work contributes to the development of mathematical models capable of predicting the growth, survival, or inactivation of pathogens such as *Listeria monocytogenes* under different environmental conditions, including temperature fluctuations, pH changes, and food preservation treatments.

One of the reasons *Listeria* remains a major challenge for the food industry, Dr. Garre highlighted, is its remarkable adaptability. Unlike many pathogens, it can grow at refrigeration temperatures, persist in food-processing environments, and form biofilms on industrial surfaces. These characteristics complicate sanitation procedures and increase the risk of contamination in ready-to-eat products.

Modern predictive microbiology combines microbiological experimentation, statistical analysis, and computational modelling to improve food safety management. Dr. Garre's research emphasizes how dynamic predictive models are increasingly being incorporated into risk assessment systems. This tool allows researchers and food companies to simulate microbial behaviour under real processing and storage conditions, improving decision-making and reducing food waste.

Despite significant progress, many uncertainties remain. Scientists are still investigating how microbial interactions within complex food microbiomes influence *Listeria* behaviour. Additionally, the globalization of food supply chains may alter contamination patterns and introduce new challenges.

Another important issue concerns the translation of predictive models into practical industrial applications. While models can provide valuable forecasts, their reliability depends on the quality of experimental data and their adaptation to real-world variability. The study of *Listeria* therefore illustrates how food safety increasingly depends on interdisciplinary science integrating microbiology, data analysis, engineering, and public health. Continued research in this area is essential to develop safer food systems and more effective prevention strategies against emerging microbiological risks.

Synapsis 4. Response of soil microbial communities to soil management.
Researcher: Prof. Dr. Raúl Zornoza.
Unit: Soil Ecology and Biotechnology.
Date: May 8, 2025.

Soil microbial communities constitute one of the most complex and essential components of terrestrial ecosystems. Bacteria, fungi, and other microorganisms play fundamental roles in nutrient cycling, organic matter decomposition, soil aggregation, carbon sequestration, and plant health. As a result, the way agricultural soils are managed has strong effects on microbial diversity and ecosystem functioning.

The research led by Prof. Zornoza has extensively examined how agricultural practices influence soil biological quality in Mediterranean environments. His studies had demonstrated that intensive management strategies, including excessive tillage, monoculture systems, and high chemical inputs, can significantly alter microbial community structure and reduce soil resilience.

One of the central concepts emerging from his dissertation is that soil should not be considered an inert substrate but rather a living ecosystem. Microorganisms respond rapidly to environmental disturbances, making them sensitive indicators of soil degradation or recovery. For example, organic amendments, cover crops, reduced tillage, and sustainable farming practices often promote higher microbial diversity and improved biochemical activity.

Several studies involving Mediterranean agroecosystems carried out by Prof. Zornoza have shown that sustainable management practices increase beneficial microbial populations associated with nutrient availability and disease suppression. Organic matter enrichment can also improve soil aggregation and water retention, enhancing resilience against drought and erosion—two critical challenges in semiarid regions.

Another important aspect of Prof. Zornoza's work concerns soil restoration in degraded or contaminated environments, including mining soils and abandoned agricultural lands. In these systems, microbial communities are essential for ecological recovery because they contribute to nutrient stabilization and vegetation establishment.

Understanding soil microbial dynamics is increasingly important in the context of climate change and global food security. Healthy microbial communities contribute to carbon storage and improve soil adaptability under environmental stress.

Overall, Prof. Zornoza highlighted the need to integrate microbiological indicators into soil management strategies to promote sustainable agriculture, preserve biodiversity, and maintain ecosystem functionality in Mediterranean and global agroecosystems.

Synapsis 5. High value-added biocompounds from fruit and vegetable by-products: opportunities and challenges in the circular economy.
Researcher: Prof. Dr. Francisco Artés Hernández.
Unit: Food Quality and Health.
Date: June 12, 2025.

The agri-food industry generates huge quantities of fruit and vegetable by-products during harvesting, processing, distribution, and commercialization. Traditionally, much of this biomass has been treated as waste, despite containing valuable compounds with significant nutritional, pharmaceutical, and industrial potential. In recent years, this paradigm has shifted, and such residues are increasingly regarded as strategic resources within the framework of the circular economy, where waste streams are redefined as secondary raw materials for new production cycles.

The scientific work associated with Prof. Artés-Hernández focuses on food quality, postharvest technology, and the recovery of bioactive compounds from horticultural products. His research contributes to the development of sustainable technologies capable of transforming agricultural by-products into high value-added ingredients, thereby improving resource efficiency and reducing environmental impact across the agri-food chain.

Fruit and vegetable residues often contain substantial concentrations of antioxidants, phenolic compounds, dietary fiber, pigments, vitamins, and a wide range of bioactive metabolites. These compounds exhibit functional properties that make them suitable for applications in functional foods, nutraceuticals, cosmetics, biodegradable packaging materials, and even pharmaceutical formulations. Representative examples given by Prof. Artés-Hernández include the extraction of lycopene from tomato processing waste, polyphenols from pomegranate, and natural pigments from leafy or root vegetable residues.

One of the main challenges in this field, Prof. Artés-Hernández stressed, lies in the development of economically viable, scalable, and environmentally friendly extraction and stabilization technologies. Bioactive compounds are frequently highly sensitive to environmental factors such as temperature, oxygen, light exposure, and enzymatic degradation, which complicates their recovery and industrial utilization. As a result, researcher of the Unit is increasingly focusing on innovative approaches such as green extraction technologies, including ultrasound-assisted extraction, microwave-assisted processes, and the use of natural deep eutectic solvents. These methods aim to maximize yield while minimizing energy consumption and chemical waste.

Another critical aspect mentioned by Dr. Artés-Hernández, involves the stabilization and formulation of recovered compounds to ensure their functional integrity during storage and application. Microencapsulation, nanoemulsions, and encapsulating compounds are being explored to enhance stability and controlled release. His research exemplifies the integration of food science, biotechnology, and sustainability principles, supporting the transition toward a more efficient and environmentally responsible agri-food system.

Synapsis 6. Improved biological control agents for sustainable and healthy agriculture.
Researcher: Prof. Dr. Pablo Bielza.
Unit: Integrated Pest Management.
Date: October 9, 2025.

In his presentation, Prof. Dr. Pablo Bielza explained how his research group, within the framework of developing biological control agents as alternatives to chemical pesticides, has used genetic variability to develop a strain of *Orius laevigatus* adapted to survive under suboptimal nutritional conditions. This strain exhibits improved nutrient utilization, enabling it to persist continuously within crops while awaiting the reappearance of the pest species it preys upon.

Research on improved biological control agents, led by Prof. Pablo Bielza Lino, is situated at the intersection of entomology, evolutionary biology, and sustainable crop protection. A central focus of his work is the enhancement of the predatory bug *Orius laevigatus*, one of the most widely used natural enemies in greenhouse integrated pest management programs against pests such as *Frankliniella occidentalis*. His research explores how artificial selection and intraspecific genetic variability can be exploited to improve performance traits relevant for agricultural deployment.

A key line of research involves selective breeding for traits that increase the robustness and adaptability of *O. laevigatus* under suboptimal environmental conditions. For example, selected strains have demonstrated improved tolerance to temperature extremes, enhanced survival, and greater reproductive performance compared to standard commercial lines, which is particularly relevant in early-season greenhouse conditions where temperatures may limit establishment of biological control agents.

Additionally, studies led by Bielza's group have demonstrated that traits such as body size, fecundity, and predatory capacity can be enhanced through selective breeding, sometimes without negative balances in pest control efficiency. In some cases, improved strains maintain or even increase their ability to suppress pest populations while gaining greater ecological fitness.

Overall, his research advances a shift from passive use of natural enemies toward actively improved biological control agents, designed through evolutionary and genetic principles. The approach strengthens sustainability in agriculture by reducing dependence on chemical pesticides while increasing the reliability and efficiency of biological pest control under real-world field conditions.

The seminar also highlighted opportunities for future collaborations involving genetic or microbiological studies that could be developed by other IBV research groups.

Synapsis 7. Sustainable agricultural production methodologies for soil recovery during cultivation.
Researcher: Prof. M. Carmen Martínez Ballesta.
Unit: Plant Genetic Resources and Sustainable Horticultural Technology.
Date: November 13, 2025.

Prof. Martínez Ballesta, coordinator at UPCT of the experimental trials within the European project Hort2thefuture, presented key findings on the evaluation of innovative irrigation water oxygenation technologies aimed at improving crop performance under conditions of reduced soil oxygen availability. This line of research addresses a growing agronomic challenge linked to soil compaction, poor drainage, and increasingly frequent extreme weather events.

The project investigates how different oxygenation strategies applied through irrigation water can enhance root system development and overall plant physiological performance in horticultural crops such as broccoli and radish cultivated in compacted or structurally degraded soils. These conditions often limit root respiration, reduce nutrient uptake efficiency, and ultimately constrain crop yield and quality. By improving oxygen availability in the rhizosphere, these technologies aim to restore more favourable conditions for plant-soil interactions.

A second major objective of the research is the assessment of the potential of these systems to mitigate the impact of soil-borne pathogens, particularly in greenhouse pepper cultivation where root hypoxia is a frequent predisposing factor for disease development. Reduced oxygen levels in the root zone are known to weaken plant defences and facilitate the proliferation of phytopathogenic fungi, increasing production losses and reducing crop resilience.

As highlighted by Martínez Ballesta, the agricultural sector is increasingly affected by episodic flooding events associated with intense and irregular rainfall patterns. These events contribute to transient soil waterlogging, which exacerbates oxygen deprivation in the root zone and is strongly correlated with higher incidence of fungal diseases and other stress-related disorders.

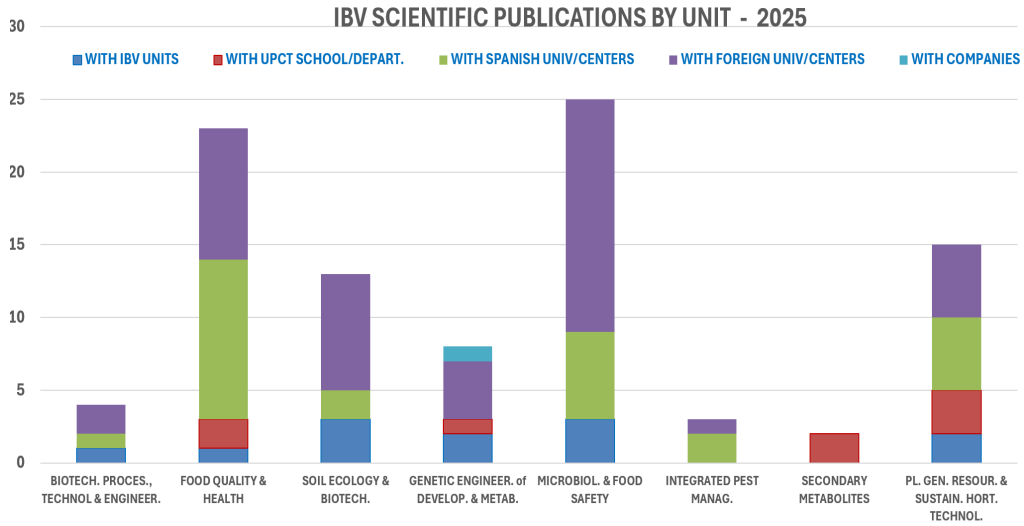
The ongoing trials aim to determine whether oxygen-enriched irrigation systems can serve as a practical and scalable tool for improving soil functionality during cultivation, enhancing plant health, and reducing dependency on chemical disease control measures. Beyond immediate productivity gains, this approach is framed within a broader strategy of soil recovery and sustainable intensification, seeking to maintain agricultural output while preserving soil ecosystem integrity.

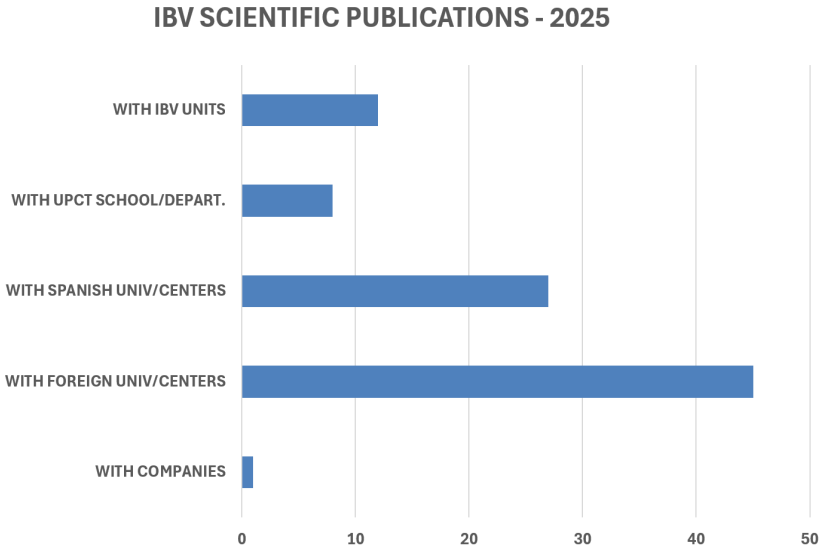
Overall, the research headed by Dr. Martínez-Ballesta contributes to the development of climate-resilient agricultural practices that integrate plant physiology, soil science, and irrigation engineering to address the combined challenges of soil degradation and climate variability.

SYNAPSIS-IBV IN NUMBERS

One of the main objectives of Synapsis-IBV is to stimulate scientific interactions among research units and promote interdisciplinary collaborations. Although the initiative was launched in 2025, early indicators already suggest an increase in internal scientific connectivity. The following figures show the total number of scientific publications, as well as the number of publications by unit, co-authored by researchers from two or more IBV units, illustrating the emergence of new collaborative links across the Institute.

These collaborations represent tangible outcomes of the Institute's commitment to fostering interdisciplinary research and demonstrate the potential of Synapsis-IBV as a catalyst for future joint projects, funding opportunities and scientific innovation.





INDICATORS

- **7 Seminars**
- **7 Units**
- **15 Attendees**
- **10 Online participants**
- **6 Videos & Interviews Generated**
- **12 Collaborative Publications Between Units**

RESEARCH HIGHLIGHTS BY UNIT

BIOTECHNOLOGICAL PROCESSES, TECHNOLOGY AND ENGINEERING



1. Main results

In 2025, 7 research articles have been published in international journals (Industrial Crops and Products, Food Engineering Reviews, Polymers, Foods, Plants, Applied Sciences) and 2 Acta Horticulturae; and 5 communications to Int. Congresses (71st International Congress of Meat Science and Technology (ICoMST); 39th EFFoST International Conference 2025). Prof. A. López Gómez is Editor of the Int. J. "Food Engineering Reviews" (Q1, IF 7.6 in 2024, Springer), and Editorial Board Member of the Int. J. "Clean Technologies" (Q2, IF 4.7 in 2024, MDPI). Dr. Ginés Benito Martínez Hernández is Editorial Advisory Board Member of ACS Food Science & Technology (Q3, IF 2.8 in 2024, ACS Publications) and member of the Editorial Board of Foods (Q1, IF 5.1 in 2024, MDPI).

2. Projects (most relevant)

-Active paper packaging for packaging fresh solid foods sold in bulk in store (ref. PID2024-MQM-20240149). Funding organization: Centro para el Desarrollo Tecnológico Industrial (CDTI, Spain). Participating entities: Universidad Politécnica de Cartagena (UPCT) and the Company EVERSIA S.A. Project Budget= 636,747 €. Jan. 2025-Dec.2027. Principal Researchers (PR): Antonio López Gómez and Ginés Benito Martínez Hernández.

-New cooling, decontamination and packaging technologies to increase food safety and shelf life of fresh pork (ref. IDI-20230345). Funding organization: CDTI, Spain. Participating entities: UPCT and Company Laboratorio y servicios técnicos alimentarios SL. Project Budget=577,219 €. Jan. 2024-Dec. 2026. PR: Antonio López Gómez and Ginés Benito Martínez Hernández.

-Production, nutritional quality, shelf life, and climate adaptation in leafy vegetables elicitation-driven hydroponics (ref. PID2024-157806OB-I00). Funding organization: Spanish Ministry of Science, Innovation and Universities (MICIU) and the State Research Agency (AEI); Programa Estatal de Investigación, Desarrollo e Innovación Orientada a los Retos de la Sociedad. Participating entities: UPCT. PR: Ginés Benito Martínez Hernández and Catalina Egea Gilabert. Antonio López Gómez is part of the research team.

3. Selected publications

-Martínez Hernández G.B., Navarro Martínez A., López-Gómez A. (2025). Carnauba wax enriched with encapsulated plant essential oils into native β-cyclodextrins as an innovative wax coating on citrus fruits. Industrial Crops and Products, 225: 120461.

-López-Cánovas A.E., Victoria-Sanes M., Martínez-Hernández G.B., López-Gómez A. (2025). Methods for determining the high molecular weight of hyaluronic acid: a review. Polymers, 17(24): 3289.

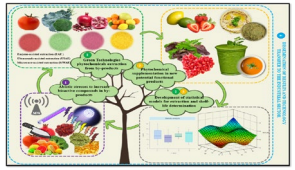
4. Others.

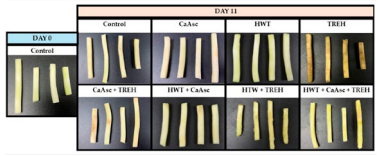
-**Extraordinary Prize** awarded to Alejandra Navarro Martínez for her doctoral thesis, entitled "Inhibition of ethylene production, and other postharvest quality-degrading enzymatic systems in fruit and vegetable products, by packaging systems containing essential oils", supervised by Ginés Benito Martínez-Hernández and Antonio López-Gómez.

-**AEFYT Award** to SECYTEF (Spanish Society of Refrigeration Sciences and Techniques), recognition from the Association of Refrigeration Companies and their Technologies (AEFYT) to this society, whose president was Prof. A. López Gómez, for standing out in innovation, trajectory and achievements in the refrigeration sector.

Staff: <u>Head of the Unit</u>: Prof. Dr. Antonio López Gómez. <u>Researchers:</u> Prof. Dr. Asunción Iguaz Gainza; Prof. Dr. Ginés Benito Martínez Hernández; <u>M.Sc. and Ph.D. Students</u>: Alejandra Navarro Martínez; Miguel Tomás Gómez Hernández; María de los Ángeles Martínez Sánchez; Elisa Orcajada Hermosilla; Natalia Rodríguez Cánovas; Miguel Victoria Sanes.

FOOD QUALITY AND HEALTH





1. Main results

-Development and validation of a multifactorial predictive model that accurately estimates the shelf life of refrigerated broccoli under domestic storage conditions, demonstrating that small temperature deviations reduce shelf life by more than 40% and providing a transferable tool to reduce household food waste.

-Development of new food products based on the valorisation of broccoli by-products, including corn tortillas fortified with up to 10% powder from dehydrated leaves and stalks, achieving significant nutritional and technological improvements, and a fresh-cut (IV range) product obtained from broccoli stalks processed into sticks, packaged under modified atmosphere and stored for 11 days at 5 ± 1 °C, where hot water treatment (55 °C, 1 min) effectively reduced browning.

-Valorisation of broccoli stalks in the form of pickled products resulted in a 26% reduction in carbon footprint.

-Pomegranate peel exhibited strong antioxidant activity and significant inhibitory effects on antidiabetic enzymes. Findings support using by-products in nutraceuticals and functional foods.

2. Projects (most relevant)

-Comprehensive and sustainable solution to minimize food loss and waste and promoting food security in the Mediterranean region-FUSION (nº2431): European Project: Partnership for Research and Innovation in the Mediterranean Area. PR: Encarna Aguayo.

-Revalorización sostenible de subproductos hortofrutícolas con tecnologías verdes para suplementar nuevos elaborados de frutas y hortalizas con biocompuestos. PID2021-123857OB-I00. PR: Francisco Artés-Hernández.

-Desarrollo de nuevos alimentos funcionales a partir de subproductos de la industria agro-alimentaria regional (Agroalnext). Co-PRs: Encarna Aguayo and Francisco Artés-Hernández.

3. Selected publications

García-Lorca N., Salas-Millán J.A., Aguayo E. (2025). Up-cycling broccoli stalks into fresh-cut sticks: postharvest strategies for quality and shelf-life enhancement. Foods, 14(14) 2476 https://doi.org/10.3390/foods14142476

Cano-Lamadrid M., Mozafari L., Martínez-Zamora L., Lorca F., García-Gómez P., Artés-Hernández F. (2025). Obtaining carotenoid encapsulates with polysaccharides carriers after pilot scale accelerated solvent extraction and ultrasound-assisted extraction from industrial tomato by-product. Food Res. Internat., 203:115908. https://doi.org/10.1016/j.foodres.2025.115908

Cano-Lamadrid M., Martínez-Zamora L., Nowicka P., Wojdyło A., Artés-Hernández F. (2025). Profiling bioactive compounds and enzyme inhibitory potential of industrial horticultural by-products associated with metabolic and neurological disorders. Food Bioscience. 72: 107453. https://doi.org/10.1016/j.fbio.2025.107453

Castillejo N., Martínez-Zamora L., Cano-Lamadrid M., Artés-Hernández F. (2025). Postharvest UV-B and visible LED lighting preserve quality and modulate bioactive compounds in strawberries. Food Bioprocess Technol. 18: 10806–10820. https://doi.org/10.1007/s11947-025-04052-9

Rasines L., San Miguel G., Corona B., Aguayo E. (2025). Environmental assessment of broccoli stalk revalorisation via pickling. J. Agric. Food Research, 23: 102266. https://doi.org/10.1016/j.jafr.2025.102266

Salas-Millán J.A., Mackrill J., Melgar S., Aguayo E. (2025). Lactofermented beverage from broccoli leaves induces calcium dysregulation and ER-mitochondrial dysfunction in colorectal cancer cells: A proteomic perspective. Food Res. Int, 217, 116819, https://doi.org/10.1016/j.foodres.2025.116819

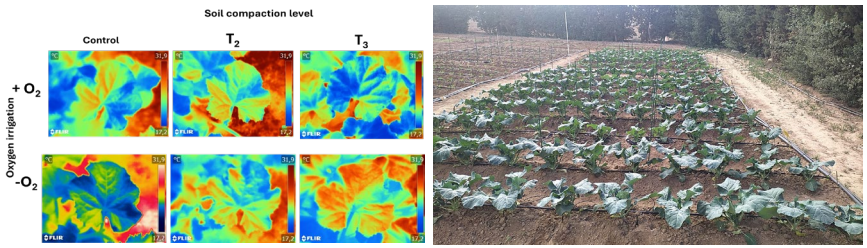
4. Others

Patents: Probiotic and antioxidant kombucha or kefir beverage (Aguayo, Aznar, Iguaz, Salas-Millán).

Awards: Biodiverso Cosmetic – Santander X Award: Best University Startup 2025.

Staff: Head of the Unit: Prof. Dr. Encarna Aguayo. Researchers: Prof. Dr. Francisco Artés-Hernández, Prof. Dr. Juan P. Fernández-Trujillo, Prof. Dr. Francisco Artés-Calero, Dr. Noelia Castillejo, and Dr. Lorena Martínez-Zamora. Ph.D. Students: José Ángel Salas Millán, Laura Rasines Elena, Rosa Zapata Arráez, Laleh Mozafari, Nieves García Lorca.

PLANT GENETIC RESOURCES AND SUSTAINABLE HORTICULTURAL TECHNOLOGY



1. Main results

In 2025, the Unit continued improving cultivation techniques for emerging horticultural and ornamental species. Work focused on optimizing hydroponic systems for baby leaf vegetables to enhance quality and postharvest performance, as well as exploring underutilized crops.

The Hort2theFuture project advanced research on irrigation water oxygenation to reduce soil compaction effects and tested alternatives to peat substrates.

The DIGIT project evaluated technologies for soil contaminant detection and bioremediation of heavy metal–polluted soils.

At the same time, the NewAgroMarMenor project developed organic fertilization strategies using enriched biochar and reduced nitrogen, measuring water and nutrient savings.

The Unit also remained committed to conserving the critically endangered Cartagena rockrose.

2. Projects (most relevant)

- Hort2thefuture: Horticultural innovations in soil-friendly practices to ensure a sustainable future. Hort2thefuture. 608,488 €. P.R.: M.C. Martínez-Ballesta.

- E-SPFdigit: Emergent soil, plant and food onsite digital services on chemical and biological contaminants. E-SPFdigit. 356,875 €.

-Prácticas agrarias innovadoras para contribuir a la mejora ambiental y de la biodiversidad en el entorno del Mar Menor. NEWAGROMARMENOR. 1,554,007 €. P.R.: M.C. Martínez-Ballesta

- Integration of photovoltaic production systems in irrigated crops managed through intelligent irrivoltaic systems. IRRIVOLTAICA. KONERY Eficiencia Energética, S.L. 01/01/2024–30/04/2027. 90,000€.

- Agroecological strategies for sustainable weed management in key European crops. AGROSUS. European Commission. Grant agreement ID: [pending]. 01/06/2023–31/05/2027. 451,250 €.

- Improvement of genetic diversity and recovery of the distribution area of *Cistus heterophyllus* in the Region of Murcia. Project #8220. Autonomous Community of the Region of Murcia. 16/01/2025–01/09/2026. 100,000 €.

- ED-HYDRO: Hidroponía optimizada por la elicitación: producción, calidad nutricional, vida útil y adaptación climática en hortalizas de hoja. Agencia Estatal de Investigación. 01/09/2025-31/08/2029. 196.250 €. PR: Catalina Egea Gilabert

3. Selected publications

Zaghdoud C., Solano C.J., Franco J.A., Bañón S., Fernández J.A., Martínez-Ballesta M. (2025). Supplemental monochromatic red light mitigates salt-induced stress in pepper (*Capsicum annuum* L.) plants. Plant Sci. 361: 112789. https://doi.org/10.1016/j.plantsci.2025.112789

Ollio I., Zornoza R., Gallego J.C., Egea-Gilabert C., Fernández J.A., Lloret E. (2025). Combined microbial inoculation and reduced inorganic fertilization enhances diversity and functionality in potato rhizosphere microbiome at field scale. Chem. Biol. Technol. Agric. 12. https://doi.org/10.1186/s40538-025-00836-5

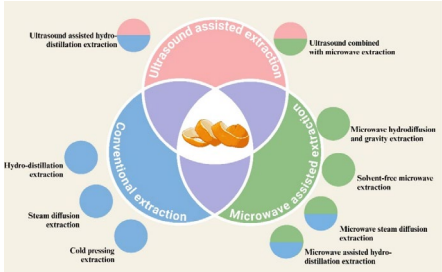
Gruda N.S., Gallegos-Cedillo V.M., Nájera C., Egea-Gilabert C., Ochoa J., Fernández J.A. (2025). Advancing Protected Cultivation: A Pathway for Nutrient-Rich Vegetables. Sci. Hortic. 44: 88-116. doi.org/10.1080/07352689.2025.2515801

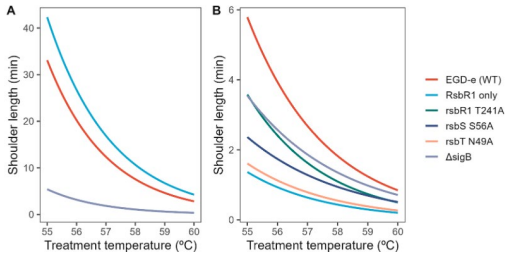
Ollio I., González Rosado M., Lloret E., Martínez-Martínez S., Egea-Gilabert C., Calviño D.F., Zornoza R., Fernández J.A. (2025). Integrating plant growth microorganisms in potato farming reduce soil CO2 emissions and improve crop quality. Soil Use Manag. 41. https://doi.org/10.1111/sum.13140

Villafranca A., Tasic I., Gallegos V., Giménez A., Ochoa J., Fernández J.A., Cano M.D. (2025). Comparing blockchain and DAG technologies for smart agriculture traceability in terms of efficiency and latency. Simul. Model. Pract. Theory 142. https://doi.org/10.1016/j.simpat.2025.103131

Staff: Head of the Unit: Prof. Dr. M. Carmen Martinez-Ballesta. Researchers: Prof. Dr. Sebastián Bañón, Prof. Dr. Encarna Conesa, Prof. Dr. Catalina Egea-Gilabert, Prof. Dr. Juan Esteva, Prof. Dr. Juan A. Fernández, Prof. Dr. Juan A. Franco, Prof. Dr. M. José Vicente, Prof. Dr. J.J. Martínez-Sánchez, Prof. Dr. Jesús Ochoa. Postdoc: Dr. Almudena Giménez, Dr., Victor Gallegos Cedillo.

MICROBIOLOGY AND FOOD SAFETY





1. Main results

During 2025, the Unit continued its research on food safety microbiology, focusing on microbial inactivation kinetics under preservation treatments, the growth dynamics of surviving populations, and the development of molecular identification methods. The Unit was funded by six research projects (European Commission, Spanish Government, and Murcia Regional Government) and two contracts. Its members participated in one national food safety network and in two EFSA risk assessment consortia. During this period, nine peer-reviewed articles and two book chapters were published.

2. Projects (most relevant)

-WastetoSafety: a circular economy approach for the valorization of orange peel to establish food safety. Horizon Europe MSCA (ref 101154490) PR: Alfredo Palop.

-Decontamination along the processing line using nanoemulsified natural antimicrobials alternatives to guarantee safety of mildly or non pasteurized vegetable liquid foods and smoothies. MICINN (ref. PID2020-116318RB-C32) PR: Pablo S. Fernández.

-Plan Complementario de I+D+i en Agroalimentación. Agroalnext. MICINN and CARM (Next Generation funding Ref. PRTR-C17.I1). PR: Pablo S. Fernández and Alfredo Palop.

-Food safety network for the development, harmonization and adoption of methodologies based on One Health focussed on the assessment of new microbiological risks. MICINN (ref. RED2022-134545-T). PR: Fernando Pérez (UCO). Net involving 10 Spanish institutions.

-Omics and analytics to tackle foodborne pathogens present in biofilms. MCIU (ref. PID2023-149211OB-C31). PR: Alfredo Palop and Enriqueta García.

-Caracterización de la variabilidad en la capacidad de crecimiento de los linajes I y II de *Listeria monocytogenes*, ¿necesitan análisis de riesgos independientes? (ref. 22574). Fundación SENECA, CARM. P.R.: Alberto Garre.

-Scientific Exchange to assess Quality and Risks of FOODs obtained by novel processing and Packaging Technologies. HORIZON-MSCA-2023-SE-01 Staff Mobility. (coordinator USAMV Romania), P.R. UPCT: Pablo S. Fernández.

3. Selected publications

Garre A., Tsagkaropoupou T., Guillén S., Karatzas K., Palop A. (2025). Optimal strategies for estimating the parameters of the Baranyi-Ratkowsky model: from (optimal) experiment design to model fitting methods. Food Res. Internat., 221: 117288. DOI: 10.1016/j.foodres.2025.117288

Luciano A., Espaillat N.A, Espaillat N., Baixauli J., Garre A., Palop A., Guillén S. (2025). Evaluation of the antimicrobial effect of nanoemulsified D-limonene washing solution for cherry tomatoes against *Staphylococcus aureus* and *Meyerozyma guilliermondii* – Impact on consumer protection. LWT, 224: 117731. DOI: 10.1016/j.lwt.2025.117731

Bodea I., Garre A., Cătunescu, G.M., Palop A. (2025). A review on microwave and ultrasound-assisted extractions of essential oil from orange peel waste. Food Bioproc. Technol. DOI: 10.1007/s11947-025-03882-x

Garre A., Fernández P., Grau-Noguer E., Guillén S., Portaña S., Possas A., Vila M. (2025). Predictive microbiology through the last century. From paper to Excel and towards AI. In Advances in Food and Nutrition Research. Academic Press. DOI: 10.1016/bs.afnr.2024.09.012

4. Others: Contracts:

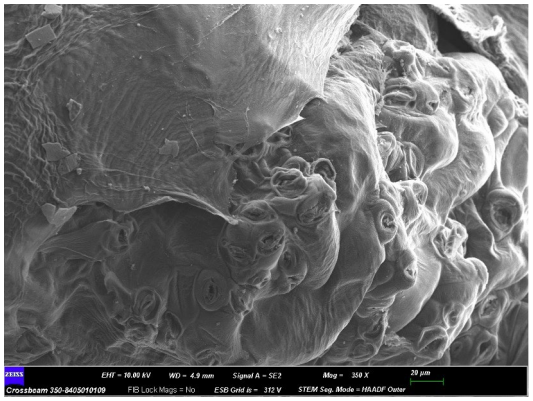
-EFSA (Ref. GP/EFSA/BIOHAW/2023/01). Consortium involving 6 EU institutions. PR: Alfredo Palop.

-EFSA (Ref. GP/EFSA/FIP/2022/01). Consortium involving 8 EU institutions PR: E. Pérez (UPV).

-Biological risk assessment evaluation and safe conditions of vegetable creams (Ref. 9056/25IA). Funder: PEPSICO EUROPE SUPPORT CENTER, S.L.

Staff: Head of the Unit: Prof. Dr. Alfredo Palop. Researchers: Prof. Dr. Pablo S. Fernández, Prof. Dr. Paula Periago, Dr. Arantxa Aznar, Dr. Arturo Esnoz, Dr. Alberto Garre, Dr. Enriqueta García. Postdoc Trainees: Dr. Ioana Bodea, Dr. Silvia Guillén. EUFORA Grants: Olga Sęczkowska, Dr. Bojan Papic, Dr. Ioana Bucka-Kolendo. M.Sc. and Ph.D. Students: Antonio Luciano, Jorge Baixauli, Ana B. Baenas, Ignacio Juan Quevedo.

GENETIC ENGINEERING OF DEVELOPMENT AND METABOLISM



1. Research interest and main results

The following research lines build the focus of our research:

-Gene function discovery "gene knockout" by Crisp/Cas and "knockdown" with Post-transcriptional Gene Silencing Technologies to uncover genes of interest for industrial purposes. Our model plants are *Petunia hybrida*, *Nicotiana benthamiana*, *Arabidopsis thaliana*. We have transferred knowledge to wheat and tomato.

-Identification of genes involved in cannabinoid synthesis in *Cannabis* using Bioinformatic analysis.

-Genetic improvement of plant cells as platforms for biotechnology production in bioreactors, using *Arabidopsis thaliana* and *Nicotiana benthamiana* mutants. We have obtained mutants with increased growth rate and friability.

-Development of protein secondary structure distance metrics.

2. Projects (most relevant)

-Proyecto PID2021-127933OB-C21- Validación de genes que coordinan crecimiento y emisión de volátiles con potencial biotecnológico.

-Agroalnext 2023-2025- Identificación de genes involucrados en friabilidad por genética reversa.

-PROMETEO-2022-26- A multiomic approach to the dissection of heterosis in *Arabidopsis*- Proyectos de Excelencia Comunidad Valenciana.

3. Selected publications

Santos M., Gila-Navarro A., Weiss J., Gonçalves B., Matos M., Egea-Cortines M. (2025). Validation of a bitmap of genes involved in cherry fruit cracking by digital PCR and qPCR, suitable for plant breeding. Scientific Reports. 15: 26619.

Verdú-Navarro F., Moreno-Cid J.A., Weiss J., Egea-Cortines M. (2025). Cascade oxygen control enhances growth of *Nicotiana benthamiana* cell cultures in stirred-tank bioreactors. Plants 14: 2879.

Navarro P.J., Salas E., Rosique F., Ruszczak B., Egea-Cortines M. (2025). Conditional generative adversarial network for segmentation and image reconstruction of grape berries in variable illumination conditions. Expert Systems with Applications: 128076.

Staff: Head of the Unit: Prof. Dr. Julia Weiss. Researchers: Prof. Dr. Marcos Egea Gutiérrez-Cortines. M.Sc. and Ph.D. Students: Fuensanta Verdú Navarro, María López-Pérez, Alberto Gila Navarro. Technicians: Ángela Espín Veracruz

INTEGRATED PEST MANAGEMENT

1. Main results

Research in 2025 focused on the genetic improvement of biological control agents, particularly *Orius laevigatus*, to enhance their performance under suboptimal environmental and nutritional conditions commonly found in protected crops. New artificially selected strains showed improved tolerance to low temperatures, greater survival during cold storage, and better fitness when feeding on alternative food sources such as pollen. These advances contribute to improving the establishment, persistence and compatibility of biological control agents within integrated pest management programs, facilitating a reduction in pesticide dependence and increasing the resilience of greenhouse production systems.

2. Projects (most relevant)

- Much better bugs for biological control: Genetic improvement of *Orius laevigatus* for better fitness on alternative food and at low temperatures (BugBetter). PID2020-116897RB-I00. MCI-AEI. 2021-2025. 242.000 €. Euros. Principal investigator: Pablo Bielza.

- Cultivos saludables en un mundo cambiante: enfoques multidisciplinarios innovadores para reforzar simbióticamente la sostenibilidad de los cultivos. (INNOSYMBIO). PLEC2021-007774. MCI-AEI. 2021-2024. 210.000 €. Euros. Principal investigator: Pablo Bielza.

3. Selected publications

Abelaira, A., Reche, M. C., Rodríguez-Gómez, A., Balanza, V., Bielza, P. (2025). Breeding cold-tolerant *Orius laevigatus* lines improves thermal tolerance and body size: implications for biological control. Pest Management Science. https://doi.org/10.1002/ps.70427.

Rodríguez-Gómez, A., Sapiña-Solano, A., Reche, M. C., Balanza, V., Abelaira, A., Bielza, P. (2025). Optimizing cold storage for *Orius laevigatus*: the role of genetic selection and fluctuating thermal regimes in enhancing survival and fecundity. J. Pest Sci. https://doi.org/10.1007/s10340-025-01920-3.

Reche, M. C., Rodríguez-Gómez, A., Balanza, V., Abelaira, A. B., Bielza, P. (2025). Critical nymphal stages of *Orius laevigatus* for suboptimal feeding with pollen: regulated deficit feeding. Biological Control. 205, 105767.

Bohloolzadeh M., Alba J. M., Serrano-Carnero D., Elragig A., Rodríguez-Gómez A., Bielza P., Legarrea S., Navajas M., Tixier M. S., Paspati A., Recker M., Montserrat M. (2025). Induced tomato defenses mediated by jasmonic acid do not have a major effect on the density of predator biological control agents. J. Pest Sci. 98: 2339–2351.

Staff: Head of the Unit: Prof. Dr. Pablo Bielza. Researchers: Prof. Dr. Josefina Contreras, Prof. Dr. Dina Cifuentes, Prof. Dr. Juan A. Martínez López, Dr. Carolina Grávalos, Dr. Virginia Balanza M.Sc. and Ph.D. Students: Amador Rodríguez, Mari Carmen Reche, Ana Belén Abelaira.

SECONDARY METABOLITES

1. Main results

The effect of salicylic acid (SA) supplementation on the in vitro response of *Cistus heterophyllus* subsp. *carthaginensis* to Pb stress was evaluated. Physiological and biochemical parameters—including mineral content, photosynthetic performance, total phenolics, and antioxidant activity—were quantitatively analyzed showing that SA pretreatment markedly reduced Pb accumulation (25%) while promoting Fe (73%), K (29%), and Mn (15%) uptake. It also alleviated Pb-induced photosynthetic impairment, preserved chloroplast integrity, increased chlorophyll content and reduced the accumulation of lipid peroxidation products. Furthermore, SA promoted the accumulation of phenolic compounds in Pb-treated shoots, resulting in increased antioxidant capacity. Overall, SA acted as an effective priming agent, maintaining mineral homeostasis, photosynthetic stability, and antioxidant defense under Pb stress. These findings highlight SA potential for enhancing plant resilience to Pb toxicity and for supporting the conservation and reintroduction of C. heterophyllus in contaminated habitats.

Four Murashige and Skoog (MS) medium variants and three cultivation systems—agar-solidified, static-liquid (L), and agitated-liquid (LA)—were evaluated to assess phenolics, antioxidant capacity, antidiabetic potential, and metabolic biochemical markers in in vitro-grown spearmint shoots. Half-strength MS (MS/2) consistently produced the highest antioxidant activity and accumulation of phenolics and sugars across all systems. The MS/2–L combination markedly boosted antioxidant responses, increasing DPPH values up to 27-fold and FRAP tenfold relative to full-strength MS. Antioxidant capacity strongly correlated with total phenolics, flavonoids, rosmarinic acid, antidiabetic activity, and carbohydrate levels. Collectively, these results highlight the strong influence of nutrient availability and culture system on the metabolic performance of in vitro-grown spearmint.

2. Projects (most relevant)

-Selección y propagación clonal de plantas aromáticas y medicinales con quimiotipos de alto valor añadido. AGROALNEXT Programme (PRTR-C17.I1). 2023-2025. P.R.: Matías López Serrano, Antonio A. Calderón.

-Uso de biofactorías vegetales y herramientas biotecnológicas para favorecer la resiliencia de plantas a estreses múltiples. Fundación Séneca (22016/PI/22). 2023-2025. P.R.: M. Ángeles Pedreño (UMU).

-Potenciando la resiliencia vegetal: Estudio ómico del efecto bioestimulante de extractos vegetales en condiciones climáticas cambiantes. MICIU (PID2024-156120OB-I00). 2025-2028. P.R.: M. Ángeles Pedreño (UMU).

3. Selected publications

Martínez-Carrillo R., Behloul F.Z., Ferrer M.A., Calderón A.A. (2025). Culture system and nutrient restriction shape antioxidant activity in *in vitro* spearmint (*Mentha spicata* L.) shoots. Plants 14(24): 3863.

López-Orenes A., Ferrer M.A., Calderón A.A. (2025). Salicylic acid mitigates lead-induced stress in the endangered shrub *Cistus heterophyllus* subsp. *carthaginensis*. Agronomy 15(12): 2792.

Staff: Head of the Unit: Prof. Dr. Antonio A. Calderón. Researchers: Prof. Dr. M. Ángeles Ferrer, Prof. Dr. Matías López Serrano.

SOIL ECOLOGY AND BIOTECHNOLOGY

Dust catchers for monitoring and characterising air erosion in mine impacted soils

Open Top Chamber (OTC) for warming simulations in mine tailing soils

Characterisation of soil microorganisms by DNA extraction.

Participation in the European Mission Soil Week in Brussels

1. Main results

-SOILPROM Project: The overall objective of SOILPROM is to deliver upgraded and integrated models for pollutant transport and fate that assess the impact of soil pollution on soil functions and related ecosystem services and to support local stakeholders towards sustainable land management strategies and policies for healthy soils all over Europe, by considering a selection of pollutants that are considered to have a high risk to the environment and humans.

-BIOservicES project. Soil analyses in the 75 experimental sites across Europe in different land uses has been finished, with results about how bacteria, fungi, protists, nematodes, mites, collembola, earthworms, isopods, myriapods, coleopters, hymenopters and arachnids change in terms of management, land use and soil type in Europe.

-InBestSoil project. We have delivered reports about how different management practices in different land uses affect soil health and the abundance of beneficial microorganisms in our European case studies.

2. Projects (most relevant)

-Modelling pollutant transport across the soil-water-atmosphere continuum and impacts on ecosystem services (101156589). SOILPROM. HORIZON-MISS-2023-SOIL-01-02, 6,847,325 € (UPCT: 563,793.75 €). PR UPCT: M. Nazaret González.

-Warming simulation in metal mine tailings soils from semiarid areas: learning lessons to face climate change in polluted environments (SIMULATE). PID2023-147960OB-I00. 287,500 €. P.R.: M. Nazaret González.

-Monetary valuation of soil ecosystem services and creation of initiatives to invest in soil health: setting a framework for the inclusion of soil health in business and in the policy making process (InBestSoil 101091099). Horizon Europe. 2023-2026. 4,999,886 € (UPCT: 523,500 €). P.R.: Raúl Zornoza. https://inbestsoil.eu/

-Linking soil biodiversity and ecosystem functions and services in different land uses: from the identification of drivers, pressures and climate change resilience to their economic valuation (BIOservicES GA 101112374). Mission Soil, EC, 2023-2028. 8,018.721 € (UPCT: 1,391,062 €). P.R.: Raúl Zornoza. https://bioservices-project.eu/

3. Selected publications

Ceacero-Moreno M., Álvarez-Rogel J., González-Alcaraz M.N. (2025). What can carbon and nitrogen mineralization reveal about soil functionality in technically restored and spontaneously colonized metalliferous mine tailings? J. Environ. Manag. 392. doi: 10.1016/j.jenvman.2025.126832.

Cuartero J., Frey B., Zornoza R., Sánchez-Navarro V., et al. (2025). The effect of sustainable management practices on the bacterial community in different European croplands. App. Soil Ecol. 215. doi: 10.1016/j.apsoil.2025.106456.

Ollio I., Zornoza R., Contreras J., Egea-Gilabert C., Fernández J.A., Lloret E. (2025). Combined microbial inoculation and reduced inorganic fertilization enhances diversity and functionality in potato rhizosphere microbiome at field scale. Chem. Biol. Tech. Agric. 12. doi: 10.1186/s40538-025-00836-5

Staff: Head of the Unit: Prof. Dr. Héctor Miguel Conesa. Researchers: Prof. Dr. José Álvarez, Prof. Dr. Ángel Faz, Prof. Dr. Raúl Zornoza, Dr. María Nazaret González. Post-docs: Dr. Virginia Sánchez, Dr. Eva Lloret, Dr. Alicia Morugán, Dr. Jesús Aguilera, Dr. Antonio Aguilar. M.Sc. and Ph.D. Students: Mohammed Mdaini, Matías Ceacero, Isabel Irene Skarmeta, Irene Ollio.

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