ANNUAL REPORT - 2024

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, INOVATION AND TECH TRANSFER

It is a great pleasure to present the 2024 Activity Report of the Institute of Plant Biotechnology (IBV), a centre that has consistently demonstrated its international vocation, capacity for attraction, and excellence in research training over more than a decade.

In the past ten years, the IBV has welcomed 225 individuals from over 30 countries, representing all levels of academic and professional development—from early-stage students to postdoctoral researchers and industry professionals. These figures are not only impressive; they stand as proof of the Institute's solid reputation as a reference hub for scientific mobility, advanced training, and interdisciplinary collaboration.

Each visitor has left a mark: in the form of new research lines, collaborative projects, technological innovation, and, above all, a richer, more diverse academic community. This report is a tribute to that shared growth.

I would also like to take this opportunity to express my sincere gratitude and recognition to Prof. Dr. Marcos Egea Gutiérrez-Cortines, who served as Director of the IBV for the past eight years. His leadership has been instrumental in reinforcing the Institute's scientific and human capital, expanding its international partnerships, and positioning it among the most dynamic centres in the European R&D ecosystem. His legacy is embedded in every achievement reflected in these pages.

At the Vice-Rectorate for Research, we remain fully committed to supporting the IBV in this new stage, confident that it will continue to attract talent, generate knowledge, and train the researchers of today and tomorrow.

Prof. Dr. Roque Torres Sánchez

FROM THE DIRECTOR

It is with great pride that I write this message as the new Director of the Institute of Plant Biotechnology (IBV) at the Universidad Politécnica de Cartagena. Although this is my first year in this role, I have been deeply involved in the IBV's development since its inception, having served as part of its leadership team throughout its evolution.

Taking on the responsibility of leading the IBV over the next six years is both an honour and a commitment that I embrace with great enthusiasm. My strategic vision is rooted in fostering synergies—both within and across our **R**esearch **U**nits, as well as with collaborators at the UPCT and at national and international levels. I believe that cooperation, interdisciplinarity, and openness are the keys to sustaining excellence and innovation in plant biotechnology.

Above all, I want to highlight that the IBV's scientific achievements are made possible by the people who contribute their knowledge, dedication, and passion. That is why this 2024 edition of the Annual Report is dedicated to them: to the many individuals who have carried out research and training stays at the IBV over the past ten years. Over the past decade, the IBV has hosted a vibrant and diverse community of researchers, from early-stage scientists seeking training and mentorship, to internationally renowned experts who have enriched our research programs through collaboration and knowledge exchange. These individuals have left a lasting impact on our institution — not only through scientific outputs but also by strengthening the cultural and academic environment of the IBV. Their presence has fostered new lines of research, promoted interdisciplinary work, and opened doors to fruitful partnerships across Europe and beyond.

This report celebrates their contributions while also highlighting the continued growth of the Institute, particularly in its capacity to attract competitive funding, enhance research infrastructure, and position itself as a reference in plant biotechnology. We hope that this memory of people and science will serve as a reflection of our shared progress and future aspirations.

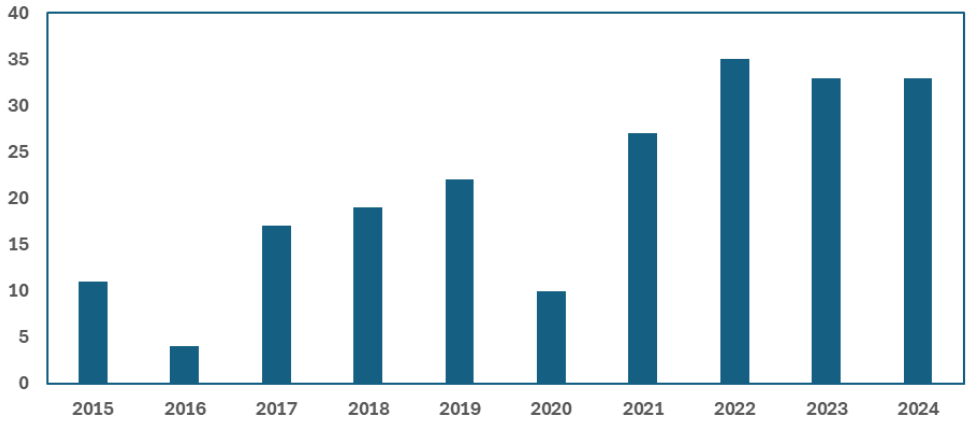
Prof. Dr. Catalina Egea Gilabert

EXCELLENCE THROUGH PEOPLE: A DECADE OF VISITING RESEARCHERS

The IBV plays a strategic role within the Universidad Politécnica de Cartagena (UPCT) as a hub for advanced research training and international scientific collaboration. Over the past decade, the Institute has hosted a significant number of research stays involving undergraduate students, postgraduate scholars, and postdoctoral researchers. Between 2015 and 2024, a total of 225 individuals completed research or training stays at the IBV (Fig. 1). The overall trend has been consistently upward, with the exception of 2020, when numbers declined markedly due to the global disruption caused by the COVID-19 pandemic.

Notably, postgraduate and postdoctoral fellows accounted for nearly half of all hosted individuals (Fig. 2), highlighting the IBV's commitment to fostering high-level scientific training and mentoring early-career researchers. In addition to academic stays, the IBV has also welcomed professionals from the private sector and technical trainees, who have undertaken specialized training and practical placements within the Institute's facilities. On average, stays lasted around one year, with postdoctoral positions representing the longest engagements, typically extending to two years (Fig. 3).

Fig. 1. Annual number of research and training stays at IBV (2015–2024)



From a geographical standpoint, 54% of participants originated from Spain, while the remaining 104 individuals came from 30 countries (Fig. 4) across four continents: Europe (54), The Americas (26), Asia (14), and Africa (10) (Fig. 5).

This level of international representation highlights the IBV's growing global visibility and its active contribution to building research capacity and fostering international collaboration in plant biotechnology.

The figures below illustrate the Institute's trajectory as a reference center for scientific mobility, training, and global partnership over the past ten years.

Fig. 2. Number and distribution of hosted individuals at IBV by academic level (2015-2024)

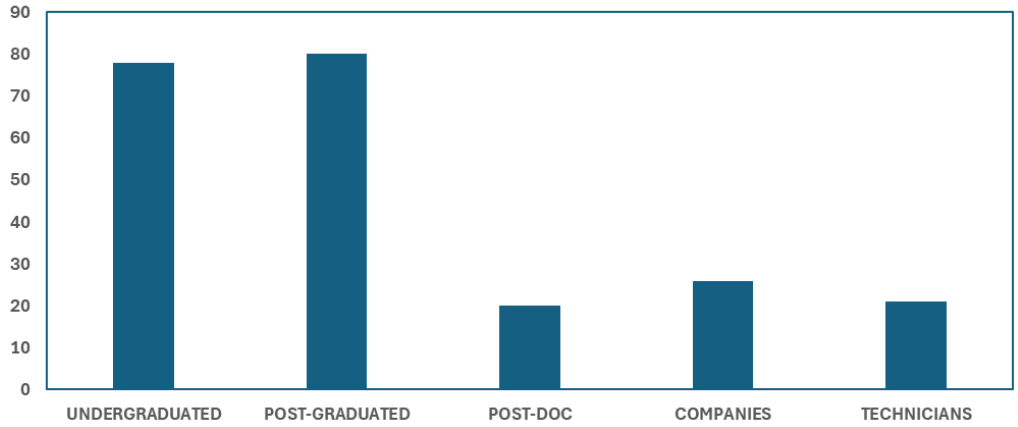


Fig. 3. Average duration of stays by type of researcher (months) at IBV (2015-2024)

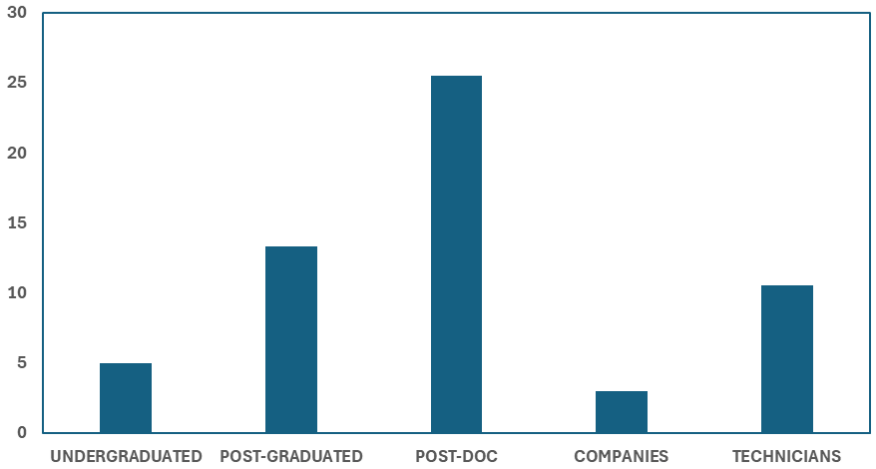


Fig. 4. Geographic origin of hosted researchers and trainees at IBV (2015–2024)

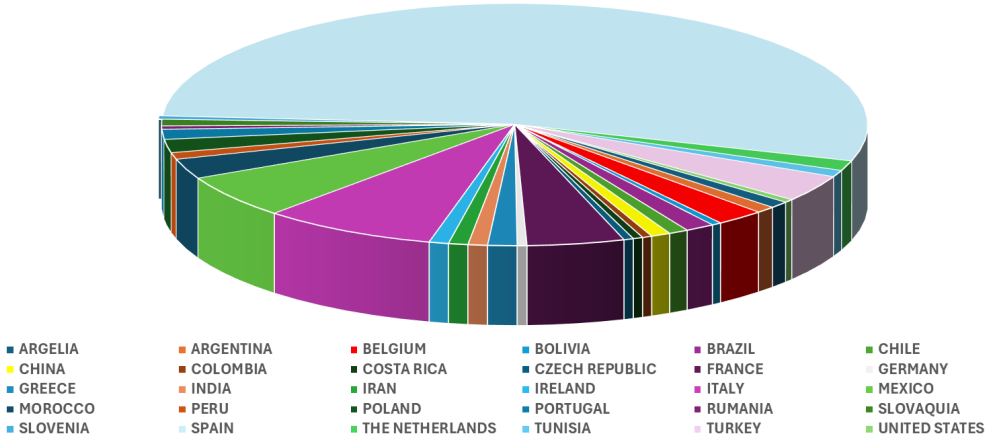
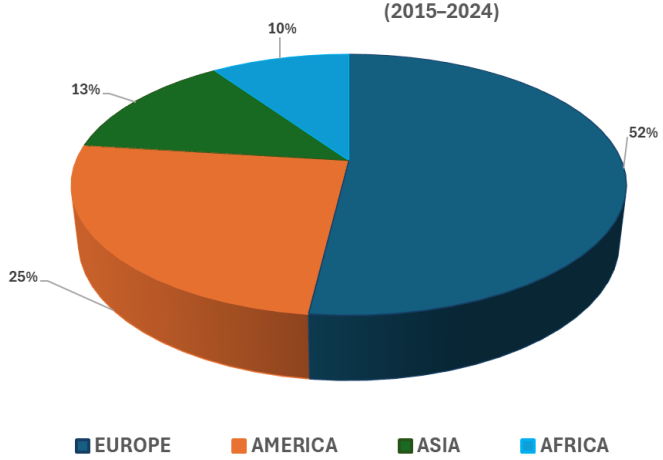


Fig. 5. Continental origin of hosted researchers and trainees (except Spain) at IBV (2015–2024)



FUNDING AND INSTITUTIONAL GROWTH

Over the past decade, the IBV has successfully attracted €14,899,535 in research funding (Fig. 6), secured through competitive calls at regional, national, and European levels (Fig. 7). This achievement reflects the Institute's strong positioning within the scientific funding landscape and its ability to lead and participate in high-impact, multidisciplinary projects.

The funding has originated from a **diverse array of national and international sources**, including the following major programs:

- **Horizon 2020 (H2020)** – The European Union Framework Programme for Research and Innovation.
- **EFSA-EUROFORA initiative** – Coordinated by the European Food Safety Authority, supporting European research on food risk assessment.
- **INTERREG SUDOE Programme** – A European Territorial Cooperation initiative promoting transnational collaboration in southwestern Europe.
- **State Programme for R&D&I Oriented to the Challenges of Society** – Part of Spain's National Plan for Scientific and Technical Research and Innovation.
- **Biodiversity Foundation (Fundación Biodiversidad)** – Supporting projects focused on terrestrial and marine biodiversity, as well as coastal ecosystem conservation.
- **Knowledge Generation Projects** – Funded within the State Programme to Promote Scientific and Technical Research and its Transfer, supporting frontier science.
- **Fundación Séneca – Plan de Actuación** – Competitive regional funding aimed at strengthening the capabilities of high-performing research groups in the Region of Murcia.
- **EU-FORA Fellowship Programme (EFSA-EUBA)** – Hosting of fellows and sites selected by the European Food Safety Authority for training in food risk assessment.

These competitive grants have played a crucial role in **strengthening the IBV's scientific infrastructure**, **expanding its international collaborations**, and **enhancing the societal impact of its research** through innovation, technology transfer, and policy support.

Fig. 6. Funding sources at IBV (€) (2015-2024)

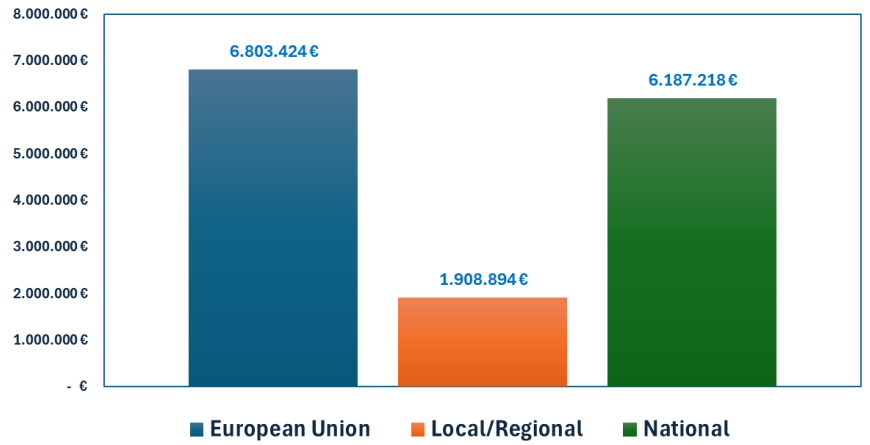
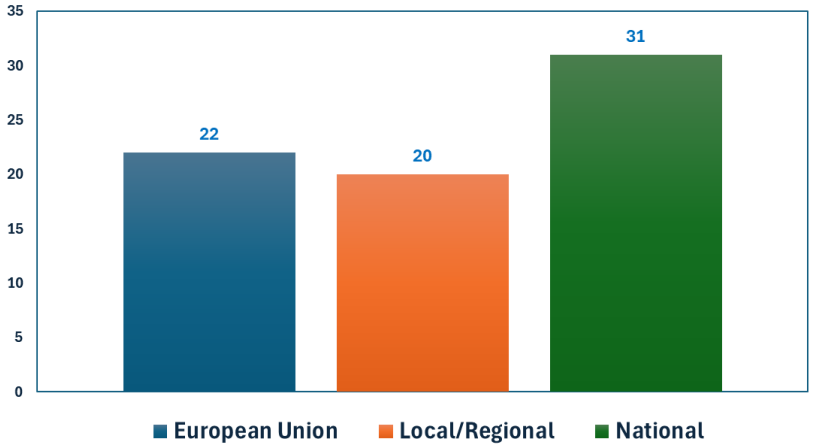
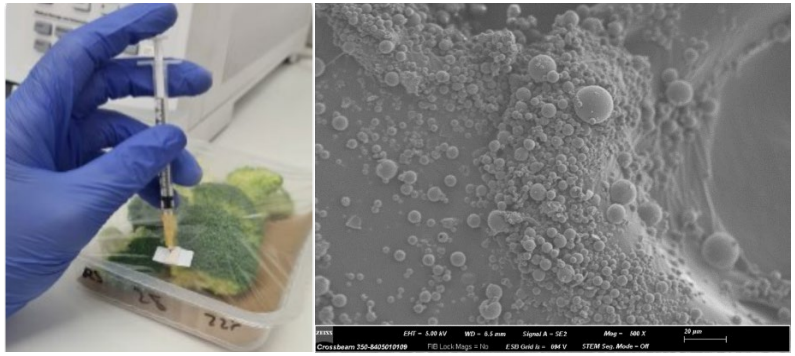


Fig. 7. Number of funded research projects at IBV (2015-2024)



RESEARCH HIGHLIGHTS BY UNITS

BIOTECHNOLOGICAL PROCESSES, TECHNOLOGY AND ENGINEERING



1. Main results

In 2023 and 2024, 10 research articles have been published in international journals (Foods, Food and Bioprocess Technology, Plants, Food Packaging and Shelf Life, Scientia Horticulturae, Clean Technologies; Food Science and Technology International); 2 patents (European patent EP24382471.1 and WO 2024/246393 A1) and 7 Book chapters (Proc. 26th IIR Int Congress of Refrigeration, and Proc. 2024 CYTEF Int Congress; Proc 5th Int Conf on Fresh-Cut Produce). Prof. A. López Gómez is Editor of the International Journal "Food Engineering Reviews" (Q1, IF 5.3 in 2023, Springer), and Editorial Board Member of the Int. J. "Clean Technologies" (Q1, IF 4.1 in 2023, MDPI). Dr. Ginés Benito Martínez Hernández is Editorial Advisory Board Member of ACS Food Science & Technology (ACS Publications).

2. Projects (most relevant)

Project title: "DETERMINATION OF THE INHIBITORY EFFECT OF ESSENTIAL OILS IN THE ETHYLENE PRODUCTION OF FRUITS AND VEGETABLES TO DEVELOP INNOVATIVE ACTIVE PACKAGING SYSTEMS" (ref. PID2020-119882RB-I00). Funding organization: Spanish Ministry of Science and Innovation; Programa Estatal de Investigación, Desarrollo e Innovación Orientada a los Retos de la Sociedad. Project Budget = 112,530 Euros; from 5. Sep. 2021-Sep.2024. Principal Researchers: Ginés Benito Martínez Hernández and Antonio López Gómez.

Project title: "RESEARCH AND DEVELOPMENT OF A NEW SYMBIOTIC AND ITS INDUSTRIAL MANUFACTURING PROCESS AS A FOOD SUPPLEMENT (SYMBIO)" (ref. IDI-20211211)**.** Funding organization: Centro para el Desarrollo Tecnológico Industrial (CDTI). Participating entities: Universidad Politécnica de Cartagena and the Company Martínez Nieto S.A. Project Budget =577,226,00 Euros; from Feb. 2021-Mar. 2023. Principal researchers: Antonio López Gómez and Ginés Benito Martínez Hernández.

3. Selected publications

Martínez-Sánchez, M. A., Martínez-Hernández, G. B., López-Gómez, A. 2024. Extending More than One Week the Shelf Life of Fresh-Cut Lettuce Using Vinegar Enriched in Bioactive Compounds Encapsulated in α-Cyclodextrins. Foods, 13(19), 3142.

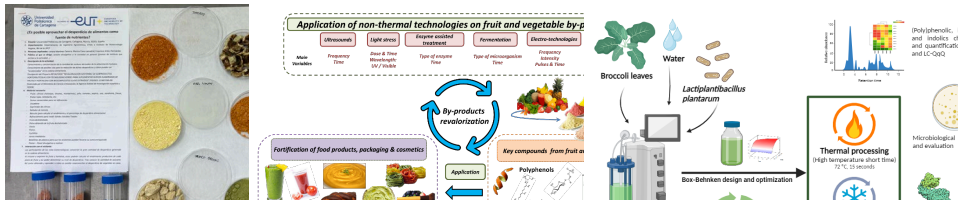
López-Gómez, A., Navarro-Martínez, A., Garre, A., Iguaz, A., Maldonado-Guzmán, P., Martínez-Hernández, G. B. 2023. Kinetics of carvacrol release from active paper packaging for fresh fruits and vegetables under conditions of open and closed package. Food Packaging and Shelf Life, 37, 101081.

4. Others. Most relevant contracts

Contract title: "DEVELOPMENT OF THE BIOSYNTHESIS AND PURIFICATION PROCESS OF HIGH MOLECULAR WEIGHT HYALURONIC ACID". Funded by Private Company (*ref ART.83 7987/23IA)*. Participants: UPCT and the Company PEACHES S.L. (Madrid); from 01/01/2023 to 31/11/2024. Principal Researchers: Antonio López Gómez and Marcos Egea Gutiérrez-Cortines.

Staff: Head of the Unit: Prof. Dr. Ing. Antonio López Gómez. Researchers: Prof. Dr. Ing. Asunción Iguaz Gainza; Prof. Dr. Ing. Ginés Benito Martínez Hernández; Dr. A.E. López Cánovas; M.Sc. and Ph.D. Students: Marta Barón Yusty; 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

• The digestive process of a functional beverage made from broccoli by-products influences the release and transformation of bioactive compounds, enhancing their bioaccessibility and health benefits.

• Fermentation-assisted extraction of a broccoli leaf-based beverage found that high hydrostatic pressure (200 MPa, 10 min) best preserves sulforaphane, LAB population, and antidiabetic potential.

• Optimizing green extraction techniques from horticultural by-products to achieve the best bioactive compounds recovery.

• The potential use of extracted biocompounds from horticultural by-products for food supplementation has been tested.

•New table grape hybrids development from teinturier population with enhanced phytochemical quality.

• The use of reusable plastic crates is the most sustainable and circular option for transporting fruits and vegetables compared to single-use cardboard and wooden crates.

2. Projects (most relevant)

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

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

-Elaboración de una bebida fermentada a partir de subproductos. CO-IP: Encarna Aguayo.

3. Selected publications

Martínez-Zamora L., Hashemi S., Cano-Lamadrid M., Bueso M.C., Aguayo E., Kessler M., Artés-Hernández F. 2024. Ultrasound-assisted extraction of bioactive compounds from broccoli by-products. Foods. 13(10): 1441. 15 pp. https://doi.org/10.3390/foods13101441

Martínez-Zamora L., Castillejo N., Artés-Hernández F. 2024. Fortification of an innovative tomato cold soup with high bioaccessible sulforaphene from UV-B treated radish seeds. Food and Bioprocess Technology. 17: 2631–2643. https://doi.org/10.1007/s11947-023-03273-0

Mozafari L., Cano-Lamadrid M., Martínez-Zamora L., Bueso M.C., Kessler M., Artés-Hernández F. 2024. Pulsed ultrasound-assisted extraction of lycopene and β-carotene from industrial grated tomato by-products. LWT- Food Science and Technology. 204: 116462. 8 pp. https://doi.org/10.1016/j.lwt.2024.116462

Rasines, L., San Miguel, G., Corona, B., Aguayo, E., 2024. Addressing the circularity and sustainability of different single-use and reusable crates used for fresh fruit and vegetables packaging. Food Packaging and Shelf Life, 46, 101391. https://authors.elsevier.com/sd/article/S2214-2894(24)00156-X

Salas-Millán, J.A., Aguayo, E. 2024. Bioaccessibility and unravelling of polyphenols, sulforaphane, and indoles biotransformation after in vitro gastrointestinal digestion of a novel lactofermented broccoli beverage. Food & Function, 11949 – 11960, https://doi.org/10.1039/d4fo03528c

Salas-Millán, Conesa-Bueno, A., Aguayo, E. 2024. A Novel Antidiabetic Lactofermented Beverage from Agro-industrial Waste (broccoli leaves): Process Optimisation, Phytochemical Characterisation, and Shelf-life Through Thermal Treatment and High Hydrostatic Pressure. Food Bioscience, 59. 103999. https://doi.org/10.1016/j.fbio.2024.103999

Zapata R., Martínez-Zamora L., Cano-Lamadrid M, Artés-Hernández F. 2024. Wounding citrus peel by-products as abiotic stress to induce the synthesis of phenolic compounds?. Horticulturae. 10: 885. 17 pp. Open Access. https://doi.org/10.3390/horticulturae10080885

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

PLANT GENETIC RESOURCES AND SUSTAINABLE HORTICULTURAL TECHNOLOGY

1. Main results

During 2024, the Unit have continued working on the introduction and fine-tuning of production techniques for new horticultural and ornamental species, on the hydroponic cultivation of baby leaf vegetables, developing a production technology to obtain a high-quality product and adequate postharvest life, the molecular characterization of marginal crops and possible reuse.

Also, we continue working on the project "Next Generation" focused on the optimization of organic fertilization versus to conventional in crop rotation systems, on a comparative study of different soilless systems in relation to their suitability for water and nutrient reuse and on the use of biodegradable and compostable materials for packaging of minimally processed products. Among the different technologies, a proof-of-concept, with a luminary robot has been registered for its use in nurseries and greenhouses. Additionally, new protocols of organic fertilization with the use of enriched biocarbon are being investigating, and root oxygenation is testing in different projects to improve root system in compacted soils and soils susceptible to different pathogens related to anoxia conditions.

On the other hand, the Unit continues working on the conservation and recovery of the jara de Cartagena, a species declared in a critical situation by the Spanish government.

2. Projects (most relevant)

Horticultural innovations in soil-friendly practices to ensure a sustainable future. Hort2thefuture. European Commission. Grant agreement ID: 101157434. 01/06/2024-31/05/2028. 6.499.797.00€.

Hort2thefuture: Horticultural innovations in soil-friendly practices to ensure a sustainable future. Hort2thefuture. 608.488,75 €.

E-SPFdigit: Emergent soil, plant and food onsite digital services on chemical and biological contaminants. E-SPFdigit. 356.875,00 €.

Prácticas agrarias innovadoras para contribuir a la mejora ambiental y de la biodiversidad en el entorno del Mar Menor. NEWAGROMARMENOR. 1.554.007,75 €.

3. Selected publications

Giménez A., et al. 2024. Enhancing the cultivation of Salicornia fruticosa with agroindustrial compost leachates in a cascade cropping system: evaluating the impact of melatonin application. Front. Plant Sci. 15:1441884. doi: 10.3389/fpls.2024.1441884

Gallegos-Cedillo, V.M. et al. 2024.An in-depth analysis of sustainable practices in vegetable seedlings nurseries: A review. Scientia Hortic., 334,113342

Gallegos-Cedillo, V.M., et al. 2024. Analysis of global research on vegetable seedlings and transplants and their impacts on product quality. J Sci Food Agric, 104: 4950-4965.

García-Gómez, P., et al. 2024. Effect of Biochar Amendment and Organic Fertilization on the Yield and Nutritional Quality of Artichoke (Cynara cardunculus L.). Horticulturae, Vol. 10, Núm. 9

Staff: Head of the Unit: Prof. Dr. María José Vicente. Researchers: Prof. Dr. Sebastián Bañón, Prof. Dr. Encarnación Conesa, Prof. Dr. Catalina Egea-Gilabert, Prof. Dr. Juan Esteva, Prof. Dr. José A. Franco, Prof. Dr. Juan A. Fernández, Prof. Dr. Juan J. Martínez Sánchez, Prof. Dr. Jesús Ochoa. Prof. Dr. María del Carmen Martínez Ballesta. M.Sc. and Dr. Almudena Giménez Martínez.

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MICROBIOLOGY AND FOOD SAFETY

1. Main results

During 2024 the Unit has continued working on the microbiological aspects of food safety, focussing mainly on the inactivation kinetics of microorganisms exposed to food preservation treatments and on the growth kinetics of the survivors to these treatments. The Unit received financial support during this period from three research projects, funded by the Spanish Government, and from two contracts. Members of this Unit participated in one Spanish food safety network and two consortia performing risk assessment for EFSA. 8 articles were published in indexed journals. Members of the Unit also organised the XXIII National Congress of Food Microbiology, of the Spanish Society for Microbiology, which was held in Cartagena during 9 – 12 September 2024.

2. Projects (most relevant)

-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) Principal investigator: Pablo S. Fernández.

-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). Principal investigator: Fernando Pérez (UCO). *Net involving 10 Spanish institutions.*

-Ómicas y analíticas para combatir patógenos alimentarios presentes en biofilms. MCIU (ref. PID2023-149211OB-C31). Principal investigator: Alfredo Palop and Enriqueta García.

3. Selected publications

Bodea I.M., Catunescu G.M., David A.P., Vidican R., Pop C.R., Stanila, A, Rotar A.M., Palop A. 2024. Optimization of microwave assisted extraction of bioactive compounds in oregano and lovage ethanolic extracts. LWT – Food Science and Technology, 212: 116973. DOI: 10.1016/j.lwt.2025.116793

Garcia-Gutierrez E, O'Mahony AK, Dos Santos RS, Marroquí L, Cotter PD. 2024. Gut microbial metabolic signatures in diabetes mellitus and potential preventive and therapeutic applications. *Gut Microbes*, 16(1). DOI: 10.1080/19490976.2024.2401654

Garre A, Fernández PS, Grau-Noguer E, Guillén S, Portaña S, Possas A, Vila M. 2024. Chapter one – Predictive microbiology through the last century. From paper to Excel and towards AI. Advances in Food and Nutrition Research, 113: 1-63. DOI: 10.1016/bs.afnr.2024.09.012

Guillén S, Possas A, Valero A, Garre A, 2024. Optimal experimental design (OED) for the growth rate of microbial populations. Are they really more "optimal" that uniform designs? International Journal of Food Microbiology, 413: 110604. DOI: 10.1016/j.ijfoodmicro.2024.110604

Somrani M, Huertas JP, Iguaz A, Debbabi H, Palop A. 2024. Biofilm busters: Exploring the antimicrobial and antibiofilm properties of essential oils against *Salmonella* Enteritidis. Food Sci Technol Int. DOI: 10.1177/10820132241227004

Yeak KYC, Garre A, Membré JM, Zwietering MH, den Besten HMW. 2024. Systematic risk ranking of microbiological hazards in infant foods. Food Research International. 192, 114788. DOI: 10.1016/j.foodres.2024.114788.

4. Others:

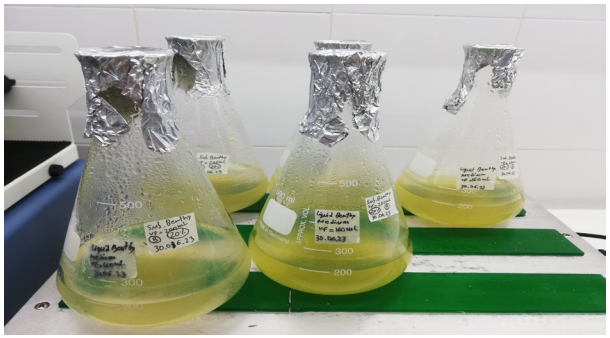
Contracts: Company: Freefield, S.R.L. Contract leader: Alfredo Palop.

EFSA (Ref. GP/EFSA/BIOHAW/2023/01). Consortium involving 6 EU institutions. Leader: A. Palop.

EFSA (Ref. GP/EFSA/FIP/2022/01). Consortium involving 8 EU institutions Leader: E. Pérez (UPV). Company: Pepsico Europe Support Center S.L. Contract leader: Pablo S. Fernández.

Staff: Head of the Unit: Prof. Dr. Alfredo Palop. Researchers: Prof. Dr. Pablo S. Fernández, Prof. Dr. Paula M. Periago, Dr. Arantxa Aznar, Dr. Arturo Esnoz, Dr. Alberto Garre, Dr. Enriqueta Garcia-Gutierrez. Postdoc Trainees: Dr. Ioana Bodea, Dr. Silvia Guillén, Dr. Mariem Somrani. EUFORA Grants: Dr. Ioana Bodea, Dr. Bojan Papić and Dr. Joanna Bucka-Kolendo. Ph.D. and Master Students: Leonidas Georgalis, José Lucas, Antonio Luciano, Jorge Baixauli, Zhour Faté.

GENETIC ENGINEERING OF DEVELOPMENT AND METABOLISM



. Research interest and main results

The following research lines build the focus of our research:

1: 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

2: Characterization of *Cannabis sativa* varieties with differences in compounds such as CBD, THC and terpenoids on the transcriptomic, genomic and metabolomic level. We focus on the identification of genetic differences involved in the regulation of the synthesis of these compounds using bioinformatic and molecular techniques such as the yeast one hybrid system.

3: Genetic improvement of plant cells as platforms for biotechnology production in bioreactors, using *Arabidopsis thaliana* and *Nicotiana benthamiana mutants.*

4: Development of protein secondary structure distance metrics

2. Projects (most relevant)

-BFU-2017 88300-C2-1-R; 2018-2021. Análisis de genes de control del desarrollo floral y la emisión de volátiles.

-Agroalnext 2023-2025

3. Selected publications

Hannu Fritze, Tero Tuomivirta, Luigi Orrù, Loredana Canfora, Jessica Cuartero, Margarita Ros, Jose Antonio Pascual, Raúl Zornosa, Marcos Egea-Cortines, Kristiina Lång, Janne Kaseva, Krista Peltoniemi. (2024) Effect of no-till followed by crop diversification on the soil microbiome in a boreal short cereal rotation. Biology and Fertility of Soils. 60: 357-374.

4. Others

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

Technicians: Ángela Espín Veracruz

INTEGRATED PEST MANAGEMENT

1. Main results

Biological control in protected crops mainly relies on omnivorous predators, such as *Orius laevigatus* (Hemiptera: Anthocoridae) and *Macrolophus pygmaeus* (Hemiptera: Miridae). Despite its success as biological control agents, there are several limitations that hinder a wider adoption. Our group is carrying out a selective breeding program to select strains of these predators better adapted to agrosystems.

2. Projects (most relevant)

-Innovative tools for rational control of the most difficult-to-manage pests ("super pests") and the diseases they transmit. SUPERPESTS. 773902. Horizon 2020 Framework Programme. 2018-2022. Total 2.991.525 €, UPCT: 240.000 €. Principal investigator: Pablo Bielza.

- 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. 2021-2024. 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

Bohloolzadeh, M., Elragig, A., Bielza, P., Montserrat, M., & Recker, M. (2024). Synergistic and antagonistic interactions between plant defences and biological pest control. Crop Protection, 184, 106841.

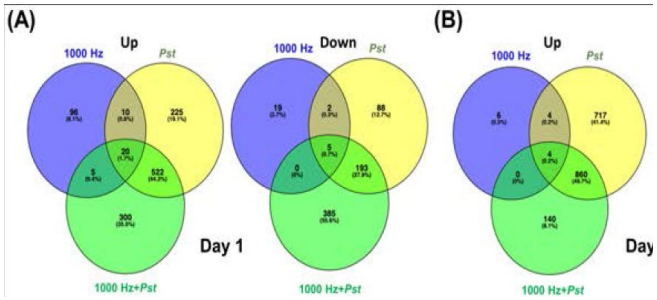
Hernández-Pelegrín, L., Rodríguez-Gómez, A., Abelaira, A. B., Reche, M. C., Crava, C., Lim, F. S., ... & Herrero, S. (2024). Rich diversity of RNA viruses in the biological control agent, Orius laevigatus. *Journal of Invertebrate Pathology*, *206*, 108175.

Mendoza, J. E., Balanza, V., Rodríguez-Gómez, A., Cifuentes, D., & Bielza, P. (2024). Relevance of diet diversification in the coexistence between Orius laevigatus and Amblyseius swirskii: prey switching and intraguild predation. Journal of Pest Science, 97(4), 1993-2005.

Zeng, B., Hunt, B. J., Pym, A., Balanza, V., Bass, C., Bielza, P., & Troczka, B. J. (2024). Aberrant splicing of a nicotinic acetylcholine receptor alpha 6 subunit is associated with spinosad tolerance in the thrips predator Orius laevigatus. *Pesticide Biochemistry and Physiology*, *200*, 105837.

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 effects of sound vibration (SV) frequencies on the physiological responses of tomato Micro-Tom were evaluated 1 and 3 days after treatment. The results showed that SV-induced physiological changes were frequency- and time-dependent, with the greatest changes recorded at 1000 Hz on day 3. SV treatments tended to alter the foliar content of metabolites and the antioxidant enzymatic activity. Microarray data showed that 1000 Hz treatment was effective in inducing transcriptional reprogramming in tomato plants grown under normal conditions, but particularly after infection with *Pseudomonas syringae* pv. *tomato* DC3000 (Pst DC3000). Pst DC3000 challenge of plants resulted in the upregulation of unique differentially expressed genes (DEGs) involved in defensive responses at 1000Hz. DEGs linked to boosted plant immunity were significantly higher in these plants than in non-SV-treated infected plants.

A combination of enzymatic and sequencing assays was carried out on stevia genotypes from Brazil and Spain with contrasting Reb-A production capabilities (off/on). *SrUGT76G1* relative expression was ~3-fold higher in Spanish samples. Protein fractions from Brazilian plants were unable to convert STV into Reb-A under in vitro conditions. The Brazilian *SrUGT76G1* gene contains a premature stop codon and mutations affecting key amino acids and is unable to catalyse STV-to-Reb-A conversion.

The phenolic profile and antioxidant activity of four fennel hybrid genotypes were analysed. The antioxidant activity results showed significant variation among fennel cultivars and methanolic extracts had the highest antioxidant activity. Total phenolic content peaked in the aqueous-methanol extracts and there was a 2-fold difference between the genotypes. Analysis identified high levels of caffeic acid derivatives, particularly in the commercial genotype.

2. Projects (most relevant)

-Factorías vegetales para la producción de anticancerígenos: Profundizando en el conocimiento de su biosíntesis, regulación y homeostasis redox en condiciones de elicitación. MICINN (PID2020-113438RB-I00). 2021-2024. Principal investigator: Javier Palazón Barandela (UB).

-Selección y propagación clonal de plantas aromáticas y medicinales con quimiotipos de alto valor añadido. AGROALNEXT Programme (PRTR-C17.I1). 2023-2025. Principal investigators: 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. Principal investigator: María Ángeles Pedreño (UMU).

3. Selected publications

Calderón, A.A., Almagro, L., Martínez-Calderón, A., Ferrer, M.A. 2024. Transcriptional reprogramming in sound-treated Micro-Tom plants inoculated with *Pseudomonas syringae* pv. *tomato* DC3000. Physiol. Plant. 176(3): e14335.

Lucho, S.R., do Amaral, M.N., Bianchi, V.J., Almagro, L., Ferrer, M.A., Calderón, A.A., Braga, E.J.B. 2024. Sequencing analysis and enzyme activity assay of SrUGT76G1 revealed the mechanism toward on/off production of Rebaudioside-A in stevia plants. J. Plant Biochem. Biotechnol. 33(2): 205–215.

Rubio, A., López-Orenes, A., Ferrer, M.A., Calderón, A.A. 2024. Influence of genotype on antioxidant activity and phenolic profile of fennel bulbs. Agronomy 14(3): 484.

4. Others:

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

October 2024: Members of the SOILPROM project consortium during the kick-off meeting held at the UPCT.

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

Soil sampling in Mediterranean orchards.

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. Between October 22 and 24, 2024, the Kick-off meeting of the European SOILPROM project was successfully held at the UPCT.

- SoildiverAgro project. All results have been obtained in all European case studies, with the identification of those practices and management that enhance soil biodiversity and crop yield and quality.

- BIOservicES project. Soil has been sampled in 75 experimental sites across Europe in different land uses (urban, agriculture, forestry, industrial, mining and semi-natural) to assess the link between soil biodiversity and the delivery of ecosystem services. Soil will be analysed during 2025.

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 €). PI UPCT M. Nazaret González. http://suelos.upct.es/es/node/268.

- 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 €. PI: M. Nazaret González.

- Soil biodiversity enhancement in European agroecosystems to promote their stability and resilience by external inputs reduction and crop performance increase (SoilDiverAgro, GA 817819). H2020-Europ. Comm. 2019-2024. 6,999,889€ (UPCT: 794.375€). PI: Raúl Zornoza. (http://www.soildiveragro.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 €). PI: Raúl Zornoza. (https://bioservices-project.eu/).

3. Selected publications

K. Peltoniemi et al., 2024. Soil and climatic characteristics and farming system shape fungal communities in European wheat fields. Agriculture, Ecosystems & Environment. 370, pp. 109035. DOI: 10.1016/j.agee.2024.109035.

H. Fritze et al., 2024. Effect of no-till followed by crop diversification on the soil microbiome in a boreal short cereal rotation. Biology and Fertility of Soils. DOI: 10.1007/s00374-024-01797-x

Conesa, H.M., Párraga-Aguado, I.M., Jiménez, F.J., Querejeta, J.I. 2024. Evaluation of the trade-off between water use efficiency and nutrient use efficiency in two semiarid coniferous tree species growing on an organic amended metalliferous mine tailing substrate. Science of the Total Environment. 940:173607. doi:10.1016/j.scitotenv.2024.173607.

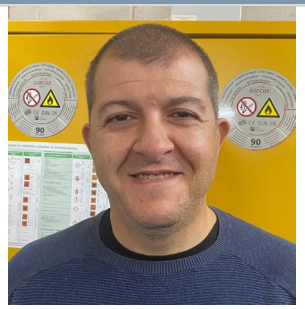
Silva, I.; Alves, M.; Malheiro, C.; Silva, A.R.R.; Loureiro, S.; Henriques, I.; González-Alcaraz, M.N. 2024. Structural and Functional Shifts in the Microbial Community of a Heavy Metal-Contaminated Soil Exposed to Short-Term Changes in Air Temperature, Soil Moisture and UV Radiation. Genes 2024, 15, 107. https://doi.org/10.3390/genes15010107.

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

MANAGEMENT TEAM

Prof. Dr. CATALINA EGEA GILABERT DIRECTOR	Prof. Dr. JULIA WEISS VICE DIRECTOR	Dr. MATÍAS LOPEZ SERRANO SECRETARY
		
Tel. +34 868071075 / 4180 catalina.egea@upct.es	**Tel.** +34 968325777 julia.weiss@upct.es	**Tel.** +34 868071281 matias.lopez@upct.es

FACILITY MANAGERS AND ADMINISTRATION

Dr. PERLA GÓMEZ DI MARCO CORE FACILITY HEAD MANAGER	Dr. MARIANO OTÓN ALCARAZ CORE FACILITY HEAD MANAGER	ANA FRUCTUOSO HERNÁNDEZ ADMINISTRATIVE OFFICER
		
Tel. +34 868071069 perla.gomez@upct.es	**Tel.** +34 868071068 mariano.oton@upct.es	**Tel.** +34 968325432 ana.fructuoso@upct.es