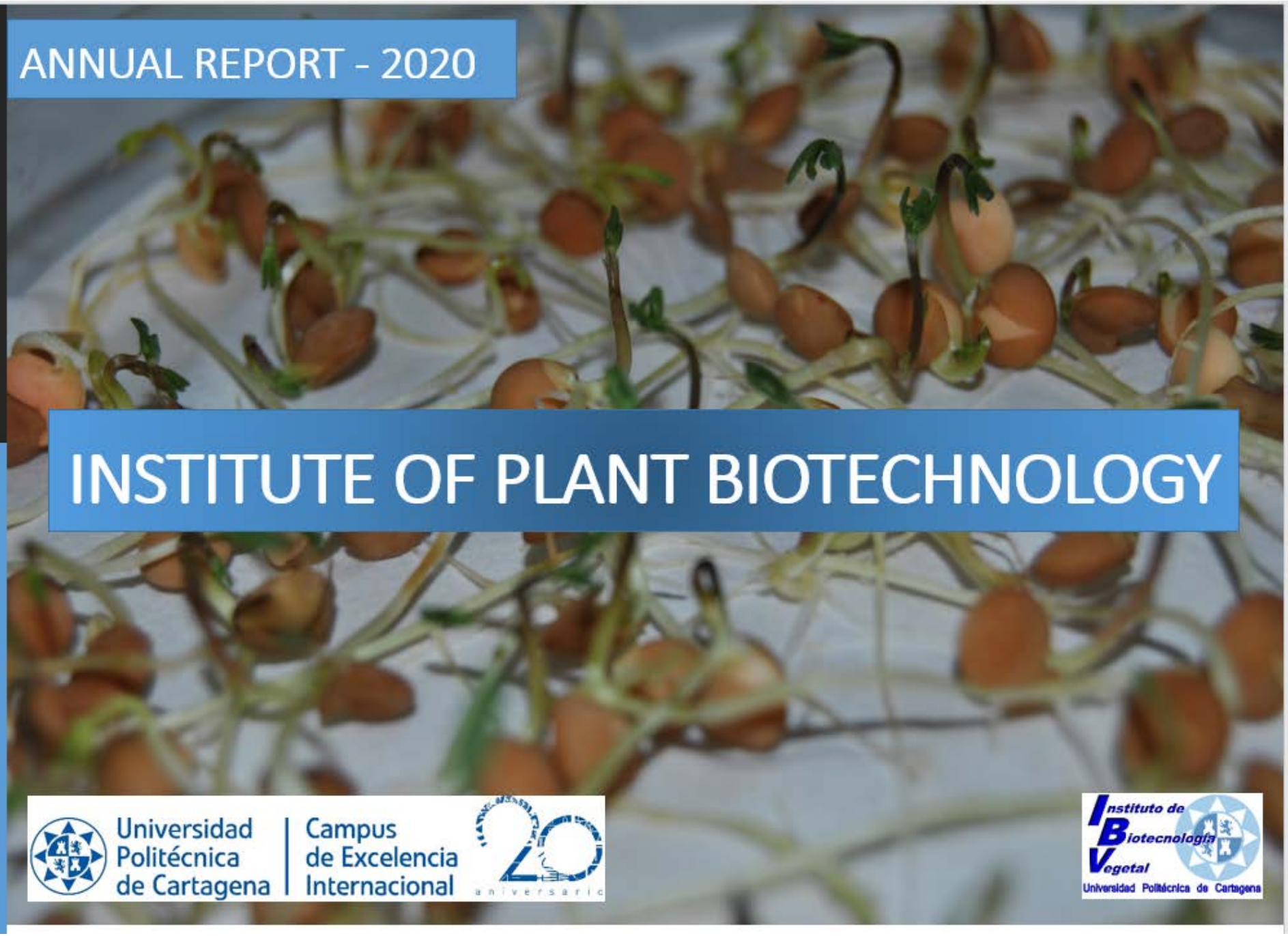
ANNUAL REPORT - 2020

INSTITUTE OF PLANT BIOTECHNOLOGY



Universidad Politécnica de Cartagena | Campus de Excelencia Internacional

Instituto de Biotecnología Vegetal
Universidad Politécnica de Cartagena

INDEX

FROM THE VICEPRESIDENT FOR RESEARCH

The pandemic that began in 2020 has highlighted the role of researchers in society. Thanks to vaccines we are seeing the light at the end of this dark tunnel. These vaccines have been developed in record time thanks to the fact that there were many years of basic research on the subject and that all the money needed for this has been put in.

Despite the adverse conditions, IBV researcher team have made an enormous effort to adapt to the circumstances. They have incorporated digitalisation into their work routines in an almost natural way in a very short time, and although many experiments had to be postponed it has been achieved to culminate this year with a high scientific output, reflected in this memory.

In addition, it is worthy to highlight this year the incorporation of new talent into the units of the IBV, which ultimately ensures the continuity and consolidation of the institute. People are key in this process; they are already the ones who must plan and carry out the transformation of research lines to adapt them to technological and social changes.

I would like to point out that Europe has already laid down very clear guidelines for us through the Green Deal and, recently, in the post-covid recovery plan. Digitalisation and sustainability are the key pillars on the road to recovery, as already demonstrated by the results of the projects carried out by the IBV researchers.

To conclude, I would like to mention in this letter the importance of the European University of Technology (EUt+) for our university, in which the IBV will play a strategic role, since it is a strength that the UPCT offers to the alliance. I am sure that with everyone's work we will achieve a prominent position in Europe in plant biotechnology.

Prof. Dr. Catalina Egea Gilabert

FROM THE DIRECTOR

The year 2020 has marked the World with the pandemic caused by the SARS-COV2 virus, causing the COVID19 sickness. The situation has completely changed the perspective for the scientific community and the education system. New methods had to be devised to work and teach online. Congresses and meetings also went online. However, and most relevant for an Institute of Biotechnology, we learned important lessons about how science and technology work, that can be distilled in the following messages:

- Basic research paved our way out of the pandemic. Four tools were needed, one was previous work on viruses infecting bats and pangolins that showed the nature of the virus. Second was the rapid sequencing and genomic tools used to obtain data. Third was the big effort and tools previously developed in phylogenetics. And finally, the development of RNA-based vaccines had occurred over a period of 40 years of research starting in 1987.
- The development of the vaccines required the fast-paced clinical trials, that otherwise may have taken ten years. This happened because money and stakeholders were aligned to speed up the process
- Finally, it soon became apparent that the biotechnology sector itself was undersized to meet the need to created vaccines for 7.5 billion people around the World

As a public Institute it has been a year of challenges. Luckily, but also due to good practice, we did not close due to personal infected with COVID19. We have many research projects that are dependent on seasonal products, such as fruits and vegetables. The curfew imposed by the pandemic and the ratios of people allowed to work made it challenging to do the planned experiments and deliver the results. This happened both for public and private funded projects. The main negative impact of the pandemic was on students training. Biotechnology is done in the lab, pilot plants and greenhouses. We created time shifts for students, thus complying with the local security COVID measures. Nevertheless, working hours had to be increased in order to meet our needs as manpower was diluted.

While we played a minor role in the public health sector, based on the basic research track record, the Molecular Genetics Unit was validated by the Ministry of Health to perform RT-QPCRs of SARS-COV2 and more than 150 samples were processed.

The IBV is in a process of complete renewal. It starts by attracting new talent to replace the senior researchers. This is a long-lasting task, requiring important efforts in order to make the IBV attractive to competitive young scientists. The newly incorporated researchers in 2020, one as Beatriz Galindo and the second as Saavedra Fajardo, and obtaining a Ramon y Cajal in 2021 bring new research lines to the UPCT strengthening our capacity to secure extramural funding. New lines also mean avoiding obsolete teaching. The different research Units have also started new research lines including the use of LED lights to improve food quality and biotechnology of plant cells for production of vaccines and other proteins in bioreactors. These research lines are at the edge of basic research and technology development.

Following our previous experience, we have a total of four technicians being trained in research that are transferred to the private and public sector upon finishing their internships.

Prof. Dr. Marcos Egea Gutiérrez Cortines

NEW RESEARCH LINES

Advanced nanoencapsulation techniques of plant-origin bioactive compounds

Dr. Ginés Benito Martínez Hernández.

I obtained a Beatriz Galindo research contract to develop my research line focused on advanced nanoencapsulation techniques of plant-origin bioactive compounds with several properties (health-promoting, antimicrobials, antioxidants, probiotics, etc.). I develop this research line in the Technology and Engineering of Biotechnological Processes unit (led by Dr. Antonio López) of the Institute of Plant Biotechnology. Nano-food is a well-known term of social media, which is linked to the application of nanotechnology [i.e., science, engineering, and technology conducted at the nanoscale (1-100 nm)] in packaged food products. This research line will allow the development of new reformulated foods with active packaging, which will lead to food products with longer shelf-life, better quality retention, microbiologically safe and improved health benefits.

The line is focused on the optimization of nanoencapsulation techniques of bioactive compounds from plant products and their incorporation within packaged food products (active packaging). It is also supported by our EOsPackSystem project (PID2020-119882RB-I00), recently (2021) funded by the Spanish Ministry of Science, that will aim to better understand, for example, how the release kinetics of these encapsulated bioactive compounds trigger cell responses in several fruit and vegetables during postharvest life. Overall, this research line will allow obtaining products with better organoleptic characteristics, safe, rich in nutritional/bioactive compounds and longer expiration dates, hence reducing food waste, which unfortunately reaches up to 45-55% for fruit and vegetables.

Global warming and ecotoxicity of anthropogenic metal-polluted soils from temperate regions

Dr. María Nazaret González Alcaraz.

After getting the 2-year Marie Sklodowska-Curie Individual Fellowship in 2017 I moved to the University of Aveiro (Portugal) to work in the R&D group led by Dr. Susana Loureiro. There, I developed a project on the effects of single/multiple climate factors (air temperature, soil moisture, atmospheric CO2, and UV radiation) on the ecotoxicity of metal-polluted agricultural/forest soils from central-northern Portugal. In 2020 I returned to the UPCT with a 3-year Saavedra Fajardo Research Contract to study the ecotoxicity of soils affected by metal pollution from the Murcia Region under forecasted climate change scenarios. Recently, I have been awarded with a 5-year Ramón y Cajal Research Contract.

At this moment I am developing a new research line focused on how global warming will impact the ecotoxicity and functionality of terrestrial ecosystems degraded by anthropogenic pollution from the Mediterranean region (one of the areas to be most impacted by climate change according to IPCC predictions), by using soil invertebrates such as oligochaetes and arthropods, microorganisms, and plants as bioindicators of possible alterations. I am putting special attention to areas affected by pollutants derived from mining, agricultural and industrial activities, considering different climate change scenarios predicted by the IPCC.

Among others, this research line will allow forecasting climate change effects on degraded terrestrial ecosystems and improving their management, which, in turn, will enable a better adaptation and/or mitigation of the effects of this global phenomenon.

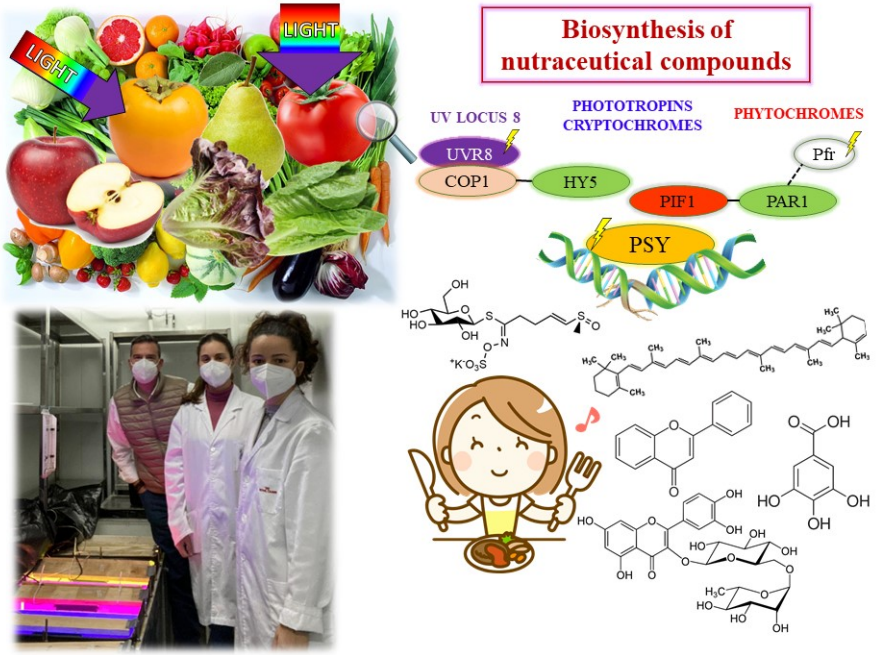
This new research line is supported by the Regional R&D project associated to the Saavedra Fajardo Research Contract of Dr. González Alcaraz (CLIMTOXFUN - Soil metal-pollution in a global warming perspective: ecotoxicological and functional aspects), and a new National R&D project funded by the Spanish Ministry of Science from which Dr. González Alcaraz is the Principal Investigator (WARMET - Functional aspects and soil ecotoxicity of abandoned mine wastes colonized by vegetation vs restored in semiarid areas: response to climate change).

Light stresses as strategy to increase phytochemicals accumulation in fruit and vegetables

The Main Objective is to elucidate the best illumination conditions and wavelengths during shelf life for quality preservation of horticultural products which may induce important phytochemicals accumulation as secondary metabolites.

Fruit and vegetables are essential in human health due to the high content in nutraceutical compounds, which have been associated with a reduction on the risk of chronic and pro-inflammatory diseases. As light is an essential factor directly related to the synthesis of primary and secondary metabolites, bioaccumulation pathways of these compounds can vary with changes in the quantity and quality of lighting applied. In fact, application of abiotic stresses throughout non-visible spectra regions, such as UV-B (280 – 315 nm), have reported an hormetic effect characterized by a positive stimulus of the metabolite biosynthesis pathways under low doses, but a negative response of the plant tissues may appear under moderate to high UV doses. In this sense, low doses of UV can be used to induce the expression of antioxidant enzymes, which increase the biosynthesis of some health promoting compounds.

In recent years, the use of colored LEDs has increased due to their low energy requirements and their possibility to customize the light intensity and spectral properties. In this sense, the use of postharvest LED lighting has already shown potential beneficial effects. However, the effect in quality and phytochemicals accumulation of horticultural commodities of the combination of different postharvest lighting conditions from the visible and non-visible spectrum is mostly unexplored.



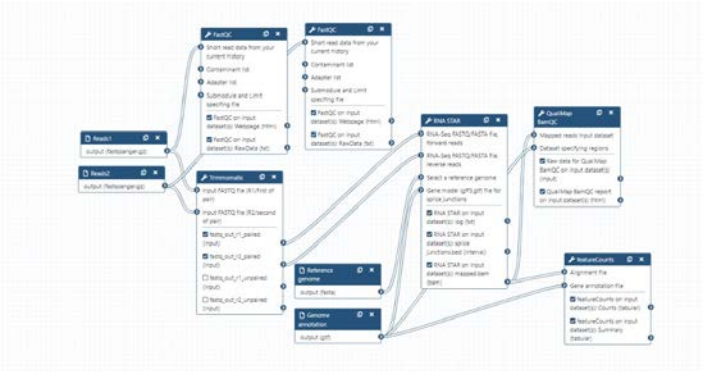
Cannabis genomics

Molecular Genetics Unit. Principal Investigators Prof. Marcos Egea-Cortines and Prof. Julia Weiss

The molecular genetics unit has been working more than 20 years in flower development. All the work has been performed using two model systems, *Antirrhinum majus* and *Petunia x hybrida*. Most of our work been centred about late flower development, when flowers start emitting scent. We have shown that there are several genetic networks with partial overlap that define the composition and quantity of scent emission. We have also studied the effects of different environmental conditions on scent emission. This led again to identify several key players in this process. While model systems do not have a major commercial value, their function is precisely to advance at a rapid pace in our understanding of complex systems.

The flower with the highest price in the World in not sold for its beauty, but for its composition of volatiles and metabolites. The inflorescence of *Cannabis.sp* has become a major crop in the last years due to changes in regulation. Furthermore, mounting evidence shows the medical benefits of some of its components. *Cannabis* has been cultured for its properties for several thousand years, and recently has undergone a major expansion in terms of varieties. This is the consequence of amateur breeding for psychotropic effects, changes in perceived scent, and in some cases to produce biomass or high-quality fibres. As a result, the genetics and genomics of *Cannabis* is overly complicated. Together with a natural complexity in its composition, it is a challenging, yet attractive crop to apply all the knowledge previously obtained using non-commercial model systems.

We are currently developing bioinformatic and functional genomic pipelines to aid in *Cannabis* breeding towards high quality varieties with reliable compositions for the industry. Our work is performed with industrial partners and based on their specific requirements for breeding.



COLLABORATIVE RESEARCH PROJECTS

Project title: DIVERFARMING: **Crop diversification and low-input farming across Europe: from practitioners engagement and ecosystems services to increased revenues and chain organization**

Coordinator: Dr. Raúl Zornoza (UPCT).

DIVERFARMING
H2020 728003

Diverfarming is a project financed by the Horizon 2020 Programme of the European Commission, within the challenge of 'Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research and the Bioeconomy'. It seeks a paradigm shift in European agriculture through the diversification of crops and the rational use of resources.

This year, the main results were:

A Decision Support Tool has been developed (web-based and free app), which places the best research results in the hands of end-users, who are guided to tailor the most suitable diversified cropping system, low-input practices and most adapted machinery to improve land productivity, revenues and ecosystem services, with mechanisms to adapt their value chains to new agribusiness models and market demands.

Guidelines for sustainable diversified cropping systems, aimed at end users to improve farm productivity, product quality standards, revenues and ecosystem services with crop diversification have been specified.

Moreover, a Protocol for the correct implementation of diversified systems, easy-to-follow by end-users has been developed as well as qualified machinery prototype to improve soil tillage by reducing environmental impacts.

Communities of Practitioners" as volunteer early adopter farmers and agribusinesses has been recruited to develop diversified cropping systems in their farming systems as real scenarios, and ensure longevity beyond the project.

The most noteworthy environmental benefits include the reduction in soil erosion in the trials, such as in a case study where they introduced capers and thyme among the alleys of a dryland almond orchard; or the increase in nitrogen in the soil due to the introduction of legumes in the alleys of the mandarin trees in another case study; or among horticultural products such as melon or broccoli. In that case it was possible to reduce the nitrogen fertilisation by 30% thanks to the contribution of the legumes and, additionally achieve a double harvest of broad beans. The diversifications have supposed, moreover, an increase in the biodiversity and in pollinisers, which are determinant for production.

Partners:

Project title: SUPERPESTS: Innovative tools for rational control of the most difficult to manage pests ("super pests ") and the diseases they transmit

Coordinator: Prof. Dr. John Vontas, Agricultural University of Athens.

UPCT Coordinator: Prof. Dr. Pablo Bielza.

The Research Unit 'Resistance to insecticides' participates in the European project 'Innovative tools for rational control of the most difficult to manage pests and the diseases they transmit (Superpests)', funded by the Horizon 2020 Framework Program. On 27 January 2020 the SuperPests Annual Consortium Meeting took place in Montpellier, France, where partners had the chance to review tasks and activities in preparation of the EU Report, clarify technical and/or managerial issues and define the action plan for Y2.

Biological control is an efficient pest control method but there are still limitations that are hindering its wider adoption. Genetic improvement of biological control agents (BCAs) can help to overcome these constraints, but the choice of key attributes for better performance that need to be selected is still an open question. Identifying the appropriate traits to be prioritized may be the first step to reverse this situation. The Resistance to insecticides Unit revealed that the best way is to look at the factors limiting the performance of key BCAs, especially generalist predators (pesticide compatibility, prey-density dependence, non-suitable crops, and extreme environmental conditions), and according to these challenges, to choose the attributes that would allow BCAs to overcome those limitations. The benefits of selection for higher resistance to toxins, whether artificially applied (pesticides) or plant produced (plant defences); increased fitness when feeding on non-prey food (supplemented or plant-derived); and better adaptation to extreme temperature and humidity are discussed. In conclusion, genetic improvement of BCAs can bring about new opportunities to biocontrol industry and users to enhance biocontrol resilience.

Insecticides of the tetronic/tetramic acid family (cyclic ketoenols) are widely used to control sucking pests such as whiteflies, aphids and mites. They act as inhibitors of acetyl-CoA carboxylase (ACC), a key enzyme for lipid biosynthesis across taxa. While it is well documented that plant ACCs targeted by herbicides have developed resistance associated with mutations at the carboxyltransferase (CT) domain, resistance to ketoenols in invertebrate pests has been previously associated either with metabolic resistance or with non-validated candidate mutations in different ACC domains. A recent study revealed that:

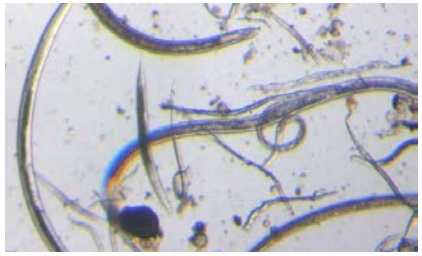
- High levels of cyclic ketoenol resistance were found in MED and MEAM1 type B. tabaci.
- Resistance is conferred by an A2083V mutation in acetyl-CoA carboxylase (ACC).
- CRISPR/Cas9 modified ACC in Drosophila confirmed high levels of resistance.
- Reciprocal crossing studies suggest an autosomal dominant mode of inheritance.
- A pyrosequencing diagnostic assay detected the spread of resistance in Spain.

Partners:

Project title: SoildiverAgro: Soil biodiversity enhancement in European agroecosystems to promote their stability and resilience by external inputs reduction and crop performance increase

Coordinator: David Fernández, Universidade de Vigo.

UPCT Coordinator: Raúl Zornoza.



Two Units of IBV (Genetic Resources and Soil Ecology and Biotechnology) participate in this Project (Ref. Ares(2020)7409280 - 07/12/2020) funded by the European Union's Horizon 2020 Research and Innovation Programme under the Grant Agreement number 817819.

Project objective:

With the long-term view of fostering synergies between crop production, biodiversity and the delivery of ecosystem services of local, regional and global relevance, the main objective of SoildiverAgro is the adoption of new management practices and cropping systems that enhance soil genetic and functional biodiversity to reduce the use of external inputs while increasing crop production and quality, the delivery of ecosystem services and the EU agricultural stability and resilience.

To achieve this objective 90 farm systems will be analysed in 9 pedoclimatic regions in Europe and 15 field case studies will be designed and established in six of the pedoclimatic regions. The focus will be on the use of innovative management practices based on soil mycorrhiza and plant growth promoting bacteria (including the development and testing of new commercial products), appropriate management of soil organisms (e.g. fungivores), the application of suitable crop rotations, multiple cropping and intercropping, the development of pest alert systems, the use of nutrient catch crops, the use of trap crops for pest control, the use of by-products as soil ameliorants and the application of adequate tillage systems.

SoildiverAgro outputs consider: 1) enhancement of soil biodiversity; 2) reduction of pest/diseases incidence; 3) increases in plant growth and development; 4) increases in crop yields, quality and value; 5) the reduction of inputs; 6) increases in soil fertility; 7) reductions of soil contamination; 8) reduction in GHG emissions; and 9) increases in soil C sequestration. To ensure rapid adoption of measures fostering soil biodiversity, improved methods and tools including for monitoring will be developed.

The successful crop management practices will be also analysed from the environmental, economic and social perspectives.

Operational diversity targets will be defined, with development of best agricultural practice strategies and tools for existing EU policies update.

Partners:

SPIN OFF companies

BIOENCAPSULATION AND iPACKAGING, S.L. (BIO-iPACK)



This spin off, created in June of 2017 by the Research Unit Biotechnological Processes, Technology and Engineering headed by Prof. Dr. Antonio López Gómez is Located in Parque Tecnológico de Fuente Álamo (Murcia, Spain). They have dedicated a big effort in the research of formulations of essential oils and their components, and micro and nanoencapsulates.

The company is mainly focused on placing on the market products and technologies associated to patents. One of these patents develops the concept of active cardboard packaging for fresh fruits and vegetables, in bulk or in flow-pack.

Essential oil formulations have been developed to be applied in vapour form or as nanoemulsion in refrigerated packaged products. The generation and application of steam from essential oils to solid foods, at an industrial level, is carried out according to patented and proven technology.

They have also established nanoencapsulated formulations of essential oils to be applied in:

- ✓ The manufacture of active packaging - cardboard or plastic, or wood - with antimicrobial and antioxidant activity and, in certain cases, with anti-germinating activity and control of ethylene production.
- ✓ The product during its preparation and / or packaging, to achieve antimicrobial and antioxidant activity.
- ✓ The manufacture of ice becoming ice with antimicrobial and antioxidant activity, applicable in the preservation of fish and shellfish, and for the preservation of certain vegetables.
- ✓ The manufacture of ice for the stunning and slaughter of aquaculture fish, according to patented technology.

web site: http://bio-ipack.com/producto

Private-funded CHAIRS

SUSTAINABLE AGRICULTURE

The Chair in Sustainable Agriculture of the UPCT is supported by the FECOAM and COAG associations, thirteen agriculture cooperatives of the Campo de Cartagena and the Fundación Bancaria "La Caixa".

Cátedra
Agricultura Sostenible
Campo de Cartagena

Director of the Chair: Prof. Dr. Juan José Martínez Sánchez.

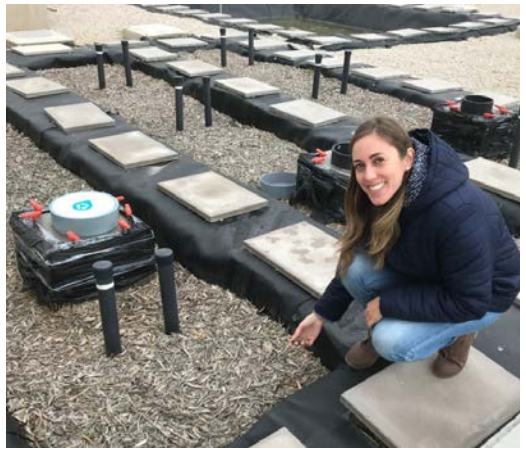
Main Results

After having carried out different experiments related to denitrifying bioreactors with wood to analyse their behaviour under different conditions of types of wood, different concentrations of salinity, effect of depth within the bioreactors, rest times between cycles ... we have a wide spectrum of interesting results. At present we continue working with the first bioreactors that were put into operation, which have already been working for 2 years and 3 months and we are obtaining results of how both the characteristics of the wood and the denitrification process evolve throughout different seasons of the year with changes in temperature.

We are currently working with the bioreactors belonging to the Sustainable Agriculture Chair at the Tomás Ferro Farm of the UPCT and with the bioreactors of the ESAMUR Wetlands and Bioreactors Pilot Plant located in the Los Alcázares WWTP. These two plants are providing very interesting data. Among the main differences of these bioreactors is that the Tomás Ferro Farm works with brine and in 24 h cycles and the Los Alcázares pilot plant works with water from the D7 channel, much less saline than in the farm of the UPCT, and in continuous mode. It means that the water does not stop flowing through the bioreactors.

Due to all the results we are obtaining, we know how bioreactors are capable of denitrifying under different conditions. We are going to continue investigating with new types of substrates, with the use of other components such as biochar.

In just one month of contacts and meetings with researchers and public and private companies we have already detected several realistic solutions for eliminating nitrates from brines or even to definitively eliminate brines through treatments that turn them into products with market value. In other words, we transform the waste into a commercial good. This is the philosophy of the circular economy, the main pillar of sustainability.



BIONET

The UPCT-BIONET Chair, signed between the UPCT and the BIONET Company in 2019, establishes a common framework for technological development in the field of Biotechnology. BIONET is a leading international company in the development of fermenters and bioreactors.

Director of the Chair: Prof. Dr. Marcos Egea Gutiérrez-Cortines.

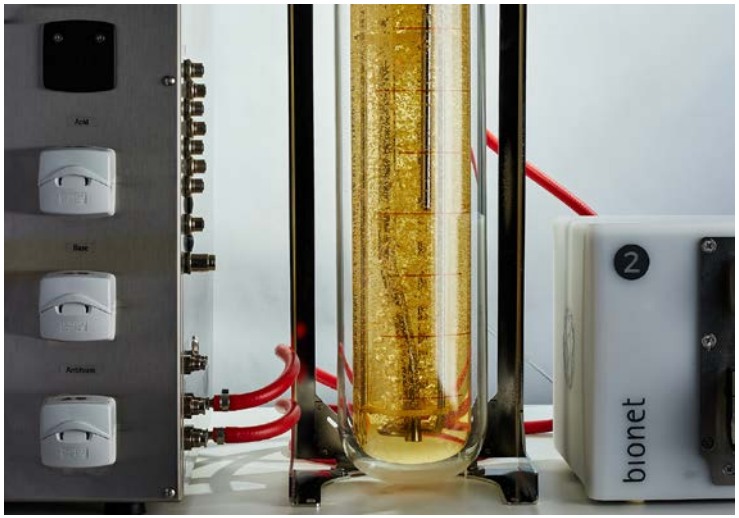
Main Results

The UPCT-BIONET Chair develops R + D activities aimed at improving the competitiveness of the services offered by BIONET. This includes the development of new processes and improvement of bioreactors. The production options comprise plant cells, animals, bacteria and yeasts, and the products obtained are aimed at the pharmaceutical, agri-food and cosmetic industries. The activities of the Chair comprise business internships, final degree and master's projects and training of doctors. In the field of R + D, activities are articulated through research projects.

BIONET is a leading manufacturer of laboratory, pilot and industrial equipment and software for the bioprocessing industry, as well as a provider of advanced bioprocess-related services for companies that want to produce biomolecules through microbial fermentation or through cell culturing processes.

As designers and manufacturers of equipment they provide Bioreactors and Fermenters, Tangential Filtration, other auxiliary equipment (e.g. Cleaning in Place Systems) and automation software solutions. For industrial clients BIONET provides complete bioproduction plants, in which they integrate proprietary equipment with technologies from other leading vendors (e.g. centrifuges, homogenizers, etc.), and provide unique centralized automation solutions for all these technologies to work jointly.

As a provider of services they support the clients all the way through the technology- election, qualification, operation and maintenance activities through a pilot plant for the performance of proof-of-concept trials and the availability of specialists in the optimization of downstream processes and in the operation and maintenance of laboratory and industrial plants.



CEFUSA

CEFUSA is a company part of the Fuertes Group, being the main supplier of pig and beef cattle to El Pozo Alimentación. The Fuertes Group is made up of an important diversity of companies, being the first business group in job creation in the Region of Murcia. Specifically, the Fuertes Group involves more than 20 companies that operate in different sectors, the most important of which is agri-food

Director of the Chair: Prof. Dr. Angel Faz Cano.

Main Results

The Chair was created in 2018 and its objective is "Sustainable management of slurry: a priority need in the environment and livestock". Research on the "management of slurry a la carte" will be promoted, taking into account the edapho-climatic characteristics and aspects related to the use and management of agricultural land and available water resources. This entails the sustainable agronomic valorisation of slurry in semi-arid areas with high livestock production, the management of slurry in vulnerable areas, obtaining quality fertilizers / amendments to implement development and edaphic improvement and carbon sequestration (carbon footprint), reuse of purified liquid effluents, the sustainable treatment of slurry and circular economy and to reduce the possible nuisances generated by the slurry to the neighbouring environment, seeking to reduce both, odours and the release of greenhouse gases, as well as implementation of the systems for applying the slurry to the ground. To achieve these objectives, the Chair is focused on a pilot farm, where a comprehensive management plan is being be proposed that can serve as model for related systems.

MEDIO AMBIENTE, AUTORIDAD PORTUARIA DE CARTAGENA, CAMPUS MARE NOSTRUM

The Cartagena Port Authority (APC)-Campus Mare Nostrum Environment Chair has been created through a collaboration agreement between the Cartagena Port Authority and the public universities of the Region of Murcia: Universidad Politécnica de Cartagena (UPCT) and Universidad de Murcia (UMU), on 2015.

Director of the Chair: Prof. Dr. María José Vicente.

Main Results

The purpose of this Chair is to establish a permanent collaboration between the APC, the UPCT and the UMU, involving research, development, technical assistance and training related to environmental issues. The contribution of other Research Centers, professionals or collaborating entities is also considered.

So far, the chair has financed nine research projects, has established two annual scholarships related to the environment and its management for the practical training of students from both universities, and annual awards to highlight the best end-of-study projects, both Works End of Degree as End of Master's Projects, related to topics of interest, such as the Natura 2000 Network, Biodiversity and Responsible Management of Species and Habitats, Underwater Noise, Marine Pollution and Contaminated Soils, among others, as well as technological developments related to the dissemination, communication or management of environmental actions.

GRUPO AGROPOR I+D+I A.I.E

The Agropor I + D + I A.I.E. Group is a subsidiary of the Agropor Group committed to research, development and innovation of the activities carried out by the different companies of the Group. These are focused on feed manufacturing, piglet production, pig feeding and agricultural production.

Director of the Chair: Prof. Dr. Angel Faz Cano.

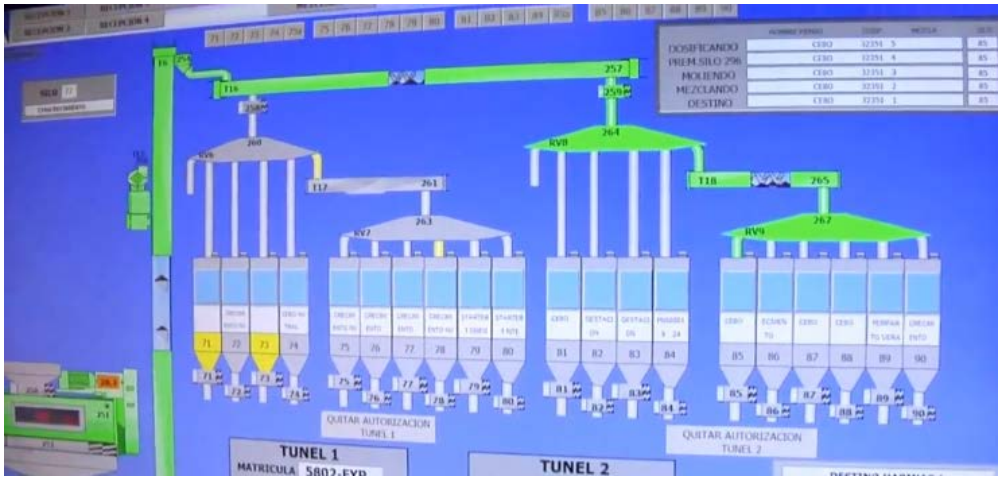
Main Results

The AGROPOR-UPCT Chair, created in December 2018, aims to promote and collaborate in dissemination and knowledge of all aspects related to the integral management of water in pig farming by with the application of the footprint water protocol.

The best available technologies for the treatment, management and reuse of water resources have been reviewed, such as desalination and denitrification, as well as the applicable legislation for the economic-social and environmental sustainability of water resources management.

The chair is looking for the dissemination and transfer of knowledge both in its academic aspect and in its application, developing studies that pursue innovation in the management of water resources and treatment and valorisation of treated effluents.

The best practices in the sustainable development of the "Integral water management in swine production" have been identified.



AYUNTAMIENTO DE FUENTE ALAMO

On June 2020, the Chair on "Environmental management for the sustainability of intensive pig farming" was signed between the UPCT and the Fuente Álamo City Council.

Director of the Chair: Prof. Dr. Angel Faz Cano.

Main Results

The Chair is strongly focused in promoting the following activities:

- ✓ Environmental impact in the subsoil of the existing slurry storage and evaporation ponds on the farms.
- ✓ Analysis of alternatives for sustainable management and valorisation of slurry: available technical improvements-mitigation of emissions-conservation and sustainable nutrition of agricultural land.
- ✓ Promote comprehensive solutions aimed at the environmental sustainability of pigs.
- ✓ Carry out studies that pursue the implementation of the technical improvements available for pigs.

DESARROLLO SOSTENIBLE AYUNTAMIENTO DE CARTAGENA

The Chair aimed for the sustainable urban development of Cartagena and studies the contaminated soils looking for the regeneration and enhancement of them.

Director of the Chair: Prof. Dr. Angel Faz Cano.

Main Results

The studies have been focused on two lines of action. The first line deals with the sustainable urban development aimed to create strategic planning tools for the Cartagena adapted to its future challenges within the 2030 Horizon frame, based on the integral sustainability of the area. Different planning tools have been developed in a comprehensive and integrated approach, covering different areas.

On the other hand, the second line for contaminated soil studies aims to assess whether there is metallic contamination in urban soils in three populations close to the Sierra Minera de Cartagena-La Unión. The objective has been to carry out a quantitative analysis of risks for the inhabitants, as well as to make proposals for recovery of the area.

MARNYS

The Chair was created to promote innovation related to food supplements and natural cosmetics.

Director of the Chair: Prof. Dr. Encarna Aguayo Giménez.

Main Results

Among the products that MARNYS develops, drinkable vials, syrups, capsules, tablets, essential oils and organic certified natural cosmetics, UPCT has collaborated by optimizing processes and studying quality.

The company has been awarded in January 2020 with the Prize of the Consejo Social for the cooperation with UPCT. Along 2020 the collaboration was focused on the development of new products and on quality assessments.

GRUPO G's ESPAÑA

Director of the Chair: Prof. Dr. Franciso Artés Hernández

Main Results

With this Chair, several UPCT students carry out their internship research, combining the knowledge and experience of both the company and the university, for the development of R + D activities.

RESEARCH UNITS

BIOTECHNOLOGICAL PROCESSES, TECHNOLOGY AND ENGINEERING

1. Main results

In this year, 9 articles have been published in international journals (Food Control, Food Engineering Reviews, Waters, Postharvest Biology and Technology, J. Sci. Food Agric., Foods, and Frontiers in Nutrition) with high impact factor in its fields. A new patent for a novel procedure of manufacturing breaded meat products has been submitted as Spanish Patent. In international congresses, 4 communications have been presented to X Iberian Congress - VIII Ibero-american Congress of Sciences and Techniques of Refrigeration (CYTEF 2020, Pamplona, Spain). Prof. Antonio López Gómez is Editor of the International Journal 'Food Engineering Reviews' (Impact factor of 5.758 in 2020).

2. Projects (most relevant)

-Pilot plant for encapsulation by spray-drying (EQC2019-006059-P). Phase – 2, European Regional Development Fund (ERDF, EU) / Spanish Ministry of Science and Innovation (MCI) - State Research Agency (AEI) through the Call for grants for the acquisition of scientific-technical equipment 2019, corresponding to the State Generation Program of Knowledge and Scientific and Technological Strengthening of the R+D+i System. January 2020/December 2021. Principal Researcher: Antonio López Gómez.

-Innovative technology based on the integration of natural substances in ice to improve animal welfare and extend shelf-life of farmed fish Phase – 2**.** (Call H2020-SMEInst-2-2016-2017), area of SMEInst-08-2016-2017; Supporting SMEs efforts for the development – deployment and market replication of innovative solutions for blue growth (ref Agreement ICE2LAST – 804493). Participants: UPCT/Univ. Murcia/Pescados de Acuicultura de Murcia S.L./CUBI-PLAYA S.L. (San Pedro del Pinatar, Murcia). May 2018/April 2020. Principal Researcher: Antonio López Gómez.

3. Selected publications

López Cánovas A.E., Cabas, I., Chaves-Pozo, E., Ros-Chumillas, M., Navarro-Segura, L., López-Gómez, A., Fernandes, J.M.O., Galindo-Villegas, J., García-Ayala, A. 2020. Nanoencapsulated clove oil applied as an anaesthetic at slaughtering decreases stress, extends the freshness, and lengthens shelf life of cultured fish. Foods. 9(12): 1904.

López Gómez, A. Ros Chumillas, M., Buendía Moreno, L., Martínez Hernández, G.B. 2020. Active cardboard packaging with encapsulated essential oils for enhancing the shelf life of fruit and vegetables. Frontiers in Nutrition. 7: 559978.

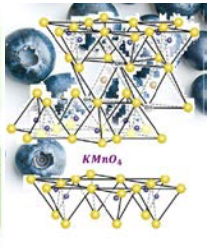
4. Others: Most relevant contracts

-New process technologies for healthy breaded products. Funded by CDTI - R&D Project 2019 (IDI- 20190627). Participants: UPCT/FRIPOZO S.A. June 2019/May 2021. Principal Researcher: Antonio López Gómez.

Staff: Head of the Unit: Prof. Dr. Antonio López Gómez. Researchers: Prof. Dr. Ing. Asunción Iguaz Gainza; Dr. María Ros Chumillas; Dr. Ing. Ginés Benito Martínez Hernández; M.Sc. and Ph.D. Students: Laura Navarro Segura; Laura Buendía Moreno; Marta Barón Yusty; Alejandra Navarro Martínez.

FOOD QUALITY AND HEALTH



1. Main results

-Patented real-time monitoring systems: a) Quick and cost-effective estimation of vitamin C in multifruit juices. b) To evaluate environmental factors affecting postharvest quality.

-Irrigation with ozonized water on Capsicum and watermelon seedlings provides an increase in catalase activity preventing the lipid peroxidation and reducing the microbial load in the water.

-Aloe vera flowers are a by-product with potential for pharmaceutical uses or nutraceutical products.

-Development of innovative ethylene scavenging systems to extend the shelf life of fruit/vegetable.

-A UV–C treatment combined with regulated deficit irrigation strategies preserved quality of cherries.

-MW and HHP processing treatments seem to be interesting techniques to develop legume-based products

2. Projects (most relevant)

-Optimización de la cadena de valor del sector hortofrutícola desde una perspectiva holística: análisis de ciclo de vida ambiental, social y económico (Karp0-LIFE). Principal researcher: Encarna Aguayo.

-Desarrollo y procesado mínimo en fresco de germinados de elevada saludabilidad mediante técnicas ecosostenibles. Evolución de la calidad y seguridad durante la vida útil. FRESHGERM. Principal researcher: Francisco Artés-Hernández.

-Desarrollo de una alternativa sostenible para reducir el aporte de nitratos en la fertirrigación del pimiento en la comarca del Mar Menor. CARM- SULCA(AEIA). Principal researcher: Francisco Artés-Hernández.

3. Selected publications

Álvarez-Hernández M.H., Martínez-Hernández G.B., Miranda D., Ávalos-Belmontes F., Artés-Hernández F. 2020. Postharvest quality retention of apricots by using a novel sepiolite–loaded potassium permanganate ethylene scavenger. Postharvest Biol. Technol. 160: 111061.

Collado E., Klug T.V., Martínez-Hernández G.B., Artés-Hernández F., Martínez–Sánchez A., Aguayo E., Artés F., Fernández-Hernández J.A., Gómez P.A. 2020. UV–C pretreatment of fresh–cut faba beans (Vicia faba) for shelf life extension. Effects of domestic microwaving for consumption. Food Sci. Technol. International. 26(2): 140–150.

Klug T.V., Collado E., Martínez-Sánchez A., Gómez P.A., Aguayo E., Artés F., Artés-Hernández F. 2020. Viability of sous vide, microwave and high-pressure processing techniques on quality changes during shelf life of fresh cowpea puree. Food Sci. Technol. International. 26(8): 706–714.

López-Pastor, J.A., Martínez-Sánchez, A., Aznar-Poveda, J., García-Sánchez, A.J., García-Haro, J., Aguayo, E. 2020. Quick and cost-effective estimation of vitamin C in multifruit juices using voltametric methods. Sensors. 20 (3): 676.

Martínez-Sánchez, A., Aguayo, E. 2020. Ozonated water irrigation improves the antioxidant status of grafted watermelon seedlings. Scientia Horticulturae. 261: 109047.

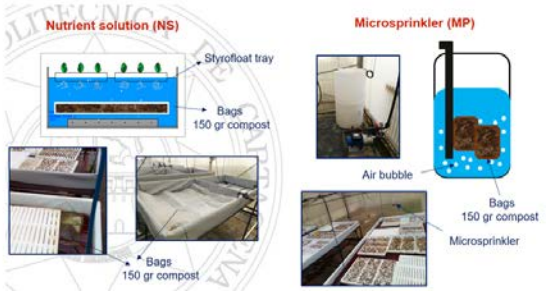
Martínez-Sánchez, A., López-Cañavate, M.E., Guirao-Martínez, J., Roca, M.J., Aguayo, E. 2020. Aloe vera flowers, a by-product with great potential and wide application, depending on maturity stage. Foods. 9: 1542.

Torres-Sánchez, R., Martínez-Zafra, M.T, Castillejo, N., Guillamón, A., Artés-Hernández, F. 2020. Real-time monitoring system for shelf-life estimation of fruit and vegetables. Sensors. 20 (7), 1860: 1-21.

Zarid, M., Bueso, M.C., Fernández-Trujillo, J.P. 2020. Seasonal effects on flesh volatile concentrations and texture at harvest in a near-isogenic line of melon with introgression in LG X. Scientia Horticulturae. 266: 109244.

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. Patricia García Mora. M.Sc. and Ph.D. Students: Noelia Castillejo, José Ángel Salas Millán, Laura Rasines Elena, Hazel Álvarez.

GENETIC RESOURCES



1. Main results

During 2020, the Unit continued working on the conservation, characterization and evaluation of genetic resources, mainly in the framework of one Project financed by the Ministerio para la Transición Ecológica of the Spanish Government. Also, we have carried out the annual collection of indigenous wild plant material and their conservation in the Germplasm Bank-UPCT.

We have also continued working on the project AGL2017-84085-C3-3-R, demonstrating that some agroindustrial composts show promise as an alternative to peat for use as organic substrate for baby leaf lettuce and spinach, improving the yield and quality of the product. Also, it has been demonstrated that the application of directly brewed compost extract improves yield and quality in baby leaf lettuce grown hydroponically and that the spraying of compost tea on baby spinach crops improves plant quality and soil health.

2. Projects (most relevant)

-Validación de compost como inductores de propiedades funcionales y de resistencia frente a patógenos para la producción sostenible de hortalizas de hoja pequeña. MINECO (AGL2017-84085-C3-3-R). Participants: UPCT, CEBAS-CSIC, UMH. 2018 – 2021. Principal researcher: C. Egea-Gilabert and Juan A. Fernández.

-Gestión de la diversidad genética de las poblaciones de Jara de Cartagena. Consejo de Gobierno CARM. 2020-2021. Principal researcher: M. José Vicente Colomer.

-Soil biodiversity enhancement in European agroecosystems to promote their stability and resilience by external inputs reduction and crop performance increase. SoildiverAgro. 2019 - 2023. Comisión Europea. H2020. nº 817819. Principal researcher: David Fernández (Universidad de Vigo).

3. Selected publications

Vicente, M.J., Martínez-Díaz, E., Martínez-Sánchez., J.J., Franco., J.A., Bañón, S., Conesa, E. 2020. Effect of light, temperature, and salinity and drought stresses on seed germination of *Hypericum ericoides*, a wild plant with ornamental potential. Sci. Hort. 270. https://doi.org/10.1016/j.scienta.2020.109433.

Martínez-Ballesta, M.C., Egea-Gilabert, C., Conesa, E., Ochoa, J., Vicente, M.J., Franco, J.A., Bañón, S., Martínez-Sánchez, J.J., Fernández, J.A. 2020. The importance of ion homeostasis and nutrient status in seed development and germination. Agronomy. 10, 504.

Giménez, A.; Fernández, J.A.; Pascual, J.A.; Ros, M.; Egea-Gilabert, C. 2020. Application of directly brewed compost extract improves yield and quality in baby leaf lettuce grown hydroponically. Agronomy 10, 370.

Ros, M.; Hurtado-Navarro, M.; Giménez, A.; Fernández, J.A.; Egea-Gilabert, C.; Lozano-Pastor, P.; Pascual, J.A. 2020. Spraying agro-industrial compost tea on baby spinach crops: evaluation of yield, plant quality and soil health in field experiments. Agronomy. 10, 440.

Giménez, A.; Fernández, J.A.; Pascual, J.A.; Ros, M.; Sáez-Tovar, J.; Martinez-Sabater, E.; Gruda, N.S.; Egea-Gilabert, C. 2020. Promising composts as growing media for the production of baby leaf lettuce in a floating system. Agronomy. 10, 1540.

Ros, M., Almagro, M., Fernández, J. A., Egea-Gilabert, C., Faz, Á., Pascual, J. A. 2020. Approaches for the discrimination of suppressive soils for *Pythium irregulare* disease. Appl. Soil Ecol. 147, 103439.

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

MICROBIOLOGY AND FOOD SAFETY

1. Main results

During 2020 the Unit has continued working on the microbiological aspects of food safety, focussing mainly in 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 one research project, funded by the Spanish Government, and from one contract with a French I+D+i center. Members of this Unit also participate in a spin-off company, recently created. Three articles were published in indexed journals. Two Ph.D. Dissertations were also presented in this period.

2. Projects (most relevant)

-Validation of new tools and processes for analysis and improvement of microbial food safety. MINECO (ref AGL2017-86840-C2-1-R). 2018-2020. Principal researcher: Alfredo Palop, Principal co-research.: Pablo Fernández.

3. Selected publications

Garre, A., Espín, J.F., Huertas, J.P., Periago, P.M., Palop, A., 2020. Limonene nanoemulsified with soya lecithin reduces the intensity of non-isothermal treatments for inactivation of *Listeria monocytogenes*. Sci. Reports. 10: 3656.

Somrani, M., Inglés, M.C., Debbabi, H., Abidi, F., Palop, A., 2020. Garlic, onion, and cinnamon essential oil anti-biofilms' effect against *Listeria monocytogenes*. Foods. 9: 567.

Clemente Carazo, M., Cebrián, G., Garre, A., Palop, A., 2020. Variability in the heat resistance of *Listeria monocytogenes* under dynamic conditions can be more relevant than that evidenced by isothermal treatments. Food Res. Int. 137: 109538.

4. Others

Ph.D. Dissertations:

-Variability in the response of *Salmonella* and *Listeria* strains to different strategies for inactivation (Ph.D. Thesis with International Mention). Author: Marta Clemente-Carazo. Supervisors: Paula M. Periago, Alfredo Palop and Alberto Garre.

-The anti-biofilm activity of essential oils of *Listeria monocytogenes* and *Salmonella* Enteritidis (Ph.D. Thesis with International Mention). Author: Mariem Somrani. Supervisors: Alfredo Palop and Hajer Debbabi.

Most relevant contracts:

Company: Adria Development. Contract leader: Pablo S. Fernández.

Spin-off Company

-Bioencapsulation and iPackaging, S.L. Fuente Álamo.

Staff: Head of the Unit: Prof. Dr. Alfredo Palop. Researchers: Prof. Dr. Pablo S. Fernández, Prof. Dr. Paula M. Periago. Ph.D. and Master Students: Mariem Somrani, Marta Clemente.

MOLECULAR GENETICS

1. Research interest and main results

Our research focuses on studying circadian clock related genetic programs as well as the genetic background of environmental factors controlling different aspects of plant development. We use reverse genetics techniques for genome edition, including "gene knock down" by silencing through interference RNA and "gene knock out" by CRISPR/Cas technologies. Plant developmental aspects include vegetative growth, flower development, flower pigmentation and volatile production, both by leaves and flowers. Characterization of plant development includes the use of computer vision and Deep learning (DL) algorithms for automatic phenotype data analysis. In 2020, and based on years working on lateral organ size, we started a new research line in plant biotechnology for high quality protein and metabolite production in bioreactors, in collaboration with BIONET.

2. Projects (most relevant)

-Diverfarming H2020; 2017-2022.

-MELOMUR-RIS3; 2018-2021.

-BFU-2017 88300-C2-1-R; 2018-2021. Análisis de genes de control del desarrollo floral y la emisión de volátiles. Desarrollo de fenotipado automático mediante visión artificial basado en máquinas de aprendizaje.

3. Selected publications

Brandoli, C., Petri, C., Egea-Cortines, M. et al. (2020). The clock gene Gigantea 1 from *Petunia hybrida* coordinates vegetative growth and inflorescence architecture. Scientific Reports 10, 275 doi:10.1038/s41598-019-57145-9

Brandoli, C.; Petri, C.; Egea-Cortines, M.; Weiss, J. (2020). Gigantea: Uncovering New Functions in Flower Development. Genes, 11, 1142.

4. Others: Ph.D. Dissertations

-Analysis of the circadian clock and its role in scent emission in *Antirrhinum majus* and *Petunia hybrida*. Author: Marta I. Terry López; Supervisors: Julia Weiss and Marcos Egea Gutiérrez-Cortines.

-Comparative genetic analysis of GIGANTEA, a gene involved in the control of circadian rhythm in *Solanaceae*. Author: Claudio Brandoli; Supervisors: Julia Weiss, Marcos Egea Gutiérrez-Cortines and César Petri Serrano.

-Efectos genéticos y medio ambientales en la estructura fenotípica de *Antirrhinum*. Author: Raquel Alcantud Rodríguez; Supervisors: Julia Weiss and Marcos Egea Gutiérrez-Cortines.

Staff: Head of the Unit: Prof. Dr. Julia Weiss. Researchers: Prof. Dr. Marcos Egea Gutiérrez-Cortines. Dr. Marta Terry López. M.Sc. and Ph.D. Students: María Victoria Díaz-Galián, Fuensanta Verdú Navarro, Onurçan Özbollat.

RESISTANCE TO INSECTICIDES

1. Main results

Trioza erytreae is the vector of the bacteria *Candidatus Liberibacter africanus*, *Orius laevigatus* (Hemiptera: Anthocoridae) is one of the main predators used in augmentative biological control. Despite its success as biological control agent, there are several limitations that hinder a wider adoption. Our group is carrying out a selective breeding program to identify strains of *O. laevigatus* better adapted to agrosystems. We have reached an agreement with the bioproducer Agrobio for the commercialization of two strains, one showing better fitness when feeding on alternative food (ORIcontrol Plus) and the other with enhanced tolerance to low temperatures (ORIcontrol Cold).

2. Projects (most relevant)

-Mejora genética del agente de control biológico *Orius laevigatus*: potencial biótico y resistencia a insecticidas. AGL2017-89600-R. MINECO. 2018-2020. Principal researcher: Pablo Bielza.

-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. Principal researcher: Pablo Bielza.

-Gestión integrada de *Trioza erytreae*: resistencia a insecticidas, control biológico, muestreo y susceptibilidad varietal. E-RTA2015-00005-C06-06. INIA. 2017-2020. Principal researcher: Pablo Bielza.

-Efecto del tamaño corporal en las características como agente de control biológico de *Orius laevigatus*. 20791/PI/18. Fundación Séneca. 2019-2022. Principal researcher: Pablo Bielza.

3. Selected publications

Bielza, P., Balanza, V., Cifuentes, D., Mendoza, J.E. 2020. Challenges facing arthropod biological control: identifying traits for genetic improvement of predators in protected crops. Pest Management Sci. 76: 3517-3526.

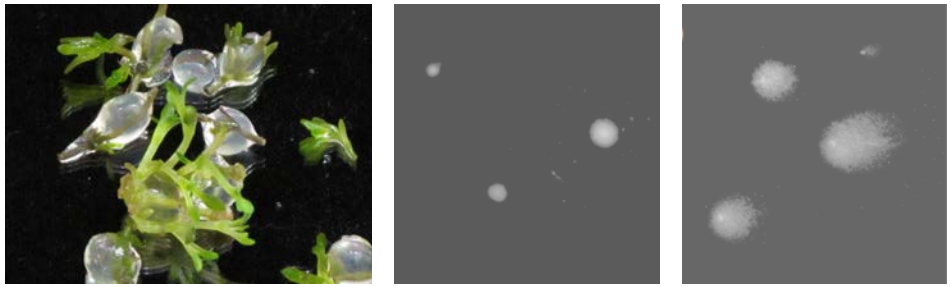
Mendoza, J.E., Balanza, V., Cifuentes, D., Bielza, P. 2020. Selection for larger body size in *Orius laevigatus*: Intraspecific variability and effects on reproductive parameters. Biological Control. 148: 104310.

Mezei, I., Bielza, P., Siebert, M.W., Torne, M., Gómez, L.E., Valverde-García, P., Belando, A., Moreno, I., Grávalos, C., Cifuentes, D., Sparks, T.C. 2020. Sulfoxaflor efficacy in the laboratory against imidacloprid-resistant and susceptible populations of the green peach aphid, *Myzus persicae*: Impact of the R81T mutation in the nicotinic acetylcholine receptor. Pesticide Biochem. Physiol. 166: 104582.

Lueke, B., Douris, V., Hopkinson, J.E., Maiwald, F., Hertlein, G., Papapostolou, K.-M., Bielza, P., Tsagkarakou, A., Van Leeuwen, T., Bass, C., Vontas, J., Nauen, R. 2020. Identification and functional characterization of a novel acetyl-CoA carboxylase mutation associated with ketoenol resistance in *Bemisia tabaci*. Pesticide Biochem. Physiol. 166: 104583.

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. M.Sc. and Ph.D. Students: Virginia Balanza, Amador Rodríguez, Nerea López Celdrán

SECONDARY METABOLITES



1. Main results

In a study aimed to characterize the effect of salicylic acid (SA) priming on the response of *Zygophyllum fabago* to Pb we observed an overall improvement in plant tolerance to the heavy metal. Our data showed the accumulation of some phytohormones, lignin, and both soluble and cell wall-bound phenolics and changes in peroxidase (PRX) activity in Pb-stressed plants upon SA pretreatments. Pb induced soluble and cell wall-bound PRX activities, mainly those related to modification of cell walls through the oxidation of coniferyl alcohol and ferulic acid, whereas SA pretreatments reduced this Pb-induced stimulation of PRX activities in roots but increased it in leaves. Organ-specific differences in phytohormone levels in response to Pb treatments were also determined. In sum, increased 12-oxo-phytodienoic acid (OPDA) accumulation in roots together with ABA accumulation in leaves provoked by SA pretreatments might play a crucial role in the expression of Pb tolerance in plants.

Other results by our group were related to biochemical characterization of glycosyltransferases, studies on genotoxicity by pollutants and optimisation of bioactive compounds extraction from aromatic plants and their residues after industrial processing.

2. Projects (most relevant)

-Functional analysis of antioxidant and redox systems in the abiotic stress tolerance of cultivated plants: new perspectives for their agronomical applications and their potential human health benefits. Fundación Séneca (19876/GERM/15). 2016-2021. Project manager: Francisca Sevilla (CSIC).

-Elicitación acústica de resistencia sistémica en plantas. MICINN (AGL2017-92217-EXP). 2018-2021. Principal researcher: Antonio A. Calderón.

3. Selected publications

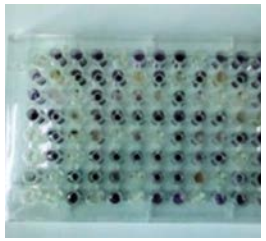
López-Orenes, A., Alba, J.M., Merijn, R.K., Calderón, A.A., Ferrer, M.A. 2020. OPDA and ABA accumulation in Pb-stressed *Zygophyllum fabago* can be primed by salicylic acid and coincides with organ-specific differences in accumulation of phenolics. Plant Physiol. Biochem. 154: 612-621.

4. Others: Contracts

-Valorización de residuos agroindustriales para la producción de antioxidantes naturales a través de métodos sostenibles. Funded by CDTI (5852/19IA-P). From 28/03/2019 to 30/09/2020. Principal researcher: Matías López Serrano.

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

SOIL ECOLOGY AND BIOTECHNOLOGY



Evaluation of soil community-level physiological profile.

Experimental plots in climate chamber.

Measuring greenhouse gas emissions in almond orchards.

Soil ecotoxicity tests with microorganisms

1. Main results

- CGL2017-82264-R: the role of soil microbiology in the biogeochemical cycles at mining impacted soils was evaluated. Bulk mine tailing soils and amended (biochar + compost) tailing soils were monitored. Effects of plant growth and litter in self-sustaining support of the functional attributes were considered.

- CGL2016-80981-R project, functionality of mine tailing soils colonized by native vegetation are being assessed as well as the effects of changes in atmospheric CO2, temperature and soil moisture in the functionality and resilience of these soils.

- Diverfarming and AsociaHortus projects: DNA of soil samples from agricultural field case studies in Spain, Italy, the Netherlands, Germany and Hungary has been extracted and bacterial 16S region has been sequenced. Greenhouse gas emissions are being measured in diversified systems to assess their role in climate change mitigation.

- SoildiverAgro project: a field trial across 8 pedoclimatic regions of Europe has been performed by sampling soil from cereal fields and extracting DNA for fungal, bacterial and nematodes community. Earthworms' diversity has also been assessed.

2. Projects (most relevant)

-Sustainability for the phytomanagement of mining polluted soil: an ecophysiological and microbiological approach (CGL2017-82264-R). MINECO. 2018-2020. Principal researcher: Héctor M. Conesa.

-Functionality and resilience of soils polluted by mining wastes under climate change conditions in Mediterranean environments: ecotoxicological aspects and the use biochar for remediation (CGL2016-80981-R). MINECO. 2017-2020. Principal researcher: José Álvarez Rogel.

- Soil metal-pollution in a global warming perspective: ecotoxicological and functional aspects, CLIMTOXFUN - (21127/SF/19). 06/20-05/23. Séneca Foundation-Murcia Region, Saavedra Fajardo Research Contract. Principal researcher: M. Nazaret González Alcaraz.

-Crop diversification and low-input farming across Europe: from practitioners' engagement and ecosystems services to increased revenues and value chain organisation – Diverfarming. GA 728003. H2020. Europ. Comm. 2017-22. Principal researcher: Raúl Zornoza.

- 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. Principal researcher: Raúl Zornoza.

3. Selected publications

V. Sánchez-Navarro, R. Zornoza, A. Faz, C. Egea-Gilabert, M. Ros, J.A. Pascual, J. A. Fernández. 2020. Inoculation with different nitrogen-fixing bacteria and arbuscular mycorrhiza affects grain protein content and nodule bacterial communities of a fava bean crop. Agronomy 10, 768.

Risueño, Y., Petri, C., Conesa H.M. 2020. The importance of edaphic niches functionality for the sustainability of phytomanagement in semiarid mining impacted ecosystems. J. Environ. Management. 266:110613.

Álvarez-Rogel, J., Barberá, G.G., Maxwell, B., Guerrero-Brotons, M., Díaz-García, C., Martínez-Sánchez, J.J., Sallent, A., Martínez-Ródenas, J., González-Alcaraz, M.N., Jiménez-Cárceles, F.J., Tercero, M.C., Gómez, R. 2020. The case of Mar Menor eutrophication: state of the art and description of tested nature based solutions. Ecological Engineering 158, 106086.

Staff: <u>Head of the Unit</u>: Prof. Dr. José Álvarez. <u>Researchers</u>: Dr. Héctor Conesa, Prof. Dr. Ángel Faz, Dr. Raúl Zornoza, Dra. María Nazaret González Alcaraz. <u>M.Sc. and Ph.D. Students</u>: Nicolas Beriot, Onurçan Özbolat, Antonio Peñalver, Yolanda Risueño, Carolina Díaz García, Virginia Sánchez-Navarro

CONTACT INFORMATION

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