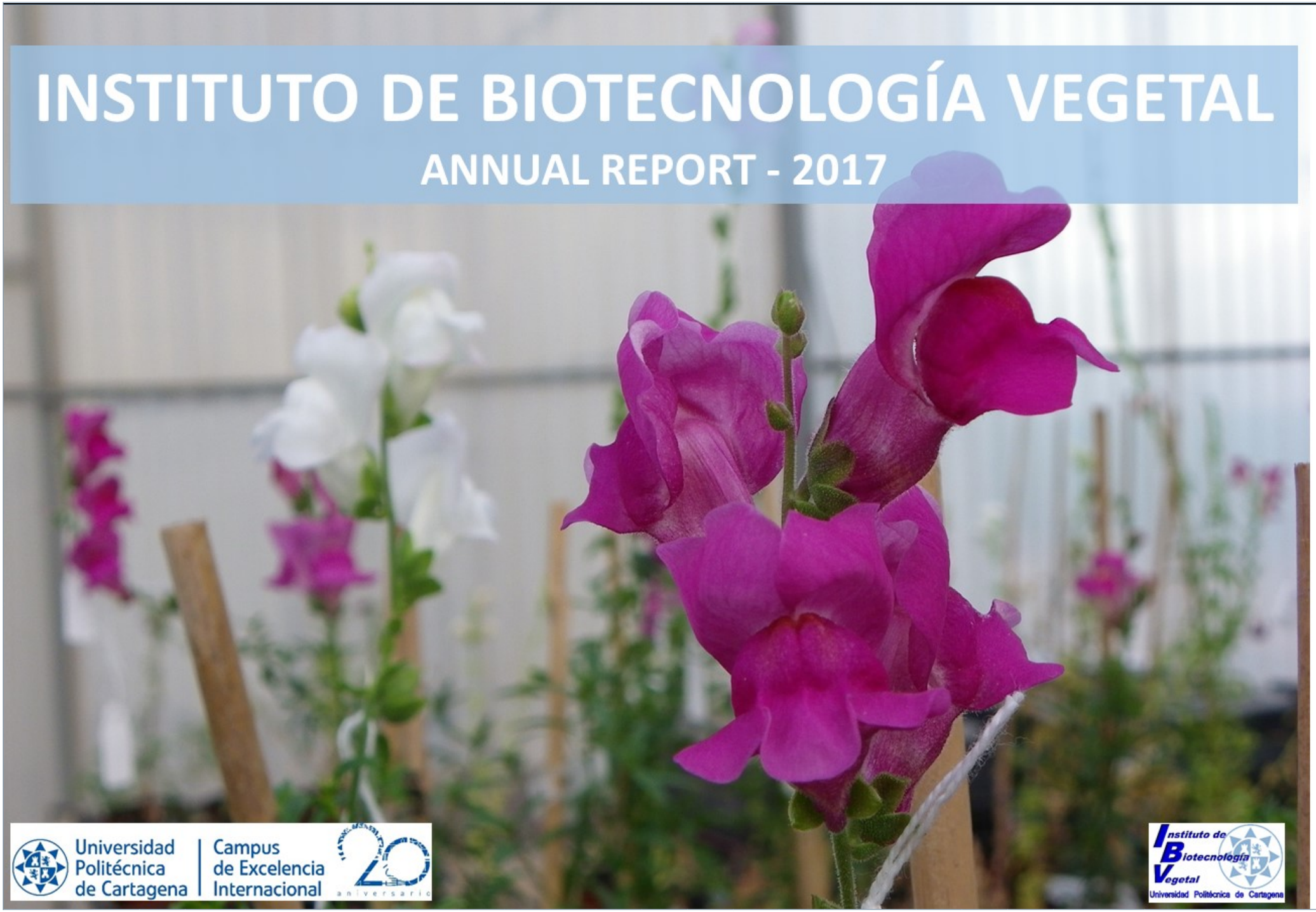
INSTITUTO DE BIOTECNOLOGÍA VEGETAL

ANNUAL REPORT - 2017



Universidad Politécnica de Cartagena | Campus de Excelencia Internacional

Instituto de Biotecnología Vegetal
Universidad Politécnica de Cartagena

INDEX

FROM THE VICEPRESIDENT FOR RESEARCH

Since its creation, the IBV has led regional, national and European research projects, becoming a benchmark in the research of our Autonomous Community, and improving their results every year. Their collaborations with the business sector of the region have allowed the creation of “cátedras” related to the agro-food business environment and contracts with companies to provide them with technological solutions. The staff of the IBV is the great strength and the engine of its success.

Prof. Dr. Beatriz Miguel Hernández

FROM THE DIRECTOR

We have composed the 2017 Annual Report aiming to expose the main activities of the IBV and its Units. As a research institute, the IBV has a strong position at the UPCT in terms of scientific productivity. But our productivity is the result of the effort performed by the different scientists and group leaders to obtain extramural funding.

The IBV, from its inception has been open to external collaborations with other research groups from the UPCT, national and international. This is reflected in the large number of projects where more than one IBV Unit join forces for scientific work, the inclusion of other research groups from outside the IBV, and collaborations with other institutions.

In this Annual Report, we give a short overview of three research projects led by IBV scientists. The EUROLEGUME was a FPVII EU project coordinated by Prof. Juan A. Fernández from the Genetic Resources Unit that ended in 2017. It had 17 partners from all over the EU and included three additional Units from the IBV and the Animal Production team from UPCT. Emerging pests are a real thread to agriculture and the project to identify and control the insect vector *Trioza*, led at the UPCT by Prof. Pablo Bielza from the Resistance to insecticide Unit is a good example of the necessity of having multidisciplinary teams and networks, in this case with national teams from other research centers and Universities. The DIVERFARMING project is a 10.4 M€ H2020 action led by Dr. Raúl Zornoza from the Soil Ecology and Biotechnology, and coordinated by the UPCT, where biodiversity and its improvement are central. It has over 50 partners in the EU and comprises three units of the IBV working on it.

Several researchers of the IBV are directly involved in coordinating chairs, and this is yet another point where the IBV is creating an impact. We present four Chairs. They include MARNYS, dedicated to food industry and supplements, Catedra Medio Ambiente with the Port of Cartagena, GS-Spain involved in fresh products export and the Sustainable Agricultre Chair dedicated to improve the situation of the water use in the Campo de Cartagena.

We have increased our scientific output by 15% as compared to the previous year, partly due to the incorporation of the highly productive Soil Ecology and Biotechnology unit.

The decision of the Government Council of the UPCT to develop a fee system to access scientific infrastructure was implemented by the IBV in 2017 and thanks to the Vicepresident Prof. Dr. Antonio Durendez and his team, we were able to start to obtain the corresponding fees to address reparations and maintenance of our own infrastructure. We have obtained over 15000€, out of which, over 40% is from outside the IBV.

Our current challenges include the long term aim of increasing the number of research technicians, in order to answer the increasing number of offers from the public and private sector. The second one is the relocation of the IBV to the Alfonso XIII Campus that should help us have a deeper contact with the students. We are convinced, by experience and statistics, that the students that work in research projects are better suited to increase the quality and competitiveness of the organizations where they find jobs, both private and public. Research is our DNA, and the level of quality, attention to detail and ethical involvement is difficult to match in other types of projects. This translates in higher and importantly, better employability of our students.

Prof. Dr. Marcos Egea Gutiérrez Cortines
Director

Publications: http://www.upct.es/ibvupct/publicaciones_2017.php

Projects and R+D Contracts: http://www.upct.es/ibvupct/proyectos_2017.php

Patents: http://www.upct.es/ibvupct/patentes.php

COLLABORATIVE RESEARCH PROJECTS

Project title: Métodos de control y contención de *Trioza erytreae*, vector del huanglongbing de los cítricos

Subproject title UPCT: Gestión integrada de *Trioza erytreae*: resistencia a insecticidas, control biológico, métodos de muestreo y susceptibilidad varietal. E-RTA2015-00005-C06-06. INIA. 2017-2020.

Partners: IVIA, ICIA, IRTA, IMIDA, IFAPA, UPCT.

Coordinator: A. Urbaneja (IVIA).

Principal investigator UPCT: Professor Dr Pablo Bielza.

Damage of *Trioza erytreae* on citrus

The African citrus psyllid *Trioza erytreae* (Del Guercio) (Hemiptera: Psyllidae) was recently (fall 2014) detected in the northwest of the Iberian Peninsula. T. erytreae with *Diaphorina citri Kuwayama* (Hemiptera: Liviidae) are considered the main threat to citrus industry worldwide since both are vectors of the "huanglongbing" (HLB), an incurable disease of citrus. Due to the large economic losses associated with HLB in those areas where the vector is present without the disease, its containment is key to reduce the risk if HLB is detected. Despite its status as a vector of HLB, most studies on *T. erytreae* have more than 30 years and also tend to be confined to the specific conditions prevailing in Africa. In fact, information related to its management outside that geographical area is still lacking. Therefore, in this project characterized by a multidisciplinary approach, ranging from basic to applied research, five research objectives have been established:

1) Biology and ecology of *T. erytreae* in Spain,

2) Improvement of chemical control of *T. erytreae,*

3) Improvement of biological control of *T. erytreae*,

4) Prospecting and detection methods 'Candidatus Liberibacter' spp. and

5) Plant tolerance, crop management and biotechnology control of T. *erytreae*. All of them focused to develop a program of control and containment of T. *erytreae* in all Spanish citrus areas.

Finally, an additional sixth objective aims to disseminate, transfer and exploit the results of this project. This latter objective is key to inform and sensitize the citrus-producing sector on the negative impact that could cause this important vector.

The ultimate goal of this project is to provide a sound scientific basis on which to develop innovative practices and sustainable protection to the challenge that faces our citrus crops with this vector.

Project title: EUROLEGUME (Enhancing of legumes growing in Europe through sustainable cropping for protein supply for food and feed) is an international research project funded by the 7th Research Framework Programme of the European Union.

Coordinator: E. Rosa (UTAD).

Principal investigator UPCT: Prof Dr. J. A. Fernández.

Despite the considerable importance of legumes to both agriculture and pristine ecosystems, key gaps in knowledge remain. The research within the framework of EUROLEGUME has been directed to improvements in yield parameters, biotic and abiotic stress resistance, nitrogen fixation (in plants and in soil), and nutritional value in sustainable legume (faba beans, peas, cowpea) cultivation systems in Europe by introducing new genotypes from different geographical regions and by exploiting/introducing available genetic resources in active cropping systems, using both molecular technologies and evaluating the influence of legumes on the following crops in rotation and as intercrops in situ.

Overall objective of the project has been to improve the sustainable production of leguminous crops and their multipurpose use in a changing climate, ensuring new varieties and new food and feed products, broadening the production area and thus turning EU more competitive and sustainable.

The EUROLEGUME project involved 18 partners (European research institutions and SMEs from 10 European countries) with a long-term experience in specific research areas enclosed to the aims and objectives of the project. Three Research Units of the IBV were involved in the Project, coordinated by Prof. Dr. Juan A. Fernández: Genetic Resources, Molecular Genetic and Food Quality and Health. Main findings of the Project have been summarized in several scientific papers, Ph.D. Dissertations, contributions to Congresses and Conferences and Dissemination material (videos, leaflets, etc.). More information is available in www.eurolegume.eu

PARTNERS

Partners
1 UTAD - Portugal
2 LLU - Latvia
3 PHRC - Latvia
4 SPPBI - Latvia
5 BIOEFECTS - Latvia
6 ECRI - Estonia
7 AUT - Albania
8 JTI - Sweden
9 FRESCURA SUBLIME - Portugal
10 UPCT - Spain
11 INIAV - Portugal
12 BOKU - Austria
13 AUA - Greece
14 BIOFORSK - Norway
15 UMB - Norway
16 SYMBIOM - Czech Republic
17 KPRA - Spain
18 ESTIRPE - Portugal

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

With the long-term view of increasing diversification and biodiversity in Europe and fostering sustainable development of bioeconomy, the Diverfarming consortium has come together to develop and deploy innovative farming and agribusiness models. Diverfarming will increase the long-term resilience, sustainability and economic revenues of agriculture across the EU by assessing the real benefits and minimising the limitations of diversified cropping systems using low-input agricultural practices that are tailor-made to fit the unique characteristics of six EU pedoclimatic regions (Mediterranean South and North, Atlantic Central, Continental, Pannonian and Boreal) and by adapting and optimising the downstream value chains organization through executing 14 field case studies and 8 additional long-term experimental plots. This approach will provide: i) increased overall land productivity; ii) more rational use of farm land and farming inputs (water, energy, fertilisers…); ii) improved delivery of ecosystem services by increments in biodiversity and soil quality; iii) proper organization of downstream value chains adapted to the new systems with decreased use of energy; and iv) access to new markets and reduced economy risks by adoption of new products in time and space.

Objectives:

1. Development of new systems: To develop and test different diversified cropping systems (rotations, multiple cropping and intercrops for food, feed and industrial products) under low-input practices, for conventional and organic systems to increase land productivity and crops quality.

2. Benefits study: to explore how the diversified cropping systems can, under low-input practices, increase the delivery of ecosystem services (soil fertility, prevention of soil and water contamination, water availability, reduced greenhouse gas (GHG) emissions, carbon sequestration, erosion prevention and pest and disease control).

3. Impact evaluation: to evaluate how the downstream value chains and the actors involved will be impacted by the new diversified cropping systems, and so, propose new organizational structures.

4. Model development: to develop and test agro-ecosystem models that will explore how the diversified cropping systems influence the land productivity and the soil-plant system.

5. Systems evaluation: to evaluate the proposed diversified cropping systems on the basis of their economic impact, at all levels. T.

6. Communication and dissemination: to communicate, disseminate and engage with European farmers, cooperatives, industry and logistics to develop, hone and embrace diversified cropping systems under low-input practices.

Partners:

CHAIRS

MARNYS-IBV

Martínez Nieto, S.A. is a laboratory dedicated to the manufacture of food supplements and natural cosmetics that has a catalogue of more than 400 high quality products. Their commitment and dedication make MARNYS® an organization in continuous growth. From its origin in 1968, control and quality from raw materials to finished products have been its raison d'être, in order to reach the highest quality standards for which MARNYS® is known in more than 60 countries, where it counts with permanent distribution networks. Among the products that MARNYS® develops, include drinkable vials, syrups, capsules, tablets, essential oils and natural cosmetics with ecological certification. The company develops healthier and more effective natural products than synthetic ones. The "natural" factor is one of the great values that differentiates them in the nutrition and beauty market where the use of synthetic elements is unbridled.

Objectives of the Chair

This company joins the Network of Chairs of the Polytechnic University of Cartagena (UPCT) in March 2017 to promote training activities, practical application of knowledge, and promotion of innovation, related to the development of nutraceutical products and natural cosmetics. Researchers of the UPCT collaborate in R & D & I projects. The Chair is directed by Dr. Encarna Aguayo. The Chair fellowship for two graduates and has hired a doctor from the UPCT for the development of R & D activities. It also incorporates other training activities and sponsorship of awards, such as the prize for the best Final Degree Project or Master.

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

MARNYS®

MEDIO AMBIENTE, AUTORIDAD PORTUARIA DE CARTAGENA, CAMPUS MARENOSTRUM

CÁTEDRA DE MEDIO AMBIENTE
APC-CMN

The Interuniversity Chair of Environment-Port Authority of Cartagena-Campus Mare Nostrum was created on July 31, 2015, with the objective of establishing a permanent collaboration structure between the Port Authority of Cartagena and the public universities of the Region of Murcia: UPCT and the University of Murcia. The idea behind was to meet the activities of research, dissemination and technical assistance and formation in matter of environment done from all these institutions.

The aim is also to cooperate with other research centres, professionals and collaborating companies related to environmental issues.

Main concern lines of action are those related to biodiversity and the responsible management of species and habitats, mainly on the port environment, as well as the promotion of environmental concepts and tools such as Nature Conservation Banks, care of the territory, the management of natural resources, the integration of environmental assessment in the planning and management of companies, as well as the design of measures aimed to the conservation, sustainable use, improvement, restoration and compensation of natural heritage and The Biodiversity.

Among its activities it is a high spot the annual call for research projects, the prizes for the best final graduated and Master projects and the professional scholarships associated to environmental activities of the Port Authority of Cartagena.

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

Submarine used to monitor underwater acoustics.

Puerto de Cartagena
Autoridad Portuaria de Cartagena

GRUPO G's ESPAÑA

Grupo G's España is a modern and dynamic company, European leader in the production and marketing of a wide range of fresh fruit and vegetables whose headquarters are located in Torre Pacheco (Campo de Cartagena). Since its creation in 1985, G's España has grown with large investments in different areas such as new products, facilities, land cultivation or water resources, strongly promoting innovation. Caring for the environment, G's is carrying out different projects to minimize the exploitation of natural resources.

Objectives of the Chair

Since its creation in 2014, the objectives have been to carry out collaborative activities in the area of training, research and best practices in the area of 'Improvement and Optimization of the Quality and Safety of Horticultural Products'.

The chair every year contributes with two grants of specialization. It also awards the best presentation at the Workshop of Doctorate Projects (WiA-TAIDA) and the best Master and graduated final projects.

G's España has also developed several R & D contracts and services in collaboration with the IBV staff, and offers practical training to graduated and post-graduate students. Every year it incorporates around ten recently-graduated students to its staff.

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

SUSTAINABLE AGRICULTURE

Cátedra
Agricultura Sostenible
Campo de Cartagena

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

Objectives of the Chair

The main research project of the Chair is to develop a sustainable and efficient system to eliminate nitrates of the brines produced by the desalting devices. We have already promising results at improving water quality.

The second task is the active collaboration with the companies Insal and Ecogest to optimize the use of drilled reservoir water in order to avoid the production of high salt wastewater. While these are the main lines of work, we are conscious of the importance of increasing agricultural outputs with a sustainable agricultural practice.

The control of fertilization and water leaching is one of our next challenges together with an increase of the biodiversity in the Campo de Cartagena.

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

RESEARCH UNITS

BIOTECHNOLOGICAL PROCESSES, TECHNOLOGY AND ENGINEERING

1. Main results

In this year 3 articles have been published in international journals (J. Food Science; Nanomaterials; and Food Microbiology) with high impact factor (first and second quartile), 1 Spanish patent has been submitted, 3 Spanish patents have been published and 2 patents have been submitted as PCT. In international congresses, 2 communications were presented to the Aquaculture Europe 2017 Congress (Dubrovnik, Croatia). The National Aquaculture Research Prize, JACUMAR 2017, from the Spanish Ministry of Agriculture and Fisheries, Food and Environmentwas received for a research work on a new method of stunning and slaughtering of aquaculture fish based on nanoencapsulated essential oils embedded in ice (Based on a CDTI Project led by Prof. Antonio López Gómez).

2. Projects (most relevant)

-Ultraclean thermoforming equipment for food packaging, a cost-effective alternative to clean rooms — CLEANPACK", Fase 2. Horizon 2020; Call: SME instrument phase 2, H2020-SMEInst-2016-2017/H2020-SMEINST-2-2016-2017; Grant Agreement nº: 777900-CleanPack. Principal Investigator: López Gómez, A.

-New antimicrobial active carton box to extend the shelf life of tomatoes and fresh peppers packaged in bulk—CARTONFRESH". PROJECT RIS3-Mur 2016. 2/16SAE00006. Participants: UPCT and S.A. Cartón Ondulado Company (Molina de Segura, Murcia). Principal Investigator: López Gómez, A.

3. Selected publications

Sánchez-Rubio,M., Guerrouj, K., Taboada-Rodríguez, A., López-Gómez, A., Marín-Iniesta, F. 2017. Control of native spoilage yeast on dealcoholized red wine by preservatives alone and in binary mixtures. J. Food Sci., 82(9): 2128-2133.

Ros-Chumillas, M., Garre, A., Maté, J., Palop, A. and Periago, P.M. 2017. Nanoemulsified D-limonene reduces the heat resistance of *Salmonella Senftenberg* over 50 times. Nanomaterials, 7(3): 65.

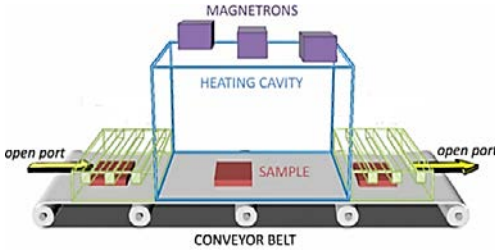
4. Others (most relevant contracts)

Refrigerated meat products without gluten and healthier. Funded by CDTI-R&D Project 2017 (*IDI- 20170705)*. Participants: UPCT and SEDIASA ALIMENTACIÓN S.A. Company (Madrid). Principal Researcher: Antonio López Gómez.

New technologies for decontamination and packaging of fresh culinary herbs. Funded by CDTI – R&D Project 2017 (*IDI- 20170712*). Participants: UPCT and AGROHERNI S.C.L. Company (Las Palas, Fuente Álamo, Murcia). Principal Researcher: Antonio López Gómez.

Staff: Head of the Unit: Prof. Dr. Antonio López Gómez. Researchers: Prof. Dr. Asunción Iguaz Gainza, Dr. Sonia Soto Jover, Dr. María Ros Chumillas, Dr. Domingo Miranzo Navarro. M.Sc. and Ph.D. Students: María José Sánchez Martínez, Laura Navarro Segura, Laura Buendía Moreno, Amanda E. López Cánovas.

FOOD QUALITY AND HEALTH



1. Main results

-Watermelon juice enriched in L-citrulline and pomegranate ellagitannins enhanced the metabolism during physical exercise.

-New minimally processed food and smoothies based on different vegetables produced using microwaves and high hydrostatic pressure.

-UV-C and hyperoxia abiotic stresses can reduce diseases and improve healthiness of some vegetables.

-Use of postharvest UV-B and UV-C effectiveness to revalorize fruit and vegetables byproducts.

2. Projects (most relevant)

-Implantación de técnicas ecoinnovadoras para la mejora de la producción, calidad y comercialización de una nueva variedad de melón. RIS3. Principal investigator: Aguayo, E.

-Innovative processing of natural refrigerated fresh vegetables smoothies improving its healthiness. MINECO. Principal investigator: Artés-Hernández, F.

-Comprehensive use of the carob pod in the elaboration of functional foods. Principal investigator: Martínez, A.

3. Selected publications

Collado, E., Venzke-Klug, T., Martínez-Sánchez, A., Artés-Hernández, F., Aguayo, E., Artés, F., Fernández, J.A., Gómez, P.A., 2017. Immature pea seeds: effect of storage under modified atmosphere packaging and sanitized with acidified sodium chlorite. J. Sc. Food Agric., 97, 4370-4378.

Formica-Oliveira A.C., Martínez-Hernández G.B., Díaz-López V., Artés F., Artés-Hernández F. 2017. Use of postharvest UV-B and UV-C radiation treatments to revalorize broccoli byproducts and edible florets. Innovative Food Sci. Emerging Technol., 43: 77-83.

Martínez-Sánchez, A., Alacid, F., Rubio-Arias, J.A., Fernández-Lobato, B., Ramos-Campo, D.J., Aguayo, E. 2017. Consumption of watermelon juice enriched in L-citrulline and pomegranate ellagitannins enhanced the metabolism during physical exercise. J. Agric. Food Chem., 7, 65(22): 4395-4404.

Venzke Kluge T., Martínez-Sánchez A., Gómez P., Collado E., Aguayo E., Artés F., Artés-Hernández F. 2017. Improving quality of a pea puree by high hydrostatic pressure. J. Sci. Food Agric., 97(13): 4362–4369.

4. Others: Ph.D. Dissertations

Adecuación de las condiciones operativas del secador de doble cilindro rotativo en el aprovechamiento de subproductos de la industria de procesado mínimo en fresco como puré en polvo.

Effect of abiotic stresses on bioactive contents of vegetables and high-pressure technology in related functional beverages.

Preservación de la seguridad alimentaria y calidad en smoothies morados mediante tratamientos térmicos suaves y altas presiones hidrostáticas.

Elaboración industrial de haba mínimamente procesada en fresco y optimización de su calidad y vida comercial.

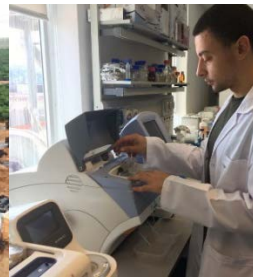
Staff: Head of the Unit: Prof. Dr. Encarna Aguayo. Researchers: Prof. Dr. Francisco Artés-Calero, Prof. Dr. Francisco Artés-Hernández, Prof. Dr. Juan P. Fernández-Trujillo, Dr. Ascensión Martínez-Sánchez, Dr. Ginés B. Martínez-Hernández, Dr. Carolina Formica, Dr. Bárbara Fernández-Lobato. M.Sc. and Ph.D. Students: Noelia Castillejo, Elena Collado, Tâmmila Venzke-Klug, Paloma Martínez-Martínez, Hazel Álvarez.

SOIL ECOLOGY AND BIOTECHNOLOGY


Sediment processing under N_2 atmosphere


Soil management for microbial analyses


Soil sampling at agricultural fields


Sequencing soil microbiota

1. Main results

-A complete biogeochemical characterization of the bottom sediments from the Mar Menor lagoon is in progress (http://suelos.upct.es/es/node/172). The main objective is to evaluate the trophic state and pollution in the sediments of the lagoon. The first results showed severe anoxic conditions in most and a massive accumulation of organic matter remains.

-Functional attributes of mine soils from La Unión mining area are under study. Soil samples were collected from a variety of environments and soil microbiology was analysed to assess the role of soil microbiota in natural processes of ecosystem recovery in the mining area. (http://suelos.upct.es/es/node/168; http://suelos.upct.es/es/node/99)

-Within Diverfarming project (http://www.diverfarming.eu/index.php/en/), the procedures for analytical methods were agreed for the characterization of soil microbial genetic and functional diversity of diversified cropping systems.

-Within the Soil Take Care project (http://soiltakecare.eu), *Lygeum spartum* and *Piptatherum miliaceum* have been selected as the most suitable species for phytostabilization of mine soils and wastes affected by metals. *Lavandula multifida* and *Rhamnus lycioides* are the most susceptible species to transfer metals through the food chain, mainly for Cd and Zn.

2. Projects (most relevant)

-Biogeochemical study of the sediments from the Mar Menor lagoon bottom. 2018-2019. UPCT-IEO-USC-UCA. Coordinator: Principal investigator: Álvarez Rogel, J.

-Functionality and resilience of soils polluted by mining wastes under climate change conditons in mediterranean environments: ecotoxicological aspects and the use biochar for remediation (CGL2016-80981-R). MINECO. 2017-2019. Principal investigator: Álvarez Rogel, J.

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

-Crop diversification and low-input farming across Europe: from practitioners' engagement and ecosystems services to increased revenues and value chain organisation – Diverfarming, Horizon 2020 EU. Principal investigator: Zornoza, R.

-Soil Take Care. SOE1/P4/F0023. Interreg-Sudoe. European Commission. 2016-2019. Principal investigator: Faz, A.

3. Selected publications

Barmentlo, S.H., van Gestel, C.A.M., Álvarez-Rogel J., González-Alcaraz M.N. 2017. Influence of climate change on the multi-generation toxicity to *Enchytraeus crypticus* of soils polluted by metal/metalloid mining wastes. Environ. Pollution 222, 101-108. http://dx.doi.org/10.1016/j.envpol.2016.12.078.

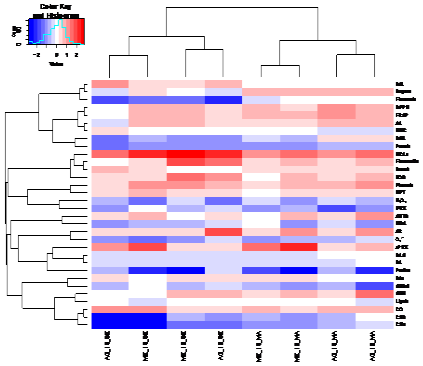
Martínez-Oró, D., Párraga-Aguado, I., Querejeta, J.I., Conesa, H.M. 2017. Importance of intra- and interspecific plant interactions for the phytomanagement of semiarid mine tailings using the tree species *Pinus halepensis.* Chemosphere. 186:405-413.

Zornoza, R., Gómez-Garrido, M., Martínez-Martínez, S., Gómez-López, M.D., Faz, A. 2017. Bioaugmentaton in Technosols created in abandoned pyritic tailings can contribute to enhance soil C sequestration and plant colonization. Sci. Total Environment, 593-594: 357 – 367.

Moreno-Barriga, F., Díaz, V., Acosta, J.A., Muñoz, M.A., Faz, A., Zornoza, R. 2017. Organic matter dynamics, soil aggregation and microbial biomass and activity in Technosols created with metalliferous mine residues, biochar and marble waste. Geoderma, 301: 19 - 29.

Staff: Head of the Unit: Prof. Dr. José Álvarez. Researchers: Dr. Héctor Conesa, Prof. Dr. Ángel Faz, Dr. Raúl Zornoza, Dr. Martín Soriano. M.Sc. and Ph.D. Students: Obdulia Martínez, Onurçan Özbollat, Antonio Peñalver, Yolanda Risueño, Virginia Sánchez-Navarro.

SECONDARY METABOLITES



1. Main results

Work on metabolic profiles of plants grown on mine tailings piles demonstrated the prominent role played by secondary metabolites in tolerance mechanisms to multi-stress conditions. Some pioneer plant species, such as *Zygophyllum fabago*, display a high physiological plasticity that allows them to successfully shift its metabolism to withstand the multiple stresses that plants must cope with. Data analyses have allowed us to identify those components of the antioxidant systems of pioneer plants that can be considered as markers of population, season, and soil conditions. Knowledge of these adaptive mechanisms is essential to improve plant resilience to multi-stress scenarios and could help to implement more effective phytomanagement strategies.

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). 2016-2020. Project manager: Sevilla Valenzuela, F. (CSIC)
-Fitomanejo de residuos mineros en entornos semiáridos empleando biochar y especies arbóreas autóctonas: aspectos ecotoxicológicos y ecofisiológicos. MINECO (CGL2014-54029-R). 2015-2018. Principal investigator: Conesa, H.M.
-Dinámica de metales y evaluación de la toxicidad de residuos mineros con hidromorfia usando bioensayos de plantas: remediación con biochar de RSU y de lodos de EDAR. MINECO (CGL2013-49009-C3-1-R). 2014-2017. Principal investigator: Álvarez Rogel, J.
-Uso de composts supresivos y sus extractos biológicos en la producción sostenible y de calidad de rúcula y lechuga baby-leaf en suelo y en bandeja. MINECO (AGL2014-52732-C2-2). 2015–2018. Principal investigator: Fernández, J.A.
-Acciones para la recuperación y conservación de la especie en peligro de extinción jara de Cartagena (*Cistus heterophyllus subsp. carthaginensis*). Fundación Biodiversidad, Ministerio de Agricultura, Alimentación y Medio Ambiente. 2017-2018. Principal investigator: Vicente Colomer, M.J.

3. Selected publications

López-Orenes, A., Bueso, M.C., Conesa, H.M., Calderón, A.A., Ferrer, M.A. 2017. Seasonal changes in antioxidative/oxidative profile of mining and non-mining populations of syrian beancaper as determined by soil conditions. Sci. Total Environment 575: 437-447.

4. Others: supervision of research stays

Simone Ribeiro Lucho, Universidade Federal de Pelotas (Brasil). Programa de Doutorado Sanduíche no Exterior -88881.136036/2017-01, Fundaçao CAPES. From April to October.

Mäel Taupin, Université de Montpellier. Erasmus+ program (Higher Education Traineeships). From March to July.

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

MICROBIOLOGY AND FOOD SAFETY

1. Main results

The Unit received financial support during 2017 from two research projects and leaded one national network, all them founded by the Spanish Government, and from one contract with a food company. Members of this Unit participated also in the creation of a new spin-off company. Two articles were published in indexed journals. One thesis was also defended in this period.

2. Projects (most relevant)

-Validation of mild heat preservation processes of foods: establishing microbial food safety. MINECO (ref. AGL 2013/48993-C2-1-R). 2014-2018. Principal investigator: Fernández, P.S., Principal co-investigator: Palop, A.

-Sterilisation of food and animal waste by means of microwave energy with uniform heating technology. MINECO (ref DPI2014-61857 EXP). 2015-2017. Principal investigator: Díaz Morcillo, A.

-Development of the structure needed to carry out a quantitative biological risk prioritization and assessment in Spain. MINECO (refAGL 2016-82014-REDT). Principal investigator: Fernández, P.S.

3. Selected publications

Maté, J., Periago, P.M., Ros-Chumillas, M., Grullón, C., Huertas, J.P. and Palop, A. 2017. Fat and fibre interfere with the dramatic effect that nanoemulsified, *D*-limonene has on the heat resistance of *Listeria monocytogenes*. Food Microbiol., 62: 270-274.

Ros–Chumillas, M., Garre, A., Maté, J., Palop, A. and Periago, P.M. 2017. Nanoemulsified *D*-limonene reduces de heat resistance of *Salmonella* Senftenberg over 50 times. Nanomaterials, 7(3): 65.

4. Others

-Ph. D. Dissertation: Preservation of food safety and quality in purple smoothies through mild thermal treatments and high hydrostatic pressure. Author: Gerardo A. González-Tejedor. Supervisors: Prof. Dr. Pablo S. Fernández and Prof. Dr. Francisco Artés-Hernández.

-Contract: Reference: 5113/17IAEA. Company: Tropicana Alvalle, S.L. Contract leader: Prof. Dr. Pablo S. Fernández

Spin-off Company: Bioencapsulation and iPackaging, S.L.

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: Alberto Garre, Gerardo González, J. Antonio Sotomayor, Mariem Sormrani, Marta Clemente.

RESISTANCE TO INSECTICIDES

Development stages of *Bemisia tabaci* (Hemiptera: Aleyrodidae)

1. Main results

The resistance to pesticides of *Myzus persicae* and *Tuta absoluta*, and the biological control agent *Orius laevigatus* were studied. A penetration resistance mechanism in *M. persicae* was found. Several strains of *O. laevigatus* highly resistant to a number of insecticides were obtained by selective breeding.

Biotechnological tools based on Tomato Leaf Curl New Delhi Virus (ToLCNDV) were developed. An infectious clone of ToLCNDV and several replicons sequence were established with one of them that may allow sequence specific mutations at a high frequency in *Solanaceae* and *Cucurbitaceae*.

Response of plant to biotic and abiotic stress was studied with new findings for stone fruit trees (*Prunus* spp).

Penicillium ulaiense, responsible of postharvest disease in citrus was studied with the first report of P. Ulaiense in Spain. It is affected by fungicides (TBZ and pyrimethanil).

2. Projects (most relevant)

-Uso sostenible de insecticidas en *Myzus persicae*: diseño de una estrategia de manejo de la resistencia. AGL2014-55298-R. MINECO. Principal investigator: Bielza, P.

-Resistencia a insecticidas en *Myzus persicae*: mecanismos implicados y estrategias de manejo. 19282/PI/14. Fundación Séneca. 2015-2018. Principal investigator: Bielza, P.

-Desarrollo de herramientas biotecnológicas basadas en el virus emergente Tomato leaf curl New Delhi virus. Fundación Séneca. 1925/PI/2014. Participants: IBV-UPCT, CEBAS-CSIC, AbioPep S.L. 2015-2018. Principal investigator: Petri, C.

-Nueva ruta biosintética de Ácido Salicílico en *Prunus*, diseccionando las respuestas de defensa de *Prunus* (DefenSA). MINECO AGL2014-52563-R. Participants: CEBAS-CSIC, IBV-UPCT. Principal investigator: Díaz Vivancos, P.

3. Selected publications

Chen, X., Hitchings, M., Mendoza, J., Balanza, V., Facey, F., Dyson, P., Bielza P., Del Sol, R. 2017. Comparative genomics of facultative bacterial symbionts isolated from European *Orius* species reveals an ancestral symbiotic association. Frontiers in Microbiol., 8: 1989.

Diaz-Vivancos, P., Bernal-Vicente, A., Cantabella, D., Petri, C., Hernández, J.A. 2017. Metabolomic and biochemical approaches link salicylic acid biosynthesis to cyanogenesis in peach plants. Plant Cell Physiol., 58: 2057-2066.

Haddi, K., Berger, M., Bielza, P., Rapisarda, C., Williamson, M., Moores, G., Bass, C. 2017. Mutation in the ace-1 gene of the tomato leaf miner (*Tuta absoluta*) associated with organophosphates resistance. J. Appl. Entomol., 141: 612-619.

Lloret, A., Conejero, A., Leida, C., Petri, C., Gil-Muñoz, F., Burgos, L., Badenes, M.L., Ríos, G. 2017. Dual regulation of water retention and cell growth by a stress-associated protein (SAP) gene in *Prunus.* Scientific Reports, 7, 332.

Roditakis, E., Steinbach, D., Moritz, G., Vasakis, E., Stavrakaki, M., Ilias, A., García-Vidal, L., Martínez-Aguirre, M.R., Bielza, P., Morou, E., Silva, J.E., Silva, W., Siqueira, H., Iqbal, S., Troczka, B., Williamson, M., Bass, C., Tsagkarakou, A., Vontas, J., Nauen, R. 2017. Ryanodine receptor point mutations confer diamide insecticide resistance in tomato leafminer, *Tuta absoluta* (Lepidoptera: Gelechiidae). Insect Biochem. Mol. Biol., 80: 11-20.

4. Others

Ph.D. Dissertation: Resistencia a emamectina benzoato en *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae). M. del Rosario Martínez Aguirre. UPCT. Supervisor Prof. Dr. Pablo Bielza.

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. César Petri, Dr. Carolina Grávalos. M.Sc. and Ph.D. Students: María A. Parra, Lidia Martín, Ana Belando, Virginia Balanza, María Martínez, José E. Mendoza, Inmaculada Moreno.

GENETIC RESOURCES

1. Main results

During 2017, the Genetic Resources Unit have continued working on the conservation, characterization and evaluation of genetic resources, mainly in the framework of the two existing Projects, one financed by the European Commission and the other one by the Ministerio de Economía y Competitividad of the Spanish government. In the same way, the staff of the Genetic Resources Unit have carried out the annual recollection of indigenous wild plant material and their conservation in the Germplasm Bank-UPCT.

2. Projects (most relevant)

-Enhancing of legumes growing in Europe through sustainable cropping for protein supply for food and feed. European Comission (FP7-BBBE.2013.1.2-02). Participants: Universidad de Tras Os Montes, Universidad de Agricultura de Atenas, Universidad Politécnica de Cartagena and 9 more. Project manager: Eduardo Rosa. J.A. Fernández at UPCT.

-Uso de composts supresivisos y sus extractos biológicos en la producción sostenible y de calidad de rucola y lechuga baby-leaf en suelo y en bandeja. Ministerio de Economía y Competitividad (AGL2014-52732-C2-2). Participants: UPCT and CEBAS-CSIC. Principal investigator: J.A. Pascual Valero, J.A. Fernández at UPCT. 72.000 €.

3. Selected publications

Pagnota, M., Fernández, J.A., Sonnante, G., Egea-Gilaber, C. 2017. Genetic diversity and accession structure in European *Cynara cardunculus* collections. PLoS ONE 12(6): e0178770. https://doi.org/10.1371/journal. pone.0178770.

Martos-Fuentes, M.M., Fernández, J.A., Ochoa, J., Caravalho, M., Carnide, V., Rosa, E., Pereira, G., Barcelos, C., Bebeli, P., Egea-Gilabert, C. 2017. Genotype × Environment interactions in cowpea (*Vigna unguiculata* l. walp.) grown in the Iberian Peninsula. Crop and Pasture Science, 68: 924–931. https://doi.org/10.1071/CP17071.

Collado, E., Venzke-Klug, T., Martínez-Sánchez, A., Artés-Hernández, F., Aguayo, E., Artés, F., Fernández, J.A., Gómez, P.A. 2017. Immature pea seeds: effect of storage under modified atmosphere packaging and sanitation with acidified sodium chlorite. J. Sci. Food Agric. 2017, 97(13): 4370–4378. DOI 10.1002/jsfa.8513.

Staff: Head of the Unit: Prof. Dr. María José Vicente Colomer. Researches: 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, Prof. Dr. Jesús Ochoa. M.Sc. and Ph.D. Students: Virginia Sánchez Navarro, Marina Martos Fuentes.

MOLECULAR GENETICS

1. Research interest and main results

We study the way genetic programs and environmental factors such as light and temperature affect plant development. We center our efforts elucidating genetic factors controlling growth and volatile production. We use computer vision and machine learning (ML) algorithms for automatic phenotype data analysis. New progress in understanding the common coordination of organ growth and secondary metabolism have been obtained.

2. Projects (most relevant)

-Project 19398/PI/14 Fundación Séneca- Determinación del control de la emisión de volátiles florales por el bucle nocturno del reloj circadiano en Petunia.

-Project Diverfarming H2020- 2017-2022.

-Project CDTI- Artificial vision and plant development-2017-2019.

-Project MELOMUR-RIS3 2018-2022.

-Proyect BFU-2017 88300-C2-1-R. 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

Carvalho, M., Muñoz-Amatriaín, M., Castro, I., Lino-Neto, T., Matos, M., Egea-Cortines, M., Rosa, E., Close, T., Carnide, V. 2017. Comparison of genetic diversity of Iberian Peninsula cowpeas with worlwide landraces using high density SNP markers. BMC Genomics, 18:891.

Pérez-Sanz, F., Navarro, P.J., Egea-Cortines, M. 2017. Plant phenomics: an overview of image acquisition technologies and image data analysis algorithms. Gigascience, 6: 1–18.

Ruiz-Hernández, V., Hermans, B., Weiss, J., Egea-Cortines, M. 2017. Genetic analysis of natural variation in Antirrhinum scent profiles identifies Benzoic acid carboxymethyl transferase as the major locus controlling methyl benzoate synthesis. Frontiers in Plant Sci., 8, 27–40.

4. Others

Ph.D. Dissertation: Marta Pawluczyk. Role of plastid markers in environmental studies on the example of the endangered species *Cistus heterophyllus.* Directors. Prof. Dr. Marcos Egea-Cortines; Prof. Dr. Julia Weiss.

Staff: Head of the Unit: Prof. Dr. Julia Weiss. Researchers: Prof. Dr. Marcos Egea Gutiérrez-Cortines. M.Sc. and Ph.D. Students: Victoria Ruiz-Hernández, Raquel Alcantud-Rodríguez, Claudio Brandoli, Fernando Pérez-Sanz, Marta I. Terry, María Victoria Díaz-Galián, Semih Arbatli, Onurçan Özbollat.

CONTACT INFORMATION

PROF. DR. MARCOS EGEA GUTIERREZ-CORTINES
DIRECTOR

Tel. +34 868071075
marcos.egea@upct.es

PROF. DR. CATALINA EGEA GILABERT
VICE DIRECTOR

Tel. +34 968325520
catalina.egea@upct.es

DR. MARTIN SORIANO DISLA
SECRETARY

Tel. +34 868071066
martin.soriano@upct.es

TECHNICAL SUPPORT AND ADMINISTRATION

DR. PERLA GOMEZ DI MARCO

Tel. +34 868071069
perla.gomez@upct.es

DR. MARIANO OTÓN ALCARAZ

Tel. +34 868071068
mariano.oton@upct.es

ANA FRUCTUOSO HERNANDEZ

Tel. +34 968325432
ana.fructuoso@upct.es