

# ESTACIÓN EXPERIMENTAL DEL ZAIDÍN



## PLAN DE ACTUACIÓN

## WORKING PLAN

2014-2017

6 de febrero de 2014

# PLAN DE ACTUACIÓN 2014-2017 EEZ

## RESEÑA HISTÓRICA

### **Cuándo se creó**

04/05/1955

### **Quién lo creó**

Prof. José Ibañez Martín, President of CSIC

### **Quién fue su primer Director**

Prof. Enrique Gutiérrez Ríos



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### **Objeto con el que fue creado**

The Institute was created with the aim of carrying out scientific research on soil and plants.

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### **Reseña histórica extendida**

Estación Experimental del Zaidín (EEZ), which belongs to the Spanish Council for Scientific Research (CSIC), is an upward and dynamic research Centre with an extended scientific history. Although it was officially established on May 4th 1955 with the aim of carrying out research on soil and plants, its origin dates back to 1940 when Granada was chosen as one of the perfect locations to achieve one of the overall objectives of the CSIC: to expand its scientific activities all over Spain.

At that time, the creation of the different research sections devoted to specific scientific objectives was based on the different chairs occupied by the young Professors that had recently arrived at the University of Granada (Faculties of Sciences and Pharmacy). In 1946 the two first Sections, devoted to Chemistry-Physics and Agricultural-Chemistry, were created under the leaderships of Prof. Enrique Gutiérrez Ríos and Dr. Ángel Hoyos de Castro, respectively. These two sections were dependent on Patronato Alonso de Herrera and were linked to the Institute of Edaphology and Plant Physiology of the CSIC in Madrid. Two additional sections were added in 1949 focusing on Soil Microbiology and Plant Physiology, under the supervision of Prof. Vicente Callao Fabregat and Dr. Luis Recalde Martínez, respectively. In 1951 the first structure of the EEZ, which would set the basis for the future institute, was completed with a new section working on Analytic Chemistry under the direction of Prof. Fermín Capitán García.

To bring together the different sections dispersed among the different Faculties of the University of Granada, the CSIC acquired a building in 1950 later known as Casa Blanca (White House), and its surrounding grounds (about 2250 m<sup>2</sup>) located next to the

currently known as Avenida de Cervantes. This new building became operative in 1953 and was fully occupied by the sections mentioned above throughout 1954. Two years later, the EEZ's emblematic building, known as Casa Amarilla (Yellow House), was purchased to foster new laboratories and administrative facilities.

The first Director of EEZ as an Institute of the CSIC was the Prof. Enrique Gutiérrez Ríos who remained in this position until 1957. A new Section named Mineralogy of Clays, with Prof. Juan Luis Martín Vivaldi as Section Head, was added to the Research Structure of EEZ in 1957.

Prof. Ángel Hoyos de Castro was Director of the Institute from 1957 to 1961. In 1958 the new Section of Animal Physiology was created under the supervision of Prof. Gregorio Valera Mosquera. This was a very important decision for the future development of EEZ since animal studies extended the original aim of focusing research mainly on plants and soil. In 1961 Dr. Luis Recalde Martínez was appointed Director of the Institute and remained in this position until 1979. During this period the structure of EEZ was enlarged with the incorporation of two new sections, one devoted to Mineralogy of Soils, with Prof. Miguel Delgado Rodríguez as Head, and the second to Agrometeorology, supervised by specialists from other Organisms. A Section of Statistics, coordinated by Prof. Dr. Alfonso Guiraum Martínez, was also established based on a Service that had been previously created in 1957.

The early sections that were created throughout the history of EEZ changed with time and new sections started to function in 1970: Biochemistry, with Prof. Federico Mayor Zaragoza as Section Head, and the Laboratory of Botany, with Prof. Fernando Esteve Chueca as Supervisor. The construction of a new building known as Casa Roja (Red Building) began in the early 1970s and became operational in 1976. Although with old facilities, this building still remains as one of the most important laboratory cores of EEZ. The former sections were re-organized into Structural Units, and nine Units were established: Physical-Chemistry and Mineral Geochemistry; Edaphology and Botany; Plant Physiology; Agricultural Chemistry; Phytopathology; Microbiology; Plant Biochemistry; Animal Physiology; and Analytical Chemistry. Under the Direction of Prof. Manuel Lachica (1979-1983), EEZ celebrated its XXV anniversary in 1980.

Prof. Dr. Julio Boza was the following Director of EEZ from 1983 to 1989. In that period the CSIC began to redefine its research lines and its objectives focusing more on biological aspects, basically Animal, Plants and Microbes. Prof. José Miguel Barea Navarro was Director of the Institute from 1989 to 1998. In this period the internationalization of the research carried out by the Institute took place and several research groups at the EEZ managed to obtain grants from the different programmes developed by the UE, which strengthened the scientific structure (personnel, equipment and publications) of the Institute. The nine Structural Units were re-organized into five Departments: Agroecology and Plant Protection; Biochemistry, Molecular and Cellular Biology of Plants; Soil Microbiology and Symbiotic Systems, Animal Nutrition, and Earth Sciences and Environmental Chemistry.

Prof. Juan Luis Ramos Martín became Director of the Institute in 1998 and remained in this position until 2007. In 1998 the Department of Animal Nutrition moved from the main central Headquarters of EEZ to a new building in Armilla, a nearby town only 4 Km far from Granada. In 2002 different emblematic buildings started being renewed and the construction of a new Casa Blanca, replacing the former one, began. This new building was inaugurated in May 2005, together with a new Auditorium. Coinciding with these events, the 50<sup>th</sup> anniversary of EEZ was celebrated with the assistance of the President of CSIC, Prof. Carlos Martínez and Prof. Federico Mayor Zaragoza, ex-Director of UNESCO. New greenhouses were also constructed replacing the old ones

and other buildings were adapted for new uses such as the Library, additional laboratories, plant growth chambers, kitchenette, etc. This period of EEZ can be considered one of the most unrestrained for both infrastructure and the incorporation of scientific personnel, mainly based in the development of the strategic plan 2005-2009 enforced by the CSIC. In the frame of this strategic plan, EEZ was again reorganized on March 2007 in the following departments: Biochemistry, Cell and Molecular Biology of Plants; Microbiology of Soil and Symbiotic Systems; Environmental Protection; and Environmental Geochemistry. In addition, the Department (Unit) of Animal Nutrition started its transition to become an Institute within the structure of EEZ. On the other hand, the Environmental Geochemistry Department planned to move out of EEZ to join Instituto Andaluz de Ciencias de la Tierra (IACT) and develop a new and stronger Centre devoted to Earth Sciences, circumstance which was completed in winter 2010.

Prof. Dr. Nicolás Toro García is the current director of EEZ since March 2007. Since then he has been in charge of the development of the 2005-2009 strategic plan and of the current one (2010-2013). In the Strategic Plan 2014-2017, EEZ will be structured on the basis of the Departments of Biochemistry, Cell and Molecular Biology of Plants; Microbiology of Soil and Symbiotic Systems; Environmental Protection; and Physiology and Biochemistry of the Animal Nutrition, whose objectives and development will be integrated within those of EEZ in the coming Strategic Plan. New infrastructure has recently been added to EEZ, i.e., a laboratory building that has been occupied by the Department of Microbiology of Soil and Symbiotic Systems. A cafeteria has also been built and the building occupied in Armilla by the Physiology and Biochemistry of the Animal Nutrition Department has been expanded. In May 2011, the First Centenary of the Yellow House was celebrated.

The research objectives of the EEZ fit well among those considered as top priority by the National Scientific Research and Technology Programmes, EC Programmes, Basic Science Research Programmes, Regional Government Research Plans and Strategic Research Plans of the CSIC.

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### **Departamentos**

- DPTO. DE BIOQUIMICA, BIOLOGIA CELULAR Y MOLECULAR DE PLANTAS
- DPTO. DE FISIOLOGIA Y BIOQUIMICA DE LA NUTRICION ANIMAL
- DPTO. DE PROTECCION AMBIENTAL
- DPTO. DE MICROBIOLOGIA DEL SUELO Y SISTEMAS SIMBIOTICOS

### **Unidades Asociadas**

- GRUPO DE CONTAMINACIÓN ATMOSFÉRICA (225P02)

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**Descripción: Organigrama, Comités asesores externos, Estructura departamental, Líneas de investigación del PA 2010-2013**

The Estación Experimental del Zaidín (EEZ) is a research Centre belonging to the Spanish Council for Scientific Research (CSIC). The Centre's science programme is focused on Agricultural Sciences and is structured on the basis of the Departments.

EEZ has the following Organizational Structure:

1. The Executive Board (EB) of EEZ is responsible for major executive and political decisions including those dealing with long-term Strategic Planning.
2. The Centre's Governing Board (CGB) is the main executive body of EEZ and assists the Director of the Centre in all scientific and administrative issues. The CGB meets monthly to increase the speed of decision making, implementation and communication.
3. The Scientific Senate (SS) assists the Director of the Centre in major scientific policies and long-term Strategic Planning. The SS holds a general meeting once a year to debate the general situation of the Centre and extraordinarily when it is necessary to analyze relevant organizational and scientific issues.
4. The EEZ's Scientific Departments are the following: Biochemistry, Cell and Molecular Biology of Plants; Microbiology of Soil and Symbiotic Systems; and Environmental Protection. These departments develop respectively the following Research Lines: Signalling, Stress and Development in Plants (supported by 5 groups); Biology and Biotechnology of Plant-Microbe Interactions (6 groups); and Bioremediation and Biological Protection of Agricultural Systems (3 groups). Additionally, the Research Line Mediterranean Pastures and Sylvopastoral Systems (1 group) also within the EEZ scientific framework, is not associated to any of the existing departments, but is currently ascribed to the Direction of the Centre.

The Head of Department leads each of the scientific departments that are integrated by different research groups which vary in size. A Group Leader is responsible for each of the research groups.

5. The Institute of Animal Nutrition (INAN) is currently under development. The Director of the Institute is responsible for its main scientific Research Lines and the development of long-term Strategic Planning.

The INAN pursues its development as a new Institute, but still remains integrated in the structure of the logistic of EEZ sharing its General Management and Services. The Research Line Metabolism of Nutrients and Energy: Productive and Health Beneficial Aspects (supported by 4 groups) is linked to this Institute (Department).

6. The Services provide support to the research activities carried out at the Centre, both at the EEZ's main premises and at the INAN in Armilla. The services are supervised by specifically appointed staff scientists. The services at EEZ are the following: Information Technologies; Knowledge Transfer; Science Outreach; Library; Radiochemistry Laboratory; Greenhouses and Plant Growth Chambers; Scientific Instrumentation; Microscopy and DNA Sequencing. In the INAN, the Carbon and Nitrogen Elemental Analysis Service is running.

7. The General Management Service is headed by the Centre's Manager and is responsible for managing all aspects dealing with the effectiveness of the Centre, both at the EEZ's main headquarters and at the INAN in Armilla. The services include: Maintenance, Repairs and Conversion Work activities and five major financial and administrative areas: Secretariat, Human Resources, Payments, Purchases and Administrative Contracts, and Project Management.

## **Análisis Crítico. DAFO Centro**

### **DAFO Debilidades**

#### 1. Personnel.

\* Large number of small research groups, what may lead to an excessive diversification of resources and scientific objectives.

\* The incorporation of young researchers might be limited because of the need of co-financing.

\* The potential innovation provided by young researchers might be conditioned by the way in which new positions are requested.

#### 2. Low participation in European programmes.

With few exceptions, most of the groups at the EEZ have experienced difficulties to obtain European funding in the course of the Sixth and Seventh Framework Programmes, which has negatively affected EEZ as a whole.

#### 3. Low knowledge transfer activity.

\* The historical trajectory of the EEZ's scientific objectives has driven our centre towards a profile more based in knowledge than in technology transfer. This tendency still prevails, although great efforts are in progress to balance this asymmetry.

#### 4. Deficient Infrastructure.

\* EEZ has suitable facilities for the development of its research activity. However, the main research building, known as the Red House (Casa Roja), cannot longer support modern facilities. In spite of that, the department of Biochemistry and most of the scientific services must carry out their activities there. This 3973 m<sup>2</sup> building was inaugurated 40 years ago and needs to be either renewed or rebuilt. A significant part of it is not being used nowadays.

#### 5. Difficulty to recruit PhD students and postdoctoral fellows.

\* It is difficult to recruit postgraduate students with competitive academic records. Also the number PhDs interested in pursuing scientific careers has descended over the last years and are often unmotivated to apply for fellowships and/or grants both in Spanish and foreign laboratories.

6. These weaknesses have been intensified by the current economic situation and are envisaged to continue in the future.

### **DAFO Amenazas**

1. Continuous leakage of human resources (18 % decrease in the last 3 years) and difficulty to recruit young scientists.

\* The number of post-doc, graduate students and technicians diminishes every year due to lowering financing by agencies.

\* There is insufficient support for new scientists to set up their own research groups due to the lack of investments and promotion by both the Ministry and the CSIC.

\* Personnel staff retiring, which are not replaced, compromising the centre's overall objectives.

## 2. Uneven distribution of technical and administrative support staff.

\* The staff dealing with management in the economic, administrative and maintenance areas of EEZ is limited by the RPT (relation of working places assigned to the Centre), and cannot be freely hired when necessary, which strongly limits the capacity of the Centre to cope with the management of its increasing research activity.

\* The personnel ascribed to the General Management lack specialized formation. In addition, they currently handle inadequate computing resources for their activity.

\* The Department of Physiology and Biochemistry of Animal Nutrition (formerly INAN) has a lack of permanent technical staff which may put at risk the future development of its scientific activity. Among these, it is particularly worrying the lack of technical staff specialized in animal experimentation; handling and welfare added to the increasing requirements and bureaucratization of animal experimentation activities.

\* The distribution of technical support within the different Departments and groups is conditioned by the still running court rulings and consolidation processes.

## 3. Increasing bureaucratization of the scientific activity.

\* The bureaucratization of research activities is translated into a loss of effectiveness of human resources, especially for administrative personnel. Group leaders and scientists are often involved in the coordination of grants, which is increasingly hampering scientific research because of the bureaucratic load.

\* Processes for personnel recruitment, financial management and acquisition of infrastructure are excessively strict and time-consuming and often unaffordable.

## 4. Financial crisis.

\* The current national and international financial crisis is affecting R&D funding compromises by both the Spanish and European research agencies.

## 5. Difficulty to obtain resources from the European Commission.

\* Obtaining resources from the EC in the course of the 6th and 7th Framework Programmes has been very difficult for most of EEZ because of excessive competitiveness and specific focus of the research topics in the EC programmes. This may generate important fluctuations in the funding raised by the research groups of EEZ.

\* The complex application processes, the necessity for lobbying strategies, and the complexity of the grant management, discourages scientists to compete for EC grants.

## 6. Little interest of the companies to invest in R&D.

\* In spite of the agricultural potential of Andalusia, there is limited interest from local, regional, national and foreign companies dealing with biotechnology, agriculture development and environmental management to invest in R&D.

7.- Lack of appropriate facilities for animal experimentation at the Institute of Animal Nutrition (Department of Physiology and Biochemistry of Animal Nutrition).

\* The present animal experimentation facilities are insufficient to develop current research projects and contracts with companies. The construction of the recent building of Earth Sciences next to the Animal Nutrition Institute makes it impossible to expand the current animal experimentation facilities. An experimental farm located not far from the Institute could help to overcome this drawback.

8. Low political weight of the CSIC in the R&D management system of the Andalusian Community.

\* Although the Andalusian government has shown its interest in supporting the regional R&D system, the Centre has to face many technical and financial obstacles associated to these grants that mainly affect personnel contracting. These problems are due to contradictory policies applied by the State and the Autonomous Community Governments.

These threats have been intensified by the current economic situation and are envisaged to continue in the future.

## **DAFO Fortalezas**

1. Multidisciplinary and integrative approaches of the research carried out at EEZ.

\* One of the main strengths of EEZ derives from its consolidated research lines with multidisciplinary and integrative approaches supported by different research groups with excellent scientific production and appropriate integration within their national and international context. Their excellent reputation in their fields is evidenced by international publications, financial support obtained from regional, national, international institutions and private companies, as well as strong national and international collaborations.

2. Equipment.

\* In the last years EEZ has acquired modern equipment that has either come to replace obsolete one or come to add new technological support to the Centre's activities. The Centre has recently purchased a HPLC/MS/MS, a GC-MS, an ICP-OES and vacuum evaporation system for the Scientific Instrumentation Service and a high throughput GS Junior Genome Sequencer 454 FLX System for pirosequencing; advanced imaging systems for chemiluminescent, fluorescent and colorimetric samples, and two quantitative PCR apparatuses. New fluorescence stereomicroscope and epifluorescence inverted microscope, and new filters for the confocal laser scanning microscope complete the Centre's already existing facilities for studies on the cellular biology of plants and plant-microbe interactions. In addition, the current equipment for the separation, identification, purification, and quantification of very low levels of a variety of organic and inorganic molecules, the analysis and quantification of gene



expression and protein synthesis by fluorescent and quimioluminescent techniques, make possible for EEZ to have a considerable initial advantage in the execution of projects involving different -omic techniques (genomics, proteomics, metabolomics, etc.). Furthermore, in the last years the Centre has made significant efforts to further improve its facilities (growth chambers and greenhouses) for the growth of plants under controlled conditions.

### 3. Infrastructure.

\* Recently two new buildings have been constructed. Consequently, the facilities at EEZ have been improved to carry out research within the specific research lines of the Centre.

\* As for the Animal Nutrition Institute, a new wing of labs has been recently constructed which has considerably increased the potential for analytical work. Among others, new microbiology, molecular biology and tissue culture labs have been installed in these new facilities.

### 4. Internationalization.

\* EEZ has set the basis for an extensive network of partnerships with research groups from many different countries. Research groups at EEZ participate in multilateral projects within Spanish, European, African and South American Networks.

\* The international course of Soil Science and Plant Biology (currently funded by the AECI with the sponsorship of UNESCO) also takes place annually at EEZ.

\* EEZ scientists are members of Editorial Boards of international journals and belong to different international scientific committees.

\* EEZ is also involved in the development of its geographical environment providing knowledge, methodologies and information management to the Andalusia region and to countries in the Mediterranean basin, an area that is critically threatened by global climate changes.

### 5. High training capacity.

EEZ has a long-established high training capacity as evidenced by the high number of specialized post-graduate and Master courses, as well as PhD theses and institutional collaborations with different companies and professional training schools. In addition, in collaboration with several schools, EEZ acts as training Centre for laboratory technicians.

### 6. Links with Universities.

\* Another strength that should be highlighted derives from the good relationship with different Universities at the national and international level, particularly with the University of Granada. Researchers from EEZ are involved as lecturers in a large number of postgraduate and Master courses and share memberships of diverse academic committees in the former University.

## 7. Interaction with technological and industrial sectors.

\* There are good interactions with the industrial sector leading to contracts and agreements. Several patents are registered periodically by the CSIC thanks to EEZ researchers. In addition, three technologically-based spin-offs have been generated: Mycovitro, Bioiliberis and Allergenome.

## 8. Scientific Services.

\* The availability of several functional services, such as a CSIC-network Library, the Scientific Instrumentation, Microscopy, DNA Sequencing, Greenhouse and Growth Chamber and the Radioactivity Services, among others, facilitate research activities at EEZ.

## **DAFO Oportunidades**

### 1. Socio-economic demand for research results.

\* Given the growing social awareness in relation to the negative impact of global climatic change, the use of fertilizers and phytosanitary products in agrosystems, and the environment impact of livestock production, there is an increasing demand of quality plant and animal-derived products, agricultural sustainability and environmental protection, which in turn provides new opportunities for the different research lines at EEZ.

### 2. Interaction with the agricultural, technological and industrial sectors.

\* The new EU regulations on fresh horticultural products free from chemicals and the increased inspections will force farmers in the region to make considerable changes in their current practices using environmentally-safe methods for controlling pests, diseases and weeds instead of other less green methods. This generates new opportunities for groups at EEZ to collaborate with companies of the biotechnology and agriculture sectors and to transfer technology generated at EEZ. At the same time, the present context of high cost of animal production systems, mainly due to the high price of animal feedstuffs, along with the ban to use of antibiotics as growth factors, open wide opportunities of collaboration of animal nutrition groups with animal additive and feeding companies.

### 3. The organization of EEZ for 2014-2017.

\* The organization of EEZ in the Departments of Biochemistry, Cell and Molecular Biology of Plants, Microbiology of Soil and Symbiotic Systems, Environmental Protection and Physiology and Biochemistry of Animal Nutrition will result in a more scientifically homogeneous institute allowing the pursuit of more specific objectives.

## **Análisis Crítico. Ventajas Selectivas Centro**

1. EEZ is currently the largest Research Centre of the CSIC Agency within the Area of Agricultural Sciences; hence EEZ represents a leading Centre within the CSIC capable of tackling new challenges within the Area with an innovative perspective.
  2. EEZ is a Centre of reference in Europe that carries cutting-edge research in the fields of bioremediation and biological protection of agricultural systems, symbiotic interactions between plants and microorganisms, signalling, stress and development in plants, and animal and human nutrition.
  3. The multidisciplinary character of the research carried out at EEZ, integrating different areas of knowledge along with the use of common modern equipment operated by specialists and a wide range of technologies, places the Centre at an excellent position to significantly contribute to the development of sustainable agriculture and environmental protection, and to unravel nutritional and metabolic related issues.
  4. The integration of the research activities at EEZ within the local and regional scenario contributes to draw attention to the Centre of the corresponding national and regional government departments and productive sectors in the Mediterranean region.
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## **Análisis Crítico. Objetivos y Estrategias Centro**

### **Objetivos Generales**

The mission of EEZ is to become a centre of excellence on plant sciences, microbiology, environmental protection and animal nutrition by:

- \* Carrying out fundamental and strategic research aimed towards the understanding and exploitation of plants, microbes and their relationships, with special emphasis on crop yield, quality, high added-value plant products and development of sustainable animal production systems yielding high-quality and healthy products, all under environmental improvement conditions.
- \* Training high quality PhD students and post-doctoral scientists in the different research lines of the Centre.
- \* Making findings and research results available to the society as a whole, disseminating knowledge, technology and know-how to meet the needs of end-users.

### **Objetivos Generales - Actuaciones propuestas**

The planned strategy is based on the different elements of the SWOT and AR, taking advantage of the Selective advantages of our Centre. The strategy will focus on key issues, such as scientific activities, human resources, equipment, infrastructure, general services, collaborations, training, science outreach, knowledge transfer, and general management.

## Scientific activity

The multidisciplinary nature of the research done at EEZ, which enables to undertake both specific research projects with the Centre's own research lines, as well as tackling other interdisciplinary ones of major and strategic dimensions, makes it possible to cope with a wide range of scientific topics on environmental and agricultural issues, including animal nutrition. On the other hand, the organization of the institute based on four homogeneous scientific programmes will enable the Centre to pursue other more specialized objectives. The following actions will be carried out to make the Centre even more flexible and capable of attracting more ambitious projects:

- \* The interrelation among groups will be stimulated and further enhanced with integrative collaborations to reach objectives from different perspectives, thus joining forces to gain strength for certain grant calls.
- \* Target actions will be carried out to facilitate the successful broadening of research activities within the groups, i.e. identifying new collaborations, more suitable scientific financial programmes, different objectives, etc.
- \* The smaller groups will join efforts to support common objectives.
- \* The recruitment of external scientists involved in these strategic targets will be pursued.

## Human resources Unit

The Human resources managed by the Centre during this Strategic Planning will be oriented to the groups based on key parameter indicators, such as funding and scientific production, with special emphasis on their quality. Tenured Scientist positions, should it happen, will also be open to external candidates. Particularly the added-value of the new researcher's expertise to the research lines will be taken into account.

- \* Young researchers will be provided with an office upon their appointment and will receive laboratory space so that they may function independently once they receive funding.

## Equipment

A policy to avoid unnecessary duplications of scientific equipment will be implemented for the acquisition of the Centre's large infrastructure. Scientific equipment will be shared by the different groups and even with the general services supporting scientific research. Whenever possible, large equipment assigned to the different groups will be placed in general use laboratories established in all research buildings.

- \* A committee will be created to analyze the Centre, services and different research groups needs of equipment and will establish acquisition priorities according to the highest demand.
- \* Current equipment with low use within the research groups will be collected and allocated to the appropriate premises.

## Infrastructure

To reinforce the infrastructure of the Centre, we propose the construction of a new building to replace the non-functional Red House. The construction of this new building will provide the correct environment to research groups and Services currently allocated in the old building while at the same time allowing the expansion of the Centre.

## General services

The availability of functional services facilitates the development of research activities at EEZ. For this reason the services should be considered of interest for our research activities. They provide support to all research lines so that human resources, infrastructure and equipment are more efficiently managed with consistent and well equipped services.

\* The Services already functioning at EEZ will be further potentiated.

\* The full electronic management concerning all services will be maintained and, even, improved if is appropriate. This promotes a feed-back policy and allows a higher involvement of scientists in the Centre's development.

## Collaborations

The extensive network of partnerships made up of research groups worldwide, and the development of international courses should facilitate the participation in EC and other international projects. Moreover, the rooted research in the local region will further increase our links with the Andalusian Community enhancing the visibility of our Centre and promoting our research within our social environment. Invitations to renowned scientists to deliver seminars in our centre through our active Seminar Sessions held once a month and the integration of foreign researchers into the staff's scientific community through diverse strategies will continue to broaden our international projection.

## Training

EEZ will maintain and further increase collaborative activities in official Masters and postgraduate university courses, organizing high quality training courses and scientific seminars. The annual International Course on Soil Science and Plant Biology is expected to continue. Likewise, EEZ researchers will continue to train highly qualified technicians, undergraduate students, PhD students and post-doctoral scientists.

## Science Outreach

The centre will disseminate the potential and the social, economic and ecological importance of the research activities done at EEZ to policy-makers, farmers and the general public by means of its own agenda/strategy including diverse educational programmes, conferences, seminars, participation in social events, increased collaboration with newspapers and magazines, the generation of booklets and the edition of text books while exploiting of modern information technologies in the internet.

Also, the outreach of science and its potentiality to young primary, secondary, and graduate students will be also pursued by the UCC + i Service.

- \* Foreign PhD and post-doc scientists will be also attracted through national and international programmes. Science outreach strategies will be implemented to publicize the activity of EEZ in international forums. International platforms such as AECE (Spanish Foreign Office), Bilateral Programmes, EU Programmes, etc. will be used to recruit foreign people for positions and fellowships.

#### Knowledge Transfer

The connection between the Knowledge Transfer and the UCC + i Services will be reinforced with the aim of favoring interactions between EEZ and the technological and industrial fields.

- \* We will use the growing social awareness with regards to the negative impact of global climate changes to exploit the interest on our research focused on agricultural sustainability and environmental protection.

- \* Interactions with the industrial sector should be increased, which will in turn help to facilitate the transfer of technology and know-how to the productive sector.

#### General Management

A policy for the continuous formation of personnel ascribed to the General Management Service will increase their skills and expertise.

- \* Hardware and software resources needed to carry out a more efficient management will continue to be improved.

- \* By using our own resources we will make efforts to change from a reactive to a proactive situation and to cope with any difficulties that may arise.

- \* In addition, this more specialized staff will ease the increasing bureaucratization of the research and will reduce the paper load from scientists who devote their time to non scientific research issues.

#### **Objetivos Científicos**

Collectively the research carried out at EEZ will contribute to the development of a more sustainable and environmentally-friendly agriculture. The improvement of crop production and fruit quality, as well as the increase of stress tolerance in plants of agronomical interest will be achieved by different means, including interactions with beneficial microorganisms and improved plant species using different strategies based on genetics, genomics and molecular biology approaches.

Our research will also be focused on the protection of soil and agricultural crops through the use of low-cost bioremediation technologies and the promotion of integrated alternatives for the sustainable management of agricultural systems and Mediterranean forestlands.

Another objective is the contribution to the production of nutritious, healthy animal products for human consumption in cost effective, environmentally friendly production systems. To achieve this objective the assessment of balanced nutrition within sustainable animal production systems, biological activity of specific compounds by studying the mechanisms of action and the effects of bioactive substances present in feed- or foodstuffs, and the interaction between diet and human health will be addressed.

### **Objetivos Científicos - Actuaciones propuestas**

To expand the knowledge available about the molecular, cellular and physiological mechanisms allowing plants to increase their tolerance to different abiotic and biotic stresses, develop a higher efficiency in carbon assimilation and improve their quality and yield throughout processes like plant reproduction.

To contribute to soil and crop protection through the use of low-cost biotechnologies and the promotion of sustainable development of agricultural systems by means of ecological alternatives. The development of new bioremediation and decontamination strategies, an integrated management of pest in agroecosystems, and methods for the evaluation, maintenance and rational exploitation of microbial biodiversity will be achieved.

To gain basic and applied knowledge on the ecology, physiology, molecular biology, genomics and biotechnology of rhizobacteria, arbuscular mycorrhiza and rhizospheric fungi to understand the physiological and molecular mechanisms underlying microbe-plant interactions, allowing their application in processes of biofertilization, biodegradation and biocontrol to improve the sustainability of agrosystems and environmental quality.

To investigate nutrient and energy metabolism of farm animals in terms of animal performance and product quality and to establish nutrient requirements of local native breeds of economic and social relevance. The mechanisms of action and biological effects of chemical fractions, bioactive compounds and metabolic modifiers in food, as well as the effects of the diet on the metabolism and ecology of ruminants will be investigated to seek for conditions which render meat and milk with the highest nutritional and health quality.

### **Objetivos de Transferencia**

To maintain and improve cooperation links with agricultural and biotechnological companies, special attention will put on direct knowledge transfer by promoting sustainable agriculture together with registration (patenting) of novel procedures derived from fundamental studies, as well as strengthening the already created, technology-based, spin-offs from EEZ researches, participated by the CSIC.

### **Objetivos de Transferencia - Actuaciones propuestas**

To complete the catalogue of EEZ knowledge transfer capacities.

To identify local demands and encourage suitable EEZ research groups to match them.

To identify and acquire software packages for critical reflection and interpretation of EEZ capacities.

### **Objetivos de Formación**

EEZ will maintain and increase the training of personnel including high quality technicians, undergraduate students, PhD students and post-doctoral scientists.

### **Objetivos de Formación - Actuaciones propuestas**

To develop measures to attract/recruit both national and international post-doc and graduate students. The website of the Science Outreach Service will serve as a portal for information to students regarding EZZ's activities.

To integrate Erasmus-Mundus students into the International Course of Soil Science and Plant Biology (formerly UNESCO Course: Edafología y Biología Vegetal).

### **Objetivos de Divulgación**

The Centre will disseminate the potential and the social, economic and ecological importance of the research carried out at EEZ to policy-makers, farmers and the general public.

### **Objetivos de Divulgación - Actuaciones propuestas**

The Science Outreach Service, implemented at EEZ in the previous Strategic Planning 2010-2013, will be further enhanced in this new Strategic Planning (2014-2017). The temporary contract of the person responsible for the Service should be transformed into a permanent position.

### **Objetivos de Internacionalización**

EEZ will maintain and strengthen collaborations and interactions with foreign laboratories and Universities, particularly from Europe, America, Africa and China, increasing EEZ's participation and creation of international consortia.

### **Objetivos de Internacionalización- Actuaciones propuestas**

EEZ will continue to maintain and strengthen collaborations and interactions with foreign laboratories and Universities increasing its participation in new international consortia with other potential countries of interest for research.

Foreign PhD and Post-doctoral students should also be attracted, as well as candidates for Tenure Staff positions.



## Listado de Servicios

[010] Nombre del Servicio: Library

[020] Tipo de Servicio: Scientific

[030] Responsable Científico: The director of EEZ

[040] Responsable Técnico: Ana María de la Fuente Navarro

[050] Descripción del Servicio:

The library at Estación Experimental del Zaidin (EEZ), Granada, Spain, is part of the CSIC's library network linked to the different Centres and Institutes that make up Consejo Superior de Investigaciones Científicas (CSIC) the largest state body of research in Spain. Although the resources of EEZ's library have a marked multidisciplinary character, this library belongs to a group of specialized libraries on agricultural sciences. Since 2000 it has been located in a new building comprising a reading room, computer room, working space and archive hall.

The catalogue of bibliographic holdings has been computerized and is shared by all libraries within the CSIC network. The catalogue can be screened via the website ([http://aleph.csic.es/F?func=file&file\\_name=find-b](http://aleph.csic.es/F?func=file&file_name=find-b)). The library collections at EEZ began around 1950 and currently include over 6000 monographs and 409 serials, nineteen of which the EEZ is currently subscribed to.

The key mission of the library is to provide support to the research being conducted at EEZ (<http://www.eez.csic.es/?q=es/node/805>). The services provided to the researchers include a reading room, on-line access to information sites, book loans, request of documents not found in the EEZ library, and off-campus online access (<http://www.eez.csic.es/?q=es/node/104>). Because of its level of specialization, the Institute's library could be defined as a restricted public library oriented to graduate University students, PhD students, researchers, and University teaching staff. In general, its major area of specialty is Agriculture and related sciences.

The services provided to external users are more limited, i.e. reading room and internet access to bibliographic information. The inter-library loan service basically deals with bibliographic exchanges with other CSIC network libraries and University libraries.

The library's internal tasks are related to technical processes: paper and electronic serials management, cooperative acquisitions, shared cataloguing and monograph classification, user service at the library desk, and replying to internal and external queries.

From a technical standpoint, the CSIC Libraries Coordination Unit (known as CBIC in Spanish) is responsible for the coordination and development of the CSIC libraries, including EEZ's library, and is in charge of monitoring and managing the automation process. At a functional level, EEZ's library is under the management and administration of EEZ.

Contact addresses: Bibzaidin@eez.csic.es and [pizaidin@eez.csic.es](mailto:pizaidin@eez.csic.es).

Statistics: <http://www.csic.es/cbic/estadisticas/estadisticas.html>

[060] Página web del Servicio: [www.eez.csic.es/?q=es/node/3552](http://www.eez.csic.es/?q=es/node/3552)

[070] Ámbito del Servicio: Internal/External

[080] ¿El Servicio tiene Certificaciones ISO?: NO [090] ¿Está en la Red de Servicios Científico-Técnicos CSIC?: YES

[100] Facturación Interna 2010-2012 (k euros): -

[110] Facturación a otros Centros CSIC 2010-2012 (k euros): -

[120] Facturación a Universidades 2010-2012 (k euros): -

[130] Facturación a Empresas 2010-2012:(k euros): -

[140] Número de grupos usuarios diferentes: 18

[150] Personal entrenado en el uso de equipos 2010-2012: -

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[010] Nombre del Servicio: Radiochemistry Laboratory

[020] Tipo de Servicio: Scientific

[030] Responsable Científico: The director of EEZ

[040] Responsable Técnico: Narciso Algaba García

[050] Descripción del Servicio:

EEZ has a Category 2 radioactive facility which is authorized, according to point 5 of the Resolution of 29/07/2004, for the storage and use of non-encapsulated radioactive material for research purposes. The isotopes authorized in the Radiochemistry Laboratory are: 3H, 14C, 32P, 33P, 35S, and 125I. (Point 7 of the Resolution of 29-7-2004, amended by Resolution 17/03/2009, D.G. Política Energética y Minas, Subdirección General de Energía Nuclear).The radiochemistry laboratory has the following facilities:

1. One facility on the first floor of Casa Roja (Red House) at the main EEZ Headquarters at Calle Profesor Albareda,1 in Granada.

The facilities at the main site contain two adjacent laboratory spaces: a monitored and a controlled area. Operations that involve the use of very low radioisotope activities, such as electrophoresis, gel drying, autoradiography, etc. are carried out in the

monitored area. Operations involving the labelling and storage of radioisotopes and radioactive residues are carried out in the controlled area. The Radiochemistry Laboratory is equipped with Geiger-Müller contamination detectors, a liquid scintillation counter, a thermocycler, a hybridization oven, a freezer, a refrigerator and suitable radiation protection equipment. It also has the necessary equipment for DNA labelling, DNA and RNA hybridization, autoradiography, tests on the incorporation of radioisotopes into plant cells and microorganisms, among others.

2. One laboratory, also owned by EEZ, numbered 116 located in Armilla at the Institute of Animal Nutrition (Calle Camino del Jueves s/n) in Armilla (Granada).

The facility at this site is made up of a single laboratory, and although it is suitable for carrying out the aforementioned operations, it is mainly used for determinations of animal hormones by radioimmune assays (RIA) with <sup>125</sup>I. It also has the necessary instruments for the detection of radiation, and the required materials for radio protection and storage of residues/waste products.

Since this is a radioactive facility, its operations are subjected to the Spanish legislation governing this type of facilities:

- Royal Decree 1836/1999 (modified by RD 35/2008), which approved the Regulations on Nuclear and Radioactive Installations.
- Royal Decree 783/2001, which approved the Regulations on Health protection against Ionizing Radiations, and the conditions and limitations established in the Resolution issued on 29th July 2004 which authorized the modification of the radioactive facilities (IR/GR-06/73).
- Law 15/1980 (amended by Law 33/2007) on the creation of the Nuclear Security Council.
- Law 25/1964 on Nuclear Energy.

According to Article 55 of the Regulations on nuclear and radioactive installations there must be at least one supervisor managing the operations at each site of the facilities. This supervisor must hold the regulation license issued by the Nuclear Security Council (point 9 of the Resolution of 17/03/2009). The current organizational structure is as follows:

- Head Supervisor: Narciso Algaba García
- Supervisors of radioactive facilities at the main site in Granada: Francisco Martínez-Abarca Pastor and Silvia Marqués Martín.
- Supervisors of radioactive facilities at the site in Armilla: Rosa María Nieto Liñán, Ignacio Fernández-Fígares Ibáñez and Manuel Lachica López.

The Head Supervisor is the person responsible for ensuring compliance with the Operation Regulations and the Emergency Plan making sure that the proper safety conditions are fulfilled for the different experiments carried out by the different users. To ensure the correct and efficient operativeness of the facility, the Head Supervisor has the following duties: management and control of the dosimeters of those exposed

to radiations in the course of their work (Point 11 of Resolution 17/03/2009); draft the Daily Operations Report (Article 69 of the Regulations on Nuclear and Radioactive Facilities, point 16 of Resolution of 17/03/2009); keep a record of the radioactive material acquired and eliminated; the results of the detection equipment verifications and calibrations; the information relating to the control of radiation and contamination levels; the training plan and the dosimeter readings for the staff; the facility's annual report and its sending to the Department of Energy Policy and Mines and to the Nuclear Security Council (Article 73.2.a of the Regulations on Nuclear and Radioactive Facilities, point 18 of Resolution of 17/03/2009); manage the storage and removal of waste products (points 23, 24 and 25 of the Resolution of 17/03/2009).

[060] Página web del Servicio: <http://www.eez.csic.es/?q=es/node/68>

[070] Ámbito del Servicio: Internal

[080] ¿El Servicio tiene Certificaciones ISO?: NO

[090] ¿Está en la Red de Servicios Científico-Técnicos CSIC?: NO

[100] Facturación Interna 2010-2012 (k euros): -

[110] Facturación a otros Centros CSIC 2010-2012 (k euros): -

[120] Facturación a Universidades 2010-2012 (k euros): -

[130] Facturación a Empresas 2010-2012 (k euros): -

[140] Número de grupos usuarios diferentes: 17

[150] Personal entrenado en el uso de equipos 2010-2012: -

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[010] Nombre del Servicio: Confocal and Transmission Electron Microscopy (CTEM)

[020] Tipo de Servicio: Scientific

[030] Responsable Científico: Juan de Dios Alché Ramírez

[040] Responsable Técnico: Alicia Rodríguez Sánchez and María del Carmen Perálvarez Gutiérrez

[050] Descripción del Servicio:

The Service of Confocal and Transmission Electron Microscopy has been conceived to fulfill the increasing demand of the researchers in this field. The service is aimed to

organizing, handling, optimizing and promoting the use of the microscopy equipment already available at the institute and to define and accomplish new necessities in this regard. The service is designed to ease the access of EEZ researchers to this equipment, particularly for the observation of samples from diverse origin. Furthermore, it also facilitates standard preparation of samples prior to observation. External users can take advantage of the use of the facilities.

[060] Página web del Servicio: <http://www.eez.csic.es/?q=en/node/4104>

[070] Ámbito del Servicio: Internal/External

[080] ¿El Servicio tiene Certificaciones ISO?: NO

[090] ¿Está en la Red de Servicios Científico-Técnicos CSIC?: YES

[100] Facturación Interna 2010-2012 (k euros): 12.36

[110] Facturación a otros Centros CSIC 2010-2012 (k euros): 42

[120] Facturación a Universidades 2010-2012 (k euros): 0

[130] Facturación a Empresas 2010-2012 (k euros): 0

[140] Número de grupos usuarios diferentes: 13

[150] Personal entrenado en el uso de equipos 2010-2012: 29

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[010] Nombre del Servicio: DNA Sequencing Service (DSS)

[020] Tipo de Servicio: Scientific

[030] Responsable Científico: Francisco Martínez-Abarca Pastor

[040] Responsable Técnico: Amparo Salido Ruiz

[050] Descripción del Servicio:

The DSS laboratory shares a sequencing service that integrates an ABI3730 high throughput sequencer and a GS Junior Genome Sequencer 454 FLX System Roche (since May 2012). It is a consolidated service that responds to the high demand of many groups at EEZ, and which has delivered up to 2500 sequencing reads in a quarter of a year. It also provides service on a regular basis to other academic and commercial institutions (external service).

The DSS currently offers the following services:

A. Derived from ABI3730 high Throughput services:

A.1) Ready Reactions.

Users perform the sequencing reactions by themselves and then send their reactions to be cleaned up and the samples run on the Abi Prism 3100 available at the service. Data are sent back to researchers via e-mail 2-3 days after receipt of samples.

A.2) DNA to Sequence (the most common request).

The DSS performs the sequencing reactions and post-reaction cleaning up in house, using the customer purified template DNA and primers. Alternatively, the service will provide the most common primers (i.e., universal, reverse, etc.).

A.3) "À la carte" sequencing.

Non standard sequencing reactions are carried out for difficult template DNA regions (hairpins, mononucleotide stretch regions, etc.). The DSS sets the specific conditions and performs the sequencing reactions and post-reactions, in-house clean up, using the customer purified template DNA and primer.

B. Derived from GS Junior Genome Sequencer 454 FLX System Roche:

B.1) 454 amplicon sequencing libraries (Amplitag) since April 2013.

A pool of up to 20 different samples is available in the service in one run. It is expected to deliver at least 5000 sequencing reads (>450 nt) per sample.

B.2) 454 general (shotgun) sequencing libraries since October 2013.

To obtain 60 Mb of DNA information. About 15-30 fold coverage of a bacterial genome.

[060] Página web del Servicio: <http://www.eez.csic.es/?q=es/node/4110>

[070] Ámbito del Servicio: Internal/External

[080] ¿El Servicio tiene Certificaciones ISO?: NO

[090] ¿Está en la Red de Servicios Científico-Técnicos CSIC?: YES

[100] Facturación Interna 2010-2012 (k euros): 64.25

[110] Facturación a otros Centros CSIC 2010-2012 (k euros): 0.42

[120] Facturación a Universidades 2010-2012 (k euros): 3.76

[130] Facturación a Empresas 2010-2012 (k euros): IN PROGRESS

[140] Número de grupos usuarios diferentes: 18

[150] Personal entrenado en el uso de equipos 2010-2012: -

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[010] Nombre del Servicio: Greenhouses and Growth Chambers

[020] Tipo de Servicio: Scientific

[030] Responsable Científico: Juan Manuel Ruiz Lozano

[040] Responsable Técnico: Fernando Caro Fernández and Fernando Flores García as maintenance crew, and Jesús Chacón Carrasco (33%) as technician.

[050] Descripción del Servicio:

The initially named Greenhouse Service (GS) initiated its activities under the 2005/09 Strategic Plan by constructing new greenhouses in the area occupied by the former less modern ones. This initiative centralized the use of the greenhouses, which came into communal use within the Centre. The service is regulated by several rules of use that were agreed upon by consensus in an EEZ Scientific Senate meeting held on the 26th of September 2005.

The service consists of 10 units numbered 1 to 10 located between the Yellow House and the Red House within the EEZ's premises. Each unit consists of a greenhouse and a small area for the storage and handling of the necessary materials for plant growth: substrates, plastic, weighing scales, etc. In the greenhouse area there are 2-3 shelves to place the plants, and additional lamps to provide artificial light. The polycarbon platforms used to place the plants have recently been replaced by stronger ones made of aluminium. The facilities are also equipped to set hydroponic cultures in greenhouses 1, 2 and 3. There is a balance in greenhouse 8, a pHmeter in greenhouse 9 and a water purification system in greenhouse 2. Each greenhouse is fully independent enabling plants to be cultivated under 10 different growing conditions.

On the other hand, from September 2007 to May 2012, a total of nine growth chambers that belonged to EEZ, but that were managed independently from the GS, were integrated in this service, which has come to be known as the Greenhouse and Growth Chamber Service (GGCS). Each of these growth chambers consists of two platforms each subdivided into five 90x60-cm trays used to place the plants.

Throughout 2012, EEZ has adapted two growth chambers and two greenhouses for confined cultures of type 1 and type 2 genetically modified organisms (GMOs). The Centre requested the necessary permissions from Consejo Interministerial de OMGs to use GMOs in these facilities. Such authorization was received on the 6th of November, 2012. The rest of the greenhouses and growth chambers are authorized for the use of GMOs type 1.

The GGCS serves a large number of EEZ researchers, enabling them to cultivate plants under controlled conditions and thus meeting the aims of the Centre's scientific staff. Also, an informatics application was issued so researchers are able to handle their reservations and set the required spaces in the facilities through this system. At present, the scientific and technical management and its use have consolidated this service as one of the most widely used at EEZ.

The service is open to external users, but is limited to 10% of the total facilities.

[060] Página web del Servicio: <http://www.eez.csic.es/?q=es/node/60>

[070] Ámbito del Servicio: Internal/External

[080] ¿El Servicio tiene Certificaciones ISO?: NO

[090] ¿Está en la Red de Servicios Científico-Técnicos CSIC?: NO

[100] Facturación Interna 2010-2012 (k euros): 36/YEAR

[110] Facturación a otros Centros CSIC 2010-2012 (k euros): 0

[120] Facturación a Universidades 2010-2012 (k euros): 0

[130] Facturación a Empresas 2010-2012 (k euros): 0

[140] Número de grupos usuarios diferentes: 10

[150] Personal entrenado en el uso de equipos 2010-2012: -

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[010] Nombre del Servicio: Scientific Instrumentation Service (SIS)

[020] Tipo de Servicio: Scientific

[030] Responsable Científico: Francisco J. Corpas Aguirre

[040] Responsable Técnico: Rafael Núñez Gómez, Mónica Pineda Dorado and Lourdes Sánchez Moreno

[050] Descripción del Servicio:

The Scientific Instrumentation Service (SIS) was created at the end of 2006 to provide a general access to chromatographic techniques and for the detection of very low levels of a variety of both organic and inorganic molecules. Consequently, the main goal of this SIS has been to provide scientists at our institute, as well as external



laboratories access to modern technologies that are difficult to acquire by a specific group, and technical support to apply in their research projects. The SIS is currently equipped with the following instruments:

A. Three High Performance Liquid Chromatography (HPLC) systems

- An HPLC Waters Alliance 2695 connected to a Micromass Quattro micro API Mass Spectrometer (HPLC/MS/MS)

- An HPLC Waters model 2487 with the following detectors: Photodiode Array Detector (PDA), Fluorescence, Refractive Index and Electrochemical Amperometric Detector. Programmable fraction collector (model WFCII)

- An HPLC VARIAN Prostar with Fluorescence detector (mod 9012) and Varian 410 autosampler

B. One Gas Chromatography-Mass Spectrometry (GC-MS) Varian 240-MS system

C. One Inductively-Coupled Plasma Optical Emission Spectrometer (ICP-OES), Varian ICP 720-ES D. One RapidVap Vacuum Evaporation Systems Labconco

[060] Página web del Servicio: <http://www.eez.csic.es/?q=es/node/1187>

[070] Ámbito del Servicio: Internal/External

[080] ¿El Servicio tiene Certificaciones ISO?: NO

[090] ¿Está en la Red de Servicios Científico-Técnicos CSIC?: YES

[100] Facturación Interna 2010-2012 (k euros): 25.6

[110] Facturación a otros Centros CSIC 2010-2012 (k euros): 3.7

[120] Facturación a Universidades 2010-2012 (k euros): 0.2

[130] Facturación a Empresas 2010-2012 (k euros): 0.83

[140] Número de grupos usuarios diferentes: 19

[150] Personal entrenado en el uso de equipos 2010-2012: 30

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[010] Nombre del Servicio: Knowledge Transfer

[020] Tipo de Servicio: Special

[030] Responsable Científico: Eduardo López-Huertas León

[040] Responsable Técnico: Alfonso Díaz Morales

[050] Descripción del Servicio:

The Knowledge Transfer (KT) Service of EEZ-CSIC was created within the context of the Agricultural Sciences Area to give advice and support to scientists from CSIC Centres ascribed to this Area. This KT Service closely works in coordination with the CSIC-VATC, searching for synergies and relying on them for some of the services provided. The KT service carries out the following basic activities related to the different technology transfer means: evaluation and protection of research results, management of public calls to develop research and development projects in collaboration with the industry and private companies; management and negotiation of research contracts; management and negotiation of patent license contracts; promotion and encouragement for the creation of new technological companies within the CSIC (CSIC spin-offs); promotion and marketing of the CSIC results; scientific and technological capacities and CSIC technologies.

The new KT Service of EEZ started on July 2007.

[060] Página web del Servicio: <http://ott.eez.csic.es/>

[070] Ámbito del Servicio: Internal/External

[080] ¿El Servicio tiene Certificaciones ISO?: NO

[090] ¿Está en la Red de Servicios Científico-Técnicos CSIC?: YES

[100] Facturación Interna 2010-2012 (k euros): -

[110] Facturación a otros Centros CSIC 2010-2012 (k euros): -

[120] Facturación a Universidades 2010-2012 (k euros): -

[130] Facturación a Empresas 2010-2012 (k euros): -

[140] Número de grupos usuarios diferentes: 18

[150] Personal entrenado en el uso de equipos 2010-2012: -

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[010] Nombre del Servicio: Unit for the Scientific Culture and Innovation (UCC + i)

[020] Tipo de Servicio: Special

[030] Responsable Científico: José Manuel Palma Martínez

[040] Responsable Técnico: Silvia Alguacil Martín

[050] Descripción del Servicio:

This unit is involved in science popularization showing society, particularly at local and regional levels, the main EEZ features, as well as the research carried out in our Institute. The UCC+i deals with all the topics investigated at EEZ (environmental protection, biochemistry, cell and molecular biology of plants, soil microbiology and animal nutrition), and uses modern tools (movies, exhibitions, conferences, mass media, etc.) to make the EEZ's activities visible to the people. In the current Strategic Plan our contribution to the dissemination of the scientific knowledge has made great progress, as evidenced by several national awards given to some of our proposals. Although this service started in the Strategic Plan 2010-13 as the Science Outreach Service (SOS), in 2012 it was given the category of UCC+i by Fundación Española para la Ciencia y la Tecnología (FECYT, Ministry of Economics and Competitiveness, Spain; [www.fecyt.es](http://www.fecyt.es)).

The main activities developed by this Unit since 2009 are as follows:

1.- Science and Technology Weeks

1.1. Nights of Science III: Evolution, in collaboration with Instituto de Astrofísica de Andalucía-CSIC (Granada; [www.iaa.es](http://www.iaa.es))

1.2. A modern laboratory in your hands

1.3. Programme Investig-Action

1.4. Programme Enter & Discover

1.5. Open-doors sessions

Some of these activities were distinguished by Fundación Ciencia en Acción (Foundation Science in Motion; [www.cienciaenaccion.org](http://www.cienciaenaccion.org))

2.- Programme PIIISA (Proyecto de Iniciación a la Investigación e Innovación en Secundaria en Andalucía; [www.piiisa.es](http://www.piiisa.es); <http://emc2astronomy.blogspot.com/>; Project for Initiation in Research and Innovation for Secondary Schools in Andalucía), in collaboration with the University of Granada ([www.ugr.es](http://www.ugr.es)), the Consejería de Educación de la Junta de Andalucía ([www.juntadeandalucia.es/educacion/](http://www.juntadeandalucia.es/educacion/)), Obra Social La Caixa (CaixaBank; <http://obrasocial.lacaixa.es/>) and FECYT

This activity has been awarded twice by Fundación Ciencia en Acción

3.- Learning Through Research. Collaboration with the Centre for Educational Innovation Huerto Alegre (Granada; [www.huertoalegre.com](http://www.huertoalegre.com)) was held

4.- Days of Science. Collaboration with the Centre for Educational Innovation Huerto Alegre (Granada)

5.- Women in Science Workshops on the occasion of Women's International Day. Collaborations with the 9 Universities of all provinces of Andalucía, Instituto de Investigación y Formación Agraria y Pesquera (IFAPA, Junta de Andalucía; <http://www.juntadeandalucia.es/agriculturaypesca/ifapa/web>), Parque de las Ciencias de Granada (<http://parqueciencias.com>) and Fundación Descubre (<http://fundaciondescubre.es/>) were kept

6.- EEZ Scientific Awards in collaboration with Fundación Descubre, Parque de las Ciencias de Granada and the private companies Mycovitro S.L. ([www.mycovitro.com](http://www.mycovitro.com)), Biolibberis R&D. ([www.bioiliberis.com](http://www.bioiliberis.com)) and Allergenome S.L. ([www.allergenome.org](http://www.allergenome.org))

7.- Annual programme of visits, once a week throughout each season

8.- Exhibitions in collaboration with the Parque de las Ciencias de Granada, University of Granada, Casa de la Ciencia, CSIC (Sevilla; [www.casadelaciencia.csic.es](http://www.casadelaciencia.csic.es)), and diverse cities all around Andalucía

9.- Fascination of Plants Day, within the framework of the European Plant Science Organisation (EPSO; <http://www.plantday12.eu/>)

10.- EEZ Seminars

11.- Dissemination of articles, connection with mass media, scientific news platforms and social networks, mainly Facebook (<https://es-es.facebook.com/pages/Estaci%C3%B3n-Experimental-del-Zaid%C3%ADn-CSIC/124938444244323>), Twitter (<https://twitter.com/EEZCSIC>) y canal YouTube (<http://www.youtube.com/user/eezcsic>), among others

12.- Breakfasts with Science

13.- SOS, Science Out at Streets

14.- Culture activities (concerts, conferences, round tables, ETC.)

[060] Página web del Servicio: <http://www.eez.csic.es/?q=es/node/6152>

[070] Ámbito del Servicio: Internal

[080] ¿El Servicio tiene Certificaciones ISO?: NO

[090] ¿Está en la Red de Servicios Científico-Técnicos CSIC?: SI

[100] Facturación Interna 2010-2012 (k euros): -

[110] Facturación a otros Centros CSIC 2010-2012 (k euros): -

[120] Facturación a Universidades 2010-2012 (k euros): -

[130] Facturación a Empresas 2010-2012 (k euros): -

[140] Número de grupos usuarios diferentes: 18

[150] Personal entrenado en el uso de equipos 2010-2012: -

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[010] Nombre del Servicio: General Management

[020] Tipo de Servicio: Management

[030] Responsable Científico: The director of EEZ

[040] Responsable Técnico: José Luis Sánchez Justicia (Centre Manager)

[050] Descripción del Servicio:

The General Management service is headed by the EEZ's Manager and is responsible for managing the settlement, delivery and operation of the Centre, both at the Granada headquarters and at the Institute of Animal Nutrition. The service includes five major financial and administrative areas (Secretariat, Human Resources, Payments, Purchases and Administrative Contracts, and Project Management) as well as Maintenance, Repairs and Conversion Work activities.

A brief description of the areas is as follows:

The Secretariat is responsible for handling all paperwork dealing with calls for projects, research grants, fellowships, etc. The Secretariat also channels the Institute's relationships with the CSIC's Central Organization and with other agencies and companies. It also provides administrative support to the Director of the Centre. Its work influences all other areas of management.

The Payment section is in charge of the management of funds and all kinds of payments: it deals with all EEZ accounts, including expenditure and income and payment of trip expenses and allowances. It constitutes the EEZ payments centre and is accountable to the CSIC central organization. The Payments section supports all the other management areas, but mainly that of Purchasing and Administrative Contracts.

The Human Resources department manages all aspects regarding the staff working at EEZ as either civil servants or contracted workers (fixed-term, temporary, and in-training contracts). Some of the HR main tasks are: staff registering, management and control of staff holidays and leaves, Social Security paperwork, temporary stay permits, official calls for filling vacancies in research projects, temporary disability and work accidents, health and safety.

The Purchases and Administrative Contract section deals with goods and services purchasing according to the regulations, as well as the management of small contracts,

open bids and negotiated contracts, etc. It is in charge of the processes involved in all purchases assigned to the centre and to the research projects, from the beginning of the contact with suppliers until final delivery and book-keeping. Two vehicles are used for collecting goods which are not directly delivered to the EEZ by suppliers and for transporting goods to the facilities in Armilla (INAN). It also updates and maintains the inventory at both headquarters.

The Project Management department controls and follows up research projects and manages all contracts and grants. It also handles the distribution of funds to projects and, in collaboration with the Purchasing section, carries out book-keeping duties. This section is also in charge of recording and producing proofs of expenditure for projects and research contracts and the elaboration of project management reports.

The Maintenance, Repair and Conversion Work area is in charge of all infrastructures and functionality of facilities at EEZ, including some of the scientific equipment, the installation and full remodelling work in laboratories, offices, and common areas.

This Service not only provides assistance to the central headquarter of EEZ, but also to the Institute of Animal Nutrition (INAN). This General Management serves the two Institutes which are gradually expanding and moreover, EEZ and INAN are 4-Km away, which makes the global functioning of the service more complicated from a logistic point of view.

On the other hand, this Service also provides assistance to the Department of Environmental Geochemistry, which in the PE2010-13 will be integrated in the future Andalusian Institute of Earth Sciences. However, since its founding and up to now this Department has fully dependent on the EEZ's General Management Service.

Overall, the General Management staff assists the needs of about 300 people working at EEZ and INAN whose activity is developed in facilities distributed in 3 two-to-four stories laboratory; the main administration building with 2 stories, a conference room for 150 people, one Library and the Purchase Department -located in independent facilities within EEZ- and diverse buildings devoted to workshops, greenhouses, plant growth chambers, storage, stables, etc.

[060] Página web del Servicio: -

[070] Ámbito del Servicio: Interno/Externo

[080] ¿El Servicio tiene Certificaciones ISO?: NO

[090] ¿Está en la Red de Servicios Científico-Técnicos CSIC?: NO

[100] Facturación Interna 2010-2012 (k euros): -

[110] Facturación a otros Centros CSIC 2010-2012 (k euros): -

[120] Facturación a Universidades 2010-2012 (k euros): -

[130] Facturación a Empresas 2010-2012 (k euros): -

[140] Número de grupos usuarios diferentes: 19

[150] Personal entrenado en el uso de equipos 2010-2012: -

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[010] Nombre del Servicio: Information Technologies

[020] Tipo de Servicio: Technical

[030] Responsable Científico: The director of EEZ

[040] Responsable Técnico: Javier de la Fuente López

Other staff of the Service: César Azorín Márquez, Alejandro Morales Jiménez, Lourdes Salmerón García

[050] Descripción del Servicio:

The aim of the Information Technologies Service (ITS) at EEZ is to offer support to research by analyzing, arranging and implementing CIT (Communications and Information Technologies) solutions on a case-by-case basis. In practice, this objective is divided into two lines of work: system administration and personalized technical support.

EEZ has a complex IT infrastructure. Almost 300 users need quick access to information in the network, check their e-mails under different levels of security, the provision of protection and privacy services, controlled access to databases and bibliographic resources, etc.

[060] Página web del Servicio: <http://www.eez.csic.es/?q=es/node/58>

[070] Ámbito del Servicio: Internal

[080] ¿El Servicio tiene Certificaciones ISO?: NO

[090] ¿Está en la Red de Servicios Científico-Técnicos CSIC?: YES

[100] Facturación Interna 2010-2012 (k euros): -

[110] Facturación a otros Centros CSIC 2010-2012 (k euros): -

[120] Facturación a Universidades 2010-2012 (k euros): -

[130] Facturación a Empresas 2010-2012 (k euros): -

[140] Número de grupos usuarios diferentes: 18

[150] Personal entrenado en el uso de equipos 2010-2012: -

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[010] Nombre del Servicio: Carbon and Nitrogen Analysis Service

[020] Tipo de Servicio: Scientific

[030] Responsable Científico: Rosa M. Nieto Liñán

[040] Responsable Técnico: Rafael Hueso Ibáñez

[050] Descripción del Servicio:

The Carbon and Nitrogen analysis Service, placed at the Animal Nutrition Institute (INAN-EEZ), was created at 2008, as a part of the Instrumentation Service of EEZ. Five years later, 2013, is developed as independent service, between the set of services of EEZ.

This service is able to quantify, in a few minutes, the total amount of Carbon and Nitrogen in a wide range of samples: soils, feeds, animal and vegetal tissues, faeces, blood or milk. It only requires that the sample be presented as homogeneously as possible.

The equipment used is an elemental analyzer Leco TruSpec CN, that detect the Nitrogen in the sample by the Dumas method: complete combustion of the sample at 950 degrees with high pressure Oxygen, chemical reduction of Nitrogen oxides to molecular Nitrogen and analysis of this molecular Nitrogen with a thermal conductivity detector (TCD). Carbon is detected as Carbon dioxide (from the sample combustion) by an infrared detector. Quantification is performed with certified standards from Leco, each one of different concentration.

Final report is given as Carbon and Nitrogen per cent in total analysed mass.

[060] Página web del Servicio: <http://www.eez.csic.es/?q=es/node/6714>

[070] Ámbito del Servicio: Internal/External

[080] ¿El Servicio tiene Certificaciones ISO?: NO

[090] ¿Está en la Red de Servicios Científico-Técnicos CSIC?: NO



[100] Facturación Interna 2010-2012 (k euros): - (In that period this service was part of the Scientific Instrumentation Service)

[110] Facturación a otros Centros CSIC 2010-2012 (k euros): - (In that period this service was part of the Scientific Instrumentation Service)

[120] Facturación a Universidades 2010-2012 (k euros): - (In that period this service was part of the Scientific Instrumentation Service)

[130] Facturación a Empresas 2010-2012 (k euros): - (In that period this service was part of the Scientific Instrumentation Service)

[140] Número de grupos usuarios diferentes: 10

[150] Personal entrenado en el uso de equipos 2010-2012: -

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## **Debilidades y Amenazas Generales**

### **Weaknesses, threats, strengths and opportunities of the Library**

#### **Weaknesses**

Lack of a formation policy from CBIC to modernize and promote library issues.

Lack of funds for the library.

Lack of informatics equipment and technological means to keep up with modern technologies.

Difficulty to directly obtain data from our own activities without the intermediation of CBIC due to system drawbacks.

Little knowledge about the technical processes done at the library, which is translated as a lack of integration of the service in the Centre, duplicating the efforts.

#### **Threats**

The instability and rapid pace at which many TIC technologies are changing and new ones are being developed (Data bases, library and edition web sites, new management programmes for libraries), which bring about:

(a) professional lag if no new formation and "recycling" programmes are implemented

(b) obsolete equipment

(c) self management and duplicity of tasks

(d) lack of resources optimization

(e) little use of the reading room at the library because access to information can be done at the scientists' own offices/labs.

## **Strengths**

From the point of view of the different technical process, the EEZ library is actively involved in the production of one of the most ambitious collective catalogues of specialized library stock, which has been computerized and made public and it is considered one of the most important countrywide.

The library is diverse and has a multidisciplinary character because of the different research lines at EEZ.

Users at EEZ have access to a high number of books and journals, as well to computerized high quality information.

Interlibrary loans to complement the lack of the library stock.

Access to bibliographic information and full journal texts from external sources to EEZ users.

Policy of donations to the library's stock.

Participation in the collective purchase of book collections to reduce costs.

New book deposits with enough new space guaranteed.

Available space for the expansion of the library activities.

Full automation of tasks which enables the users to meet their needs outside the library's own premises.

Distribution of tasks between the personnel working in the library. This specialized personnel is aware of the weaknesses of the system and is keen to promote any necessary changes to enhance and improve this service.

## **Opportunities**

To have access to resources not acquired by EEZ or hired by it (high quality resources without expenditures).

Shared tasks with other CSIC libraries within the same area.

Substantially increase the volume of the collections at EEZ.

Face up to the costs of scientific information.

Establish professional links with colleagues.

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## **Weaknesses, threats and opportunities of the Radiochemistry Laboratory Service**

### **Weaknesses**

Both the number of users and the different techniques used have increased in line with the growth of EEZ in recent years, and so has the use made of the Radiochemistry Laboratory, which means that there are too many users working in a limited space and with limited equipment.

### **Threats**

The adverse biological effects of ionizing radiations have led researchers to look for means of replacing radiochemical techniques with other safer methods whenever possible.

### **Strengths**

As this is a Service regulated by law, the conditions in which it is managed are inspected annually by the national regulatory body (CSN), who indicates what should be done to correct any possible deviations from the provisions of current legislation.

The high sensitivity of radiochemical methods makes them an essential part of numerous experimental procedures in molecular biology and physiology.

The number and type of isotopes authorized to work meets the needs of EEZ's research groups.

### **Opportunities**

The wide variety of the high sensitivity scientific experiments that can be performed using isotopes and which are currently performed by other external bodies, e.g. the quantitative determination of animal hormones using RIA (in the Department of Animal Nutrition, EEZ site of Armilla) will contribute to the design of research projects with tasks based in radiochemistry parameters.

The potential future renewal of the Red House will allow modernizing the facilities in the main EEZ site in Granada.

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## **Weaknesses, threats and opportunities of the Confocal and Transmission Electron Microscopy (CTEM)**

### **Weaknesses**

This is a technical service of relatively new creation. Technical staff (both a graduate and a higher scientific officer) incorporated to this unit and consolidated as two permanent positions throughout 2010-2013 to develop its tasks. Although staff has taken numerous formation and training courses in the period 2010-2013 they can still be considered in formation.

This service lacks a unique emplacement: the equipment is currently split into two different buildings. Some basic infrastructure is still needed (benches, tables, chairs, shelves, etc.).

The CLSM system available corresponds to a very basic configuration (non-spectral system, manual change of objectives, filters, view mode etc.), and it is only fitted with a limited number of laser lines. The CLSM is not fitted with a standard CCD camera for fluorescence. This configuration is unable to adequately perform advanced applications on confocal microscopy (FRAP, FRET, FLIM, ROI analyses, live microscopy). Therefore, and even though the system can be upgraded, the elevated price of this operation (c.a. 180.000 €) makes it highly advisable to purchase a new microscope with the adequate built-in accessories.

There is no specific image treatment and analysis software available.

The available microtome and ultramicrotome belong to a research group and are over 25 years old; therefore, the acquisition of updated devices by the service is highly recommended. Also, the Ar 488 laser line of the confocal unit is approaching the end of its estimated lifespan (2.000 h of use).

### **Threats**

Lack of a currently stable structure, with permanent financial support currently harming the maintenance of the microscope units. Technical maintenance is not currently performed in a periodical, stable basis, and is currently carried out by scientific and technical staff from the service. Failures produced in the equipment are costly, and unfortunately more and more frequent as the facilities become older and used. Currently all equipment is out of guarantee and not subjected to maintenance agreements either.

Acquisition of the new equipment needed for the settlement of the unit since its creation in 2010 was stopped and is seriously compromised by the present economic situation. The same applies to the further formation in microscopy techniques of the technical staff.

Self-financing of the service, particularly at this early stages, should not be considered a priority.

### **Strengths**

Basic Equipment is already available and actively used.

The two major microscopes (CLSM Nikon acquired in 2003 and TEM JEOL in 2005) are still within their effective period of use, foreseen that resources are provided for their maintenance.

A number of projects developed in EEZ include analysis by both electron microscopy and CLSM. The demand of this service is increasing.

Both major microscopes can be easily upgraded and complemented with different accessories as the result of their modular design, to become adapted to new uses on demand.

Several researchers of the institute have ample experience in the use and maintenance of microscopy devices, as well as in the use of state-of-the-art microscopy techniques.

There is a good level of cooperation with other microscopy services in the surrounding geographical regions, many of them sharing similar technological tasks and even identical equipment.

There is a good level of cooperation with suppliers of microscope equipment and technical services for microscope maintenance, built throughout a long period of time. In addition to the commercial relationships, this cooperation includes technical assistance, advice, participation in joint activities (congresses, courses), update of software, interchange of information etc.

The service has had through the nearly three years of activity a remarkable impact on the institute, with numerous collaboration, teaching, generation of publications, catalogues etc. The web page of the unit contains increasing amount of interesting information and links for researchers and potential users.

### **Opportunities**

Microscopy is becoming an invaluable tool for functional analysis. As a consequence there is an increasing demand (both internal and external) for these techniques, which should be fulfilled.

Microscopy imaging is an extremely dynamic discipline currently taking advantage of numerous technical improvements. These include the development of new techniques of microscopy, the advances in the synthesis and characterization of new molecular probes, and particularly, the improvement of the methods for image capture, treatment and analysis. The appearance of new commercially available products and new companies in the field are improving both availability and pricing.

The service can take advantage of the excellent relationships and collaborations of some EEZ researchers with members of the Spanish Microscopical Society (SME), the European Microscopical Society (EMS), the Royal Microscopical Society (RMS-UK) and the Spanish Network for Advanced Light Microscopy (REMOA), providing a good visibility for this service.

The service can progressively increase the number and the nature of the facilities offered once it becomes properly settled.

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### **Weaknesses, threats and opportunities of the DNA Sequencing Service (DSS)**

#### **Weaknesses**

Cost of maintenance of the equipments further stressed by the current crisis.

Difficulty in incorporating new offers and protocols in the service. Expensive long term trainings, etc.

Current limited capacity of the DSS to attract external users.

## **Threats**

Competition with other services in the same and out of the geographical area (Granada, in terms of quality, speed, broader expertise, prices, etc).

The lack of specialized personnel and permanent financial support is currently harming the maintenance of the DSS.

Self-financing of the service must be considered a priority in their current state.

## **Strengths**

This service has currently an assigned emplacement in an independent laboratory equipped with some basic facilities (benches, tables, seats, shelves...).

After a 3 year period (2010-2012) we can state a consolidation of the service since a change has been observed in the pattern of expenses of the DNA sequencing carried out by different groups in the centre. This consolidation is also due to a competitive improvement in the quality of services of sequencing in a small set of request (low number of reads <50). This improvement is reinforced by the increase in the number of external users (particularly from the University of Granada).

Good level of cooperation with other DNA sequencing services of the Granada Area, many of which share similar technological tasks and even similar equipment (IPBLN for ABI3730, Hospital Clínico San Cecilio, for GS Junior Genome Sequencer 454 FLX System Roche).

Good assistance from vendors (Applied Biosystems and Roche), built through a long period of time. In addition to the commercial relationships, this cooperation includes technical assistance, advice, update of software, interchange of information, etc.).

## **Opportunities**

DNA sequencing is an invaluable tool for Molecular Biology laboratory analysis. As a consequence, there is an increasing demand (both internal and external) for these techniques which should be fulfilled.

The DSS solves specific problems with difficult template DNA regions that other services do not usually offer.

The DSS can progressively increase the number and the nature of the services offered once it becomes properly settled.

In May 2013, the NGS service (derived from GS Junior Genome Sequencer 454 FLX System Roche, and acquired through Plan Equipa) started. It opens new opportunities for the service and increases the Bioinformatics approaches and services to be developed within the groups of EEZ and for external requests. Also the increase of synergies with other DNA sequencing services at local, national and international levels.

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## **Weaknesses, threats and opportunities of the Greenhouses and Growth Chambers Service**

### **Weaknesses**

The number of groups demanding this service is increasing every year, particularly for the growth chambers. At present, these facilities are at 80% occupancy. However, the most important limitation comes from the different growth conditions that are demanded by the users, which in some cases do not fit with the available number of chambers.

The increasing demand for greenhouses will lead to insufficient surface area to grow plants under controlled conditions. The available space to build new greenhouses is at present compromised.

The risk of pests and diseases affecting plants growing within the chambers and the lack of personnel with appropriate background formation for the control of phytopathogens in the GGCS is also a potential weakness.

### **Threats**

No funding for the acquisition of new growth chambers and the high cost of electricity and maintenance.

The difficulties to recruit technicians with the appropriate backgrounds for the service from the OEP (Public Employment Offer) to cover the needs of the personnel in charge of controlling pests and diseases.

### **Strengths**

The GGCS is widely used by the different groups at EEZ. Up to now, the design and distribution of the greenhouses and growth chambers surface areas has met the needs of the researchers with over 90% of the facilities being in continuous use throughout the year.

The infrastructure of the service allows a wide range of conditions to be set up in greenhouses (aeration for hydroponic crops, additional illumination, individual temperature control, etc.) making it highly versatile.

The setting up of both growth chambers and greenhouses for culturing of GMOs opens new perspectives for future scientific projects proposed by EEZ scientists.

### **Opportunities**

In the last few years the service has integrated four growth chambers that have enabled plant growth under a wider set of conditions. The recent partial incorporation (33% dedication) of new personnel will provide technical support to this service. In particular, such personnel will be in charge of controlling pests and diseases, which will undoubtedly contribute to the correct and enhanced functioning of the service.

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## **Weaknesses, threats and opportunities of the Scientific Instrumentation Service**

### **Weaknesses**

Our Institute is formed by different departments with a wide range of different analytical requirements. Therefore, the staff personnel of the service need to set up and optimize the specific protocols for each analysis depending on the sample origin; this requires a considerable time, effort and commitment on their behalf.

### **Threats**

Efficacy must be one of the SIS targets. The SIS needs to respond to analytical demands as soon as possible. Otherwise, the researchers may demand these services outside our Institute.

On the other hand, the economical cost to keep instruments in good conditions is also an important threat because in addition to the necessary periodic revisions to set up some of the components which undergo mechanical wear out, there are unexpected breakdowns of instruments. This could be a real problem because the cost to fit them is usually hard to afford, especially in the present economical situation. This may provoke some technical stops of some of the facilities of the service.

Additionally, chromatographic techniques are continuously developing with significant technical advances. Therefore, in a certain period of time some of the available instruments will become old and, consequently, less competitive with other external services with more modern instruments. In this sense, although the three technicians are highly qualified, it must be considered that they need also to have the opportunity to attend specific workshops to keep them updated in new chromatography and spectroscopy techniques.

### **Strengths**

The three technicians are highly qualified since they obtained their respective PhD degrees and all three have perfect knowledge of the available techniques and their applications. Consequently, they have the capacity to provide the users with appropriate advice and support to new technical approaches.

The external demand started several years ago and is progressively increasing. The good service provided to other institutions will increase the external demand.

The SIS is able to provide and develop protocols and specific approaches on demand.

### **Opportunities**

The SIS has explored the analytical necessity of the different researchers in our Institute and other institutions. The instrumental offers a wide and flexible spectrum of analytical applications; therefore it is very important to determine the potential lines of work of the SIS for the future.

The recent acquisition of new equipments, such as the ICP-OES, will fulfill most of the analytical needs of EEZ research groups, thus improving their research capacity, and will allow competing with other services for the elementary analysis of samples.



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## **Weaknesses, threats, strengths and opportunities of the Knowledge Transfer Service**

### **Weaknesses**

A complete catalogue of the knowledge transfer capacities of EEZ and other Institutes of belonging to the Agricultural Area is not available yet.

Knowledge management is poorly optimized: computer tools allowing the homogenization and systematization of the performed activity archives are not available to the present date.

Bureaucratic over-reliance on management of knowledge transfer with the CSIC in Madrid. Poorly flexible management not adapted to reality, structure, timing and organization of companies.

### **Threats**

Low capacity of technological absorption by the Spanish industrial sector.

High competitiveness among other OPIs (Organismos Públicos de Investigación; Public Research Centres) whose technology transfer structures are more flexible in their relationships with the companies.

The lack of recognition of the knowledge transfer activities in the recruiting processes of scientific staff and in professional promotion.

### **Strengths**

An important number of scientists from EEZ contribute to new cutting-edge capacities and technologies.

Development of fundamental applied and technological research from the multidisciplinary and multisector prospective.

Human resources with high quality standards, extensive professional experience in technology transfer activities and deep knowledge of the internal procedures of CSIC.

Important relational capital with the Agents of the Regional Innovation System (Andalusian region).

### **Opportunities**

Institutional support to the knowledge transfer functions within the CSIC.

Close collaboration and cooperation with the Vicepresidency for Knowledge Transfer of CSIC.

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## **Weaknesses, threats, strengths and opportunities of the Unit for Scientific Culture and Innovation (UCC + i)**

### **Weaknesses**

The main weakness is the eventuality of the technician involved in the Unit. The lack of public jobs offered for science outreach profiles implies that candidates can only be recruited through specific co-financed contracts launched through national open calls from the Ministry. The resolution of these calls is carried out by an external committee and depends on available budget, number of applicants countrywide, and other parameters not specific to the research center.

There are limited human resources for a high time-consuming activity. Since its start in the current Strategic Plan, the UCC+i (former SOS, Science Outreach Service), has greatly increased its activity every year. Actually, the number of events which EEZ organizes has been demanded by many collectives with diverse purposes. This has brought to EEZ the main CSIC centre in Agricultural Sciences Area with continuous and novel dissemination proposals in the last years. However, at present, there is only one full-time person who manages and handles most of the activity.

There is shortage of financial funding to the Service, since our yearly proposals to the FECYT calls are mediated and integrated within the CSIC Scientific Culture Unit.

### **Threats**

The main and very crucial threat is the continuity of the Technician in charge of the Unit, since her contract ends in 2015. If there are no possibilities to maintain this job (national calls, promotion, etc), the service will be drastically diminished with repercussions on duties on the Institute itself and, consequently, on the CSIC.

### **Strengths**

The own entity as a UCC + I, which allows functioning with certain autonomy to raise proposals by itself without the sponsoring of UCC-CSIC.

The Unit has strong connections with many organizations devoted to Science Outreach such as the Parque de las Ciencias de Granada, Fundación Descubre, Huerto Alegre, FECYT, etc. and participates in diverse dissemination networks.

The involvement of many people from all EEZ working scales strengthens the activity of the Unit.

### **Opportunities**

The increasing demand of scientific knowledge as part of the society's cultural background.

At the present moment, Science is considered as one of the pillars where economical recovery in Spain could reside. The reinforcement of such belief by clear and precise dissemination protocols is one of the tasks of the Units for Scientific Culture.

The contribution to educational programmes which promote and make attractive the access to scientific and technological careers for young students is also one of the aims of the UCC-EEZ.

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## **Weaknesses, threats, strengths and opportunities of the General Management**

### **Weaknesses**

Shortage and limited specialized formation of the administrative support staff

Human Resources Unit

Lack of IT tools to facilitate the management of the area and to distribute information to other EEZ services.

Delays in processing due to the intense bureaucratization of tasks and the high volume of work.

Project Management

IT resource deficiencies.

Communication between researchers and the project management area lacks fluidity.

Purchases and Administrative Contracts

The accounts software available (SAICI) offers limited functionality and runs very slowly. It does not allow analytical accounting.

The supporting staff has limited training in financial management.

Excessive administrative steps while processing, which translates into a heavy bureaucratic load.

Contracts are made through the Servicio de Adquisición Centralizada (Centralized Procurement Service of goods and services) from the Ministry of Economy and Competitiveness, which translates into a heavy bureaucratic load, higher prices and extreme slowness of the acquisition process.

The dedicated software (SICOM) is unstable and leads to many errors in the order processing.

Maintenance, repair and conversion works

Lack of specialized continuing education.

### **Threats**

The bureaucratization of research activities is being translated into a loss of effectiveness of the administrative personnel. Processes for personnel recruitment, financial management and acquisition of infrastructure are excessively strict, time-consuming and sometimes unaffordable.

The General Management shared between Estación Experimental del Zaidín in Granada and the Institute of Animal Nutrition at Armilla lacks CSIC backup in terms of human and material resources which weakens the functionality of this Service in both headquarters.

The loss of positions at the Administration. These positions are taken up the CSIC in a general bourse and are reallocated by the Institution.

The lack of replacement of relevant positions within the Administration because of the policy from the Ministry of Public Administrations.

#### Project Management

Lack of well-defined guidelines regarding proof of expenses on behalf of the financing agencies.

#### Human Resources Unit

Dehumanization, due to the rigid regulations and fiscal rules our services are subjected to.

#### Purchases and Administrative Contracts

Highly bureaucratic and repetitive tasks that undermine the staff's capability and motivation.

Due to the instability of the accounting software, order processing could collapse and this would have an impact on the "individual project accounts", which are vital for proofs regarding project expenditures.

Given the growth of EEZ and delays in the current system (SIBI) to assign reference numbers to the inventory, the registered material could be erroneously mislocated.

#### Maintenance, Repair and Conversion Works

Contracting external companies to carry out the maintenance and refurbishing tasks.

### **Strengths**

#### Human Resources Unit

It follows established protocols from the HR's Secretaría General Adjunta of the CSIC which facilitates efficiency.

Skill and capacity of the staff in their professional performance.

Ability to process the variety of tasks attributed to the Service.

#### Project Management

Experience and efficiency, especially in meeting deadlines.

Commitment of the staff to solve the problems arising from the weaknesses outlined.

Purchases and Administrative Contracts

Experience in dealing with suppliers

Maintenance, Repair and Conversion Works

Rapid response to requests once the corresponding incidence is identified.

Better cost-effectiveness regarding refurbishing and work carried out by our own staff compared to contracting external companies.

The staff is cooperative and keen to solve any type of incident.

### **Opportunities**

The electronic management is being applied on administrative procedures and processing.

The increase in RDI resources encourages the improvement of management tools.

Technological development of computer software by the CSIC, especially in the management of purchases and orders.

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### **Weaknesses, threats, strengths and opportunities of the Information Technologies Service**

#### **Weaknesses**

Deficiencies in the VoIP infrastructure.

Lack of financial resources to purchase and maintain equipment and improve the network infrastructure.

Undefined administrative procedures.

#### **Threats**

The voice and data communications could be disrupted by lack of financial resources.

The implementation of Electronic Management in the other services of the Centre results in increased demand for IT services.

#### **Strengths**

A strong adaptive capacity.

Fundamental service to the development of the research work and general operation of the Institute.

Commitment of the personnel to enhance the development of the Centre.

The service has a good external image.

## **Opportunities**

Good start in service infrastructure and facilities for performance improvement.

Information, research and development are the drivers for future growth.

The potential and the quick progress of the field.

The staff in the ITS is now in consonance with the size of the Institute, which means that new tasks requested by EEZ personnel are more easily attended. This situation allows, on the one hand, developing new IT services and, on the other hand, having a more efficient ITS.

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## **Weaknesses, threats, strengths and opportunities of the Carbon and Nitrogen Analysis Service**

### **Weaknesses**

The Carbon and Nitrogen analysis requires a minimum amount of samples (approximately 50 mg depending the N and C content). Usually this is not a limitation, but sometimes (for example for lyophilized liquids) it could become a problem to meet the users' needs.

There is only one person 100% qualified to work with the equipment and to perform the preventive maintenance and the routine tasks.

The service does not do any step of sample preparation due to enough time availability.

### **Threats**

There are other services that combine this kind of elemental analysis (N and C but also H, O and S) with elemental analysis of a wide range of elements, using Inductively Coupled Plasma (ICP) instruments.

### **Strengths**

The carbon and nitrogen analysis is performed quickly and with good precision and accuracy. It is possible to analyze a large number of samples per day.

We are able to analyze carbon and nitrogen in a wide range of samples, from blood, food or animal tissues to soils, plants or liquids.

The technical staff is well qualified to work with the equipment which improves its efficiency.

This service, combined with the optical ICP of the Scientific Instrumentation Service at the main EEZ headquarters, provides the chance to obtain the data of a wide range of elements from a sample inside EEZ.

## **Opportunities**

The possibility to discriminate between organic and inorganic carbon in routine analysis.

This kind of analysis is very useful in different areas so it is expected to have more samples to analyze, since the Carbon and Nitrogen analysis has visibility at EEZ web site. The Carbon and Nitrogen analysis is now a routine technique for many groups in EEZ, and could be a very useful analysis for other groups outside EEZ (University, for example).

The possibility of perform some sample preparation steps.

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## **Posibles Soluciones**

Full access to scientific networks on the activities carried out by the different EEZ services will be pursued, so that all services may have the chance of sharing methodology, databases, etc.

Technological Offers will be implemented through different media to reach the productive sector.

Policy to maintain the UCC + i position (at present achieved through a co-financed contract) will be pursued with the CSIC authorities. The huge number of events and materials issued through this service makes this Unit indispensable to disseminate agricultural science, not only locally but also countrywide.

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## **GRUPOS DE INVESTIGACIÓN POR DEPARTAMENTOS**

### **Dpto. Microbiología del Suelo y Sistemas Simbióticos**

- Biofertilización y Biorremediación por Hongos Rizosféricos
- Micorrizas
- Estructura, Dinámica y Función de Genomas de Rizobacterias
- Genética de Infecciones Fitobacterianas
- Interacciones Planta-Bacteria
- Metabolismo del Nitrógeno

### **Dpto. Protección Ambiental**

- Microbiología Ambiental y Biodegradación
- Protección Vegetal
- Relaciones Planta-Suelo

### **Dpto. Bioquímica, Biología Celular y Molecular de Plantas**

- Antioxidantes, Radicales Libres y Óxido Nítrico en Biotecnología y Agroalimentación
- Señalización por Especies de Oxígeno y Nitrógeno Reactivo en Situaciones de Estrés en Plantas
- Biología Reproductiva de Plantas
- Homeostasis Iónica y Transportadores de Membrana
- Regulación Redox, Señalización por Azúcares y Respuesta al Estrés Biótico y Abiótico del Proceso Fotosintético

### **Dpto. Fisiología y Bioquímica de la Nutrición Animal**

- Producción de Pequeños Rumiantes
  - Biodisponibilidad de Minerales
  - Nutrición Animal
  - Salud Gastrointestinal
- 
- Grupo de Pastos y Sistemas Silvopastorales Mediterráneos



## **RESEARCH GROUPS BY DEPARTMENTS:**

### **Dpt. of Biology and Biotechnology of Plant Microbe Interactions**

- Biofertilization and Biodegradation by Rhizospheric Fungi
- Mycorrhizas
- Structure, Dynamics and Function of Rhizobacterial Genomes
- Genetics of Phytobacterial Infections
- Plant-Bacteria Interactions
- Nitrogen Metabolism

### **Dpt. of Bioremediation and Biological Protection of Agricultural Systems**

- Environmental Microbiology and Biodegradation
- Plant-Soil Relationships
- Plant Protection

### **Dpt. of Signalling, Stress and Development in Plants**

- Antioxidants, Free Radicals and Nitric Oxide in Biotechnology and Agro-Food (ARNOBA)
- Reactive Oxygen and Nitrogen Species Signaling under Stress Conditions in Plants
- Plant Reproductive Biology
- Ion Homeostasis and Membrane Transporters
- Redox Regulation, Sugar Signalling and Response against Biotic and Abiotic Stress of the Photosynthetic Process

### **Dpt. of Metabolism of Nutrients and Energy: Productive and Health Beneficial Aspects**

- Small Ruminants Production
  - Bioavailability of Minerals
  - Animal Nutrition
  - Gastrointestinal Health
- 
- Group of Mediterranean Pastures and Silvopastoral Systems

## **BIOFERTILIZACIÓN Y BIORREMEDIACIÓN POR HONGOS RIZOSFÉRICOS**

### **BIOFERTILIZATION AND BIODEGRADATION BY RHIZOSPHERIC FUNGI**

Dpto. Microbiología del Suelo y Sistemas Simbióticos

*Dpt. of Biology and Biotechnology of Plant Microbe Interactions*

Área Científica: A4. Ciencias Agrarias

A4.3 Interacciones plantas/organismos/medioambiente

Disciplinas ERC: LS - LIFE SCIENCES

LS9 Applied Life Sciences and Non-Medical Biotechnology

Industrial Leadership: 7. Other

7.1. Other

Societal Challenges: 2. Food security, sustainable agriculture, marine and maritime research and the bioeconomy

2.1. Sustainable agriculture and forestry

#### **Descripción**

Mejorar el crecimiento de plantas mediante la utilización de hongos rizosféricos con capacidades biofertilizantes y bioremediadoras.

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*Improve the plant growth by using rhizosphere fungi with biofertilizers and bioremediation capabilities.*

#### **Objetivos PA2014-2017**

1.- Interacción sinérgica entre hongos saprobios y hongos endófitos de raíz: Señalización y procesos reguladores en la interacción entre planta, endófito de raíz y hongo saprobio. Mecanismos fisiológicos y bioquímicos implicados en la interacción beneficiosa de los hongos saprobios en las plantas micorrizadas.

2.- Regulación molecular de la simbiosis micorriza arbuscular: Papel de fitohormonas en el proceso de regulación de la micorrización. Caracterización y análisis funcional de genes reguladores del proceso de micorrización.

3.- Señalización y regulación en interacciones mutualistas y patogénicas entre plantas y microorganismos del suelo. Identificación y comparación del papel de compuestos de señalización y mecanismos de regulación en diferentes interacciones entre microorganismos simbióticos y patogénicos de plantas.

4.- Empleo de microorganismos en la mejora del cultivo de plantas de interés agrícola e industrial en suelos degradados o contaminados.

5.- Empleo de hongos saprobios para la biorremediación de alpeorujos y su uso como fertilizante orgánico. Contribución de los hongos micorrízicos en el efecto fertilizante del alpeorujos transformado por hongos saprobios. Repercusión del alpeorujos transformado por hongos saprobios en la fisiología de la planta y la calidad del suelo. Empleo del alpeorujos transformado por hongos saprobios en descontaminación, biocontrol y conservación de la biodiversidad del suelo. Empleo de hongos saprobios y arbusculares en la valorización de otros residuos agrícolas e industriales.

6. Biorremediación de suelos contaminados con PAHs mediante consorcios entre plantas micorrizadas, nuevas cepas fúngicas capaces de oxidar PAHs y bacterias productoras de biosurfactantes. Estudio de los mecanismos de actuación de la simbiosis micorriza arbuscular frente a la degradación de PAHs.

7.- Diseño, formulación y mejora de biofertilizantes de base micorriza en combinación con otros microorganismos promotores del crecimiento vegetal: Efectos de distintas formulaciones de biofertilizantes de base micorriza sobre diversas plantas de interés agrícola, forestal y medioambiental. Estudio de las interacciones de cepas de potencial interés en inoculantes micorrízicos con otros microorganismos promotores del crecimiento vegetal. Aprovechamiento de subproductos de alto interés comercial producidos durante la simbiosis micorrízica. Establecimiento de protocolos estándar para la cuantificación y certificación de la presencia de micorrizas en sistemas de producción de plantas a escala industrial.

8.- Estudio de los exudados de interés biológico (hormonas, aminoácidos, etc.) producidos por inoculantes micorrízicos in Vitro: posibles aplicaciones en la industria agropecuaria, viverística, medioambiental, farmacéutica y cosmética.

El éxito en el logro de estos objetivos estará sujeto a las siguientes amenazas:

a) Serias dificultades para contar con jóvenes investigadores debido a la poca expectativa y oportunidad de desarrollar su trabajo en el futuro. Aún no disponemos de jóvenes investigadores con una posición estable para desarrollar su investigación;

b) La política de financiación de la investigación científica inestable y no bien definida de investigación de financiación, y

c) La falta de apoyo en la financiación científica por parte de la industria y entidades privadas

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*1. To study synergistic interaction between endophyte fungi and saprobe fungi in the rhizosphere: Signalling and process implicated in their interaction. To study physiological and biochemical mechanisms implicated in the interaction between saprobe fungi and Arbuscular Mycorrhizal plants.*

*2. Molecular regulation of Arbuscular Mycorrhizal (AM) symbiosis: Role of plant hormones in the regulation of the process of mycorrhization. Characterization and functional analysis of regulatory and marker genes associated to AM symbiosis.*

3. *Signalling in mutualistic and pathogenic interactions between plants and soil microorganisms. Identification and comparison of the role of signal compounds and regulatory mechanisms in different interactions between plants and pathogenic or mutualistic microorganisms.*

4. *Use of microorganisms to improve the growth of plant with agronomic and industrial interest in degraded or polluted soils.*

5. *Bioremediation of olive dry residue by saprobe fungi and use of this transformed residue as organic amendment. Effect of the mycorrhizal fungi in the fertilizing effect of olive dry residue transformed by saprobe fungi. Impact of bioremediated olive dry residue on the plant physiology and soil quality. Use of the bioremediated olive dry residue by saprobe fungi for decontamination, biocontrol and soil biodiversity conservation. Valorization of other agricultural and industrial waste by saprobe and arbuscular fungi.*

6. *Bioremediation of soils contaminated with PAHs by the consortium between mycorrhizal plants, new fungal strains capable of oxidizing PAHs and biosurfactant producing bacteria. Mechanisms of action of the arbuscular mycorrhizal symbiosis against degradation of PAHs.*

7. *Design, development and improvement of biofertilizers inocula based on Arbuscular Mycorrhiza fungi in combination with other plant growth promoting microorganisms: Effect of different formulations of these biofertilizers inocula on various plants of agricultural, forestry and environmental interest. Study of the interactions between AM fungal strains with potential interest as inoculants and other plant growth promoting microorganisms. Use of sub-products with high commercial interest produced during mycorrhizal symbiosis. Establishment of standard protocols and methodologies to quantify and certify the presence of mycorrhizae in the plant production systems on an industrial scale.*

8. *Study of biological interest exudates (hormones, amino acids, etc..) from Mycorrhizal inoculants produced "in vitro": potential applications in the agricultural, nursery, environmental, pharmaceuticals and cosmetic industries.*

*Success in achieving these objectives is subject to clearly identified threats, such as:*

a) *Great difficulties to get young researchers due to little expectative and opportunity to develop their work in the future. We have not young researchers with stable position to develop investigation;*

b) *Unstable and non-well-defined scientific policy of funding investigation; and*

c) *Lack of industrial support and private funding for research.*

### **Personal de plantilla**

Juan Antonio Ocampo Bote. Profesor de Investigación

José Manuel García Garrido. Investigador Científico

Inmaculada García Romera. Investigador Científico

Alberto Bago Pastor. Científico Titular

Narciso Algaba García. Técnico Especialista Grado Medio de OPIs

Custodia Cano Romero. Auxiliar de Investigación de OPIs

Julia Martín Trujillo. Auxiliar de Investigación de OPIs

M<sup>a</sup> Isabel Tamayo Navarrete. Personal Laboral

Nuria Molinero Rosales. Personal Indefinido no Fijo

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## **MICORRIZAS**

### ***MYCORRHIZAS***

Dpto. Microbiología del Suelo y Sistemas Simbióticos

(Dpt. of Biology and Biotechnology of Plant Microbe Interactions)

Área Científica: A4. Ciencias Agrarias

A4.3 Interacciones plantas/organismos/medioambiente

Disciplinas ERC: LS - LIFE SCIENCES

LS9 Applied Life Sciences and Non-Medical Biotechnology

Industrial Leadership: 4. Biotechnology

4.1. Boosting cutting-edge biotechnologies as future innovation drivers

Societal Challenges: 2. Food security, sustainable agriculture, marine and maritime research and the bioeconomy

2.1. Sustainable agriculture and forestry

### **Descripción**

Este Grupo realiza estudios básicos y estratégicos sobre la ecología, fisiología, bioquímica, biología molecular, genómica funcional y biotecnología de las micorrizas arbusculares, en relación con la nutrición y protección de las plantas frente a estreses bióticos y abióticos, y su contribución, en interacción con microorganismos, a la recuperación de ecosistemas degradados y conservación de flora amenazada, y como alternativa al uso excesivo de agroquímicos y fitosanitarios en agricultura.

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*This research Group carries out basic and strategic studies on the ecology, physiology, biochemistry, molecular biology, functional genomics and biotechnology of arbuscular mycorrhizas, in relation to nutrition and protection of plants against biotic and abiotic stresses, and their contribution, in interaction with other soil micro-organisms, to the recovery of degraded ecosystems and conservation of threatened flora, and as an alternative to the excessive use of agrochemicals in agriculture.*

## **Objetivos PA2014-2017**

### Objetivos generales

Desarrollo de investigación fundamental y estratégica en relación con la ecología, fisiología, bioquímica, biología molecular y biotecnología de las micorrizas arbusculares (MA), y/o los hongos MA, que permita avanzar en su conocimiento y facilitar su aplicación en agricultura y medio ambiente.

### Objetivos específicos

Objetivo operacional # 1. Analizar la diversidad de hongos MA en ecosistemas naturales. Establecimiento y mantenimiento de colecciones de hongos MA

Objetivo operacional # 2. Establecer las bases moleculares de la nutrición de plantas micorrizadas y de su tolerancia al exceso de metales.

Objetivo operacional # 3. Establecer las bases fisiológicas y moleculares de la tolerancia a estreses osmóticos (salinidad y sequía) de las plantas micorrizadas

Objetivo operacional # 4. Procesos de señalización y reconocimiento en micorrizas arbusculares. Mecanismos de inducción de resistencia frente a patógenos por los hongos MA

Objetivo operacional # 5. Promover desarrollos biotecnológicos que faciliten la aplicación de los hongos MA en agricultura, en la restauración de ecosistemas Mediterráneos degradados y en la recuperación de flora amenazada

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*To promote basic and strategic research related to the ecology, physiology, biochemistry, molecular biology and biotechnology of arbuscular mycorrhizas (AM) and/or the AM fungi, allowing their rational application to improve agricultural sustainability and environmental quality.*

*1. To analyse the diversity of AM fungi in target agricultural systems and natural ecosystems, and implementation of AM fungal collections (germplasm bank).*

*2. To gain information on the molecular basis of nutrient exchange and metal homeostasis in mycorrhizal plants.*

*3. To gain information on the physiological and molecular basis of the tolerance of mycorrhizal plants to abiotic stresses (salinity, drought and extreme temperatures).*

*4. Signalling processes in arbuscular mycorrhizas. Mechanisms responsible for the induction of plant resistance to pathogens by AM fungi.*

5. *Biotechnology and application of AM fungi in agriculture and for the recovery of mediterranean degraded ecosystems, and endangered and/or endemic flora.*

#### **Personal de plantilla**

Concepción Azcón González de Aguilar. Profesor de Investigación.

Rosario Azcón González de Aguilar. Profesor de Investigación

Nuria Ferrol González. Investigador Científico

Juan Manuel Ruiz Lozano. Investigador Científico

Ricardo Aroca Álvarez. Científico Titular

Juan Antonio López Ráez. Científico Titular

María José Pozo Jiménez. Científico Titular

Eulogio Javier Palenzuela Jiménez. E. Técnicos Superiores Especializados de OPIS

Domingo Álvarez Gómez. Técnico Especialista de Grado Medio OPIs

Francisca González Iglesias. Ayudante de Investigación de OPIs

Ascensión Valderas Jiménez. Ayudante de Investigación de OPIs

Virginia Cuéllar Maldonado. Personal Laboral

Juan Manuel García Ramírez. Personal Laboral

Sonia María Molina Arias. Personal Indefinido no Fijo

José Miguel Barea Navarro. Profesor de Investigación Ad honorem

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#### **ESTRUCTURA, DINÁMICA Y FUNCIÓN DE GENOMAS DE RIZOBACTERIAS**

#### ***STRUCTURE, DYNAMICS AND FUNCTION OF RHIZOBACTERIAL GENOMES***

Dpto. Microbiología del Suelo y Sistemas Simbióticos

*Dpt. of Biology and Biotechnology of Plant Microbe Interactions*

Área Científica: A4. Ciencias Agrarias

A4.3 Interacciones plantas/organismos/medioambiente

Disciplinas ERC: LS - LIFE SCIENCES

LS2 Genetics, Genomics, Bioinformatics and Systems Biology

## Industrial Leadership:4. Biotechnology

### 4.1. Boosting cutting-edge biotechnologies as future innovation drivers

## Societal Challenges: 2. Food security, sustainable agriculture, marine and maritime research and the bioeconomy

### 2.4. Sustainable and competitive bio-based industries

## Descripción

La actividad de investigación del grupo está orientada a la microbiología del suelo con una perspectiva global o de sistema, centrandó las líneas de investigación en el estudio de la estructura, función, plasticidad, dinámica y evolución de los genomas de bacterias simbióticas fijadoras de nitrógeno así como de metagenomas de la rizosfera de plantas de interés agroforestal. Para ello se combinan aproximaciones microbiológicas, bioquímicas y genético-moleculares más clásicas con las tecnologías de secuenciación masiva de alto rendimiento de desarrollo más reciente.

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*The group investigates soil microbiology from a systems biology perspective. Current research lines involve the study of the structure, function, plasticity, dynamics and evolution of nitrogen-fixing symbiotic bacterial genomes as well as of metagenomes of the plants rhizosphere from agro-forestry ecosystems. Experimental approaches combine classical microbiology, biochemistry and molecular-genetics methods with cutting edge next generation deep-sequencing technologies.*

## Objetivos PA2014-2017

Objetivos específicos de las líneas de investigación del grupo son:

- 1) Explorar la diversidad genética y funcional de las bacterias que establecen interacciones de interés biotecnológico con plantas mediante la caracterización del genoma común (genoma "core") y el genoma accesorio del simbiote de alfalfa *Sinorhizobium meliloti* y de los metagenomas de suelos y rizosferas de ecosistemas diversos.
- 2) Caracterización del conjunto de elementos genéticos móviles (moviloma) de *S. meliloti* como una de las fuentes de plasticidad genómica en estas bacterias.
- 3) Caracterización y explotación biotecnológica de la diversidad y mecanismos de movilidad de los intrones bacterianos del grupo II.
- 4) Estudio de la estructura y función de la fracción no codificante (RNoma) de los genomas de cepas diversas de *S. meliloti* y caracterización de los mecanismos de regulación post-transcripcional mediados por RNAs no codificantes en esta bacteria simbiótica.

La amenaza para el grupo, y por ello el mayor problema para conseguir alcanzar nuestros objetivos es la actual inestabilidad del sistema de I+D+i en España que lleva



a la falta de recursos económicos y humanos, la pérdida de personal cualificado y el desinterés de los estudiantes graduados por seguir la carrera científica. Asimismo, los actuales problemas económicos del CSIC dificultan el progreso de nuestra investigación.

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*1) Exploring the functional and genetic diversity of biotechnologically relevant bacteria that establish beneficial interactions with plants through the characterization of the pan genome (i.e. core and accessory genome) of the alfalfa symbiont Sinorhizobium meliloti and of soil and rhizosphere metagenomes from a diversity of ecosystems.*

*2) Characterization of the S. meliloti mobilome (i.e. set of mobile genetic elements) as a major source of genomic plasticity in these group of soil bacteria.*

*3) Characterization and biotechnological exploitation of the diversity of S. meliloti group II introns and their mobility mechanisms.*

*4) Study of the structure and function of the noncoding RNomes of diverse S. meliloti strains and deciphering of the mechanism involved in the sRNA-mediated post-transcriptional control of gene expression in this symbiotic bacterium.*

*The threat to the group, hence the major problem to achieve these objectives, is the current instability of the Scientific Research Policy in Spain that involves lack of economical and human resources, loss of high qualified personnel, and disinterest by graduate's students to pursue the scientific career. Likewise, the current economical problems of the CSIC is hampering the progress of our research.*

### **Personal de Plantilla**

Nicolás Toro García. Profesor de Investigación

Francisco Martínez-Abarca Pastor. Investigador Científico

Manuel Fernández López. Científico Titular

José Ignacio Jiménez Zurdo. Científico Titular

Pablo José Villadas Latorre. E. Técnicos Superiores Especializados de OPIS

José María del Arco Martín. Personal Laboral

Fernando Manuel García Rodríguez. Personal Laboral

Ascensión Martos Tejera. Personal Indefinido no Fijo

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## **GENÉTICA DE INFECCIONES FITOBACTERIANAS**

### **GENETICS OF PHYTOBACTERIAL INFECTIONS**

Dpto. Microbiología del Suelo y Sistemas Simbióticos

*Dpt. of Biology and Biotechnology of Plant Microbe Interactions*

Área Científica: A4. Ciencias Agrarias

A4.3 Interacciones plantas/organismos/medioambiente

Disciplinas ERC: LS - LIFE SCIENCES

LS2 Genetics, Genomics, Bioinformatics and Systems Biology

Industrial Leadership: 4. Biotechnology

4.1. Boosting cutting-edge biotechnologies as future innovation drivers

Societal Challenges: 2. Food security, sustainable agriculture, marine and maritime research and the bioeconomy

2.1. Sustainable agriculture and forestry

### **Descripción**

El interés científico del grupo se centra en la identificación de nuevos determinantes genéticos y mecanismos moleculares que permiten el establecimiento de infecciones bacterianas en plantas. Para lograr este objetivo, utilizamos como modelo de estudio fundamentalmente la interacción *Sinorhizobium meliloti*-*Medicago* spp., y como estrategia investigamos aspectos de la vida en superficie de *Rhizobium*. Concretamente, nos interesan los mecanismos que gobiernan la motilidad tipo swarming y el desarrollo de biofilms en *Rhizobium*, dada la demostrada conexión de estos fenómenos con la virulencia de bacterias patógenas.

Con el conocimiento adquirido esperamos desarrollar nuevas herramientas biotecnológicas que permitan el control de bacteriosis en plantas y/o la producción de biofertilizantes más efectivos con los que se incremente la producción vegetal, siendo respetuosos con el medioambiente.

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*The scientific interest of the group is focused on the identification of new genes and molecular mechanisms that allow the establishment of bacterial infections in plants. To achieve this goal, we employ as a model system the *Sinorhizobium meliloti*-*Medicago* spp. interaction. The strategy used is based on the study of rhizobial cells living on surfaces. Specially, the group is interested in investigating mechanisms involved in the control of swarming motility and biofilm development, considering the close connection of these two phenomena with the virulence of pathogenic bacteria.*

## Objetivos PA2014-2017

El objetivo general del grupo es la identificación de nuevos determinantes genéticos y mecanismos moleculares que permiten el establecimiento de interacciones planta-bacteria. Especialmente nos interesa identificar señales químicas y nuevos componentes bacterianos implicados en la colonización y posterior invasión de las plantas. Para ello, utilizamos como estrategia la investigación de fenómenos bacterianos asociados a superficie como son el control de la motilidad y formación de biofilm fundamentalmente en la bacteria modelo *Sinorhizobium meliloti*. Algunos de nuestros objetivos concretos son:

- 1.-Identificar determinantes genéticos y mecanismos reguladores que gobiernan los distintos tipos de motilidad en superficie mostrados por *S. meliloti*, investigar su función en el desarrollo de biofilms y en la interacción con la planta.
- 2.-Dilucidar el mecanismo de acción de 2-tridecanona (2-TDC) por el que interfiere negativamente en el establecimiento de infecciones bacterianas (Patente P201231248).

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*The main objective is the identification of new genes and molecular mechanisms that allow the establishment of bacteria-plant interactions. We are especially interested in identifying chemical signals and new bacterial components which play a role in plant colonization and invasion. In order to achieve this goal, we investigate bacterial surface-associated phenomena such as the control of motility and biofilm formation in the model bacterium *Sinorhizobium meliloti*. Some of our specific objectives are:*

- 1.-Identification of genes and regulatory mechanisms involved in the different types of surface motility shown by *S. meliloti*, as well as to investigate their roles in biofilm development and in the establishment of associations with plants.*
- 2.-To elucidate the mechanism of action of 2-tridecanone (2-TDC) responsible for the prevention of plant bacterial infections (Patent P201231248).*

## Personal de plantilla

María José Soto Misffut. Científico Titular

Virginia Cuéllar Maldonado. Personal Laboral

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## **INTERACCIONES PLANTA-BACTERIA**

### ***PLANT-BACTERIA INTERACTIONS***

Dpto. Microbiología del Suelo y Sistemas Simbióticos

*Dpt. of Biology and Biotechnology of Plant Microbe Interactions*

Área Científica: A4. Ciencias Agrarias

A4.3 Interacciones plantas/organismos/medioambiente

Disciplinas ERC: LS - LIFE SCIENCES

LS9 Applied Life Sciences and Non-Medical Biotechnology

Industrial Leadership: 4. Biotechnology

4.2. Biotechnology-based industrial processes

Societal Challenges: 3. Secure, clean and efficient energy

3.5. New knowledge and technologies

### **Descripción**

Mecanismos moleculares que rigen las interacciones planta-bacteria mutualistas y patogénicas.

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*Molecular mechanisms driving mutualistic and pathogenic plant-bacteria interactions.*

### **Objetivos PA2014-2017**

El objetivo general de este grupo es adquirir conocimientos básicos sobre los mecanismos moleculares de las interacciones planta-bacteria y bacteria-bacteria. Específicamente se aborda:

1.-Identificación y caracterización de componentes moleculares y respuestas bacterianas y vegetales importantes durante el establecimiento de asociaciones planta-microbio de tipo mutualista y patogénico.

2.-Señalización molecular a través de c-di-GMP en interacciones planta-bacteria mutualistas y patogénicas

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*The broad goal of this group is to acquire new knowledge on the molecular mechanisms governing diverse plant-bacteria and bacteria-bacteria interactions. Specific objectives are:*

1.- *Identification and characterization of molecular components and plant and bacterial responses during the establishment of mutualistic and pathogenic plant-bacterial associations.*

2.- *c-di-GMP molecular signaling in mutualistic and pathogenic plant-bacteria interactions*

### **Personal de plantilla**

Juan Sanjuán Pinilla. Profesor de Investigación

M<sup>a</sup> Trinidad Gallegos Fernández. Investigador Científico

Antonia Felipe Reyes. Ayudante de Investigación de OPIs

Socorro Muñoz Rodríguez. Ayudante de Investigación de OPIs

María José Lorite Ortega. Personal Laboral

José Olivares Pascual. Profesor de Investigación Ad honorem

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## **METABOLISMO DEL NITRÓGENO**

### ***NITROGEN METABOLISM***

Dpto. Microbiología del Suelo y Sistemas Simbióticos

*Dpt. of Biology and Biotechnology of Plant Microbe Interactions*

Área Científica: A4. Ciencias Agrarias

A4.3 Interacciones plantas/organismos/medioambiente

Disciplinas ERC: LS - LIFE SCIENCES

LS8 Evolutionary, Population and Environmental Biology

Industrial Leadership: 4. Biotechnology

4.3. Innovative and competitive platform technologies

Societal Challenges: 2. Food security, sustainable agriculture, marine and maritime research and the bioeconomy

2.1. Sustainable agriculture and forestry

## Descripción

Se estudian las bases moleculares y regulación de los procesos de respiración microaeróbica y desnitrificación en bacterias endosimbióticas de las leguminosas, tanto en vida libre como en la interacción bacteria-planta-medio ambiente. Con ello se pretende estudiar las relaciones entre la fijación del dinitrógeno atmosférico y la desnitrificación, caracterizar reguladores clave implicados en dichos procesos, disminuir la contaminación de nitratos en suelos y aguas, reducir las emisiones de óxido nitroso de suelos agrícolas a la atmósfera, analizar la biodiversidad de bacterias implicadas en el ciclo del N y disminuir el efecto que los estreses abióticos ejercen sobre la simbiosis.

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*We study the molecular basis and regulation of microaerobic respiration and denitrification processes in endosymbiotic bacteria of legumes, both as free-living and in the plant-bacteria-environment interaction. Our aim is to analyze the relationships between atmospheric dinitrogen fixation and denitrification, characterize key regulators involved in these processes, reduce pollution of nitrate in soil and water, diminish nitrous oxide emissions from agricultural soils to the atmosphere, to analyze the biodiversity of bacteria involved in the nitrogen cycle and reduce the effect of abiotic stresses exerted on the symbiosis.*

## Objetivos PA2014-2017

Obtener conocimientos sobre la desnitrificación utilizando la bacteria endosimbiótica *Bradyrhizobium japonicum* como modelo para estudiar el proceso tanto en vida libre como en simbiosis con leguminosas. Para ello, se contempla el estudio integrado de los factores ambientales, genes y enzimas y procesos de óxido-reducción que intervienen en la desnitrificación, prestando especial interés a la identificación de los reguladores transcripcionales que controlan su expresión y actividad y a la caracterización del mecanismo molecular de dichos reguladores. En la interacción planta-bacteria-medio ambiente, el Grupo trata de establecer la interrelación fijación de N<sub>2</sub>-desnitrificación, y conocer los factores y reguladores implicados en la reducción de la emisión del gas invernadero óxido nitroso por bacterias endosimbióticas asociadas a cultivos de leguminosas, así como el análisis de la biodiversidad de tales bacterias. Mediante estudios de metagenómica se pretende analizar la abundancia relativa, la diversidad funcional, y la actividad de las poblaciones de bacterias desnitrificantes en muestras medioambientales, fundamentalmente aguas y sedimentos contaminados con nitratos, así como analizar su distribución espacial y temporal. Finalmente, el Grupo está interesado en el estudio de los mecanismos del microsimbionte con potencial para incrementar la tolerancia de la simbiosis bacteria-leguminosa a estreses abióticos. La consecución de estos objetivos está supeditada a los presupuestos futuros que, a corto y medio plazo, las distintas Instituciones, regionales, nacionales e internacionales, dediquen a la política científica incluyendo la investigación, el desarrollo y la innovación y, especialmente, los recursos humanos.

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*Get knowledge of denitrification using the endosymbiotic bacteria *Bradyrhizobium japonicum* as a model to study the process both in the free-living and in symbiosis with legumes. To this end, the study includes integrated environmental factors, genes and enzymes and redox processes involved in denitrification, with particular interest in the*

*identification of transcriptional regulators that control their expression and activity, and the characterization of the molecular mechanism of those regulators. In the plant-bacteria-environment system, the Group seeks to establish the relationship between N<sub>2</sub> fixation and denitrification, understand the factors and regulators involved in mitigation of the release into the atmosphere of the greenhouse gas nitrous oxide produced by endosymbiotic bacteria associated with leguminous crops, as well as the diversity of such bacteria. Using metagenomics, we study the relative abundance, functional diversity, and activity of denitrifying bacteria populations in environmental samples, mainly water and sediments contaminated with nitrates, and analyze spatial and temporal distribution. Finally, the group is interested in the study of the mechanisms of microsymbiont potential to increase tolerance of bacteria-legume symbiosis to abiotic stresses. Achievement of these objectives is subjected to the future budgets that, in the short and medium terms, the various regional, national and international Institutions devote to the scientific policy, including research, development and innovation and, especially, human resources.*

### **Personal de plantilla**

Eulogio J. Bedmar Gómez. Profesor de Investigación

M<sup>a</sup> Jesús Delgado Igeño. Investigador Científico

M<sup>a</sup> Socorro Mesa Banqueri. Científico Titular

Germán Tortosa Muñoz. Ayudante de Investigación de OPIs

Jesús Chacón Carrasco. Personal Laboral

Alba Hidalgo García. Personal Indefinido no Fijo

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## **MICROBIOLOGÍA AMBIENTAL Y BIODEGRADACIÓN**

### ***ENVIRONMENTAL MICROBIOLOGY AND BIODEGRADATION***

Dpto. Protección Ambiental

*Dpt. of Environmental Protection*

Área Científica: A4. Ciencias Agrarias

A4.2 Biología, bioquímica y fisiología vegetal

Disciplinas ERC: LS - LIFE SCIENCES

LS2 Genetics, Genomics, Bioinformatics and Systems Biology

Industrial Leadership: 4. Biotechnology

#### 4.1. Boosting cutting-edge biotechnologies as future innovation drivers

Societal Challenges: 7. Other

##### 7.1. Other

### Descripción

El grupo se deriva del grupo Degradación de Tóxicos Orgánicos fundado por el Profesor J. L. Ramos. Inicialmente su investigación se centró en diferentes aspectos de la degradación de contaminantes ambientales por bacterias, pero a medida que el grupo se fue expandiendo sus intereses científicos se dirigieron hacia el estudio y explotación biotecnológica de los mecanismos moleculares mediante los cuales las bacterias persisten en el medio ambiente, favorecen la degradación de contaminantes e influyen en la salud vegetal. Se realiza un abordaje multidisciplinar, combinando análisis genéticos, genómicos o metagenómicos con bioinformática, bioquímica de proteínas, química orgánica y ensayos de campo. El grupo está liderado por el Profesor Ramos, recientemente galardonado con el Premio Jaime I de Investigación en Medio Ambiente y compuesto por 9 científicos en plantilla, 7 técnicos, dos R&C y varios becarios pre-doctorales y contratados doctores. El tamaño de medio es de unas 35 personas.

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*The group has its origin in the Degradation of Organic Toxics group that was founded by Professor Juan Luis Ramos. Initially the group focused on different aspects of the degradation of environmentally relevant contaminants by bacteria. With time, the group expanded their scientific interests towards the biotechnological exploitation of the molecular mechanisms by which bacteria persist in the environment, favour the degradation of contaminants and influence plant health following a multidisciplinary approach, combining genetic, genomic and metagenomic analysis with bioinformatics, protein biochemistry, organic chemistry and field assays. The group is led by Professor Ramos, who was recently awarded with the prestigious prize "Jaime I" in Environmental Sciences and comprises 9 staff scientists, 7 technicians (staff), one administrative, two Ramón y Cajal scientists and several PhD students and postdocs. The size of the group during the last 8 years was around 35 persons.*

### Objetivos PA2014-2017

Los objetivos científicos del grupo se pueden clasificar en tres categorías interrelacionadas:

i) Descifrar los mecanismos moleculares implicados en la persistencia y adaptación de bacterias en vida libre y en comunidades multicelulares (biofilms) asociadas al sistema radicular de plantas. Utilizando *Pseudomonas* como modelo se estudian respuestas mediadas por vías de quimioseñalización, sistemas reguladores de uno y dos componentes, expresión génica a nivel global y circuitos metabólicos. Asimismo analizamos el papel de segundos mensajeros (di-GMP cíclico, indol), proteínas



extracitoplásmicas y moléculas señal como ácidos grasos, acilhomoserina lactonas o sideróforos.

ii) Caracterizar las bases moleculares de la degradación de contaminantes, en particular hidrocarburos aromáticos mono y policíclicos, así como halo-, sulfo- y nitroaromáticos, en diferentes bacterias aisladas del medio ambiente, tanto aerobias como anaerobias. Se analizan tanto las rutas biodegradativas y su regulación como los mecanismos de tolerancia a estos compuestos tóxicos.

iii) Estudiar la respuesta de las comunidades bacterianas a la presencia de contaminantes derivados del petróleo mediante aproximaciones metagenómicas. El objetivo último es caracterizar la diversidad funcional de la microbiota que participa en la respuesta e identificar los microorganismos y genes implicados en los procesos de biodegradación en el medio ambiente.

La utilización del nuevo conocimiento generado en distintas aproximaciones biotecnológicas aporta un valor añadido a esta investigación, con el consiguiente beneficio para la sociedad.

Como ejemplos, se estudia el uso de bacterias rizosféricas y degradadoras de contaminantes para estrategias de biorremediación en suelos; el de bacterias tolerantes a disolventes orgánicos para la síntesis de compuestos de valor añadido; o el de cepas de *Pseudomonas* en promoción del crecimiento vegetal o protección frente a infecciones por patógenos. Desde nuestro grupo se han generado varias patentes y se ha creado una empresa de base biotecnológica (Biolliberis) que opera en el sector agrario y medioambiental.

El grupo pretende mantener su vocación formativa, participando de forma habitual en los programas de formación de doctores del Plan Estatal de Investigación, del CSIC y de la Junta de Andalucía, y en los programas de prácticas de los Institutos de Formación Profesional para personal técnico. Asimismo, los científicos del grupo participan en distintos Másteres de las Universidades de Granada, Málaga y Huelva. En los últimos 5 años se han defendido 16 Tesis Doctorales, en casi todos los casos dando lugar a la continuación de una carrera científica o a la incorporación en empresas de I+D.

Toda esta actividad continuará reflejándose en publicaciones científicas, notas de prensa y apariciones en medios de comunicación, como parte de los objetivos de difusión y divulgación. Durante los últimos 5 años se han publicado unos 25 capítulos de libros y 90 artículos de investigación, casi todos en revistas SCI dentro del 25% de mayor impacto en su ámbito. Entre estas actividades se incluyen también numerosas participaciones en congresos, siendo en más de 30 ocasiones como conferenciantes invitados a congresos internacionales. Paralelamente, la investigación se da a conocer a la sociedad a través de nuestras páginas web, artículos en periódicos, o entrevistas por radio y televisión. El grupo participa además en actividades de divulgación como la Semana de la Ciencia, jornadas de puertas abiertas o exhibiciones en el Parque de las Ciencias de Granada.

La consecución de los objetivos vendrá determinada por la disponibilidad de recursos económicos y humanos, actualmente amenazada por las limitaciones y retrasos en las convocatorias.

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*The scientific objectives of the group can be clustered in three interrelated categories:*

*i) Deciphering the molecular mechanisms involved in the persistence and adaptation of free living bacteria and bacteria in multicellular communities (biofilms) associated to the root system of plants. Using Pseudomonas as a model organism, we study the responses mediated by chemosensory pathways, one- and two-component regulatory systems, global gene expression and metabolic circuits. We also analyze the role of second messengers (cyclic di-GMP, indole), of extracytoplasmic proteins and of signaling molecules such as fatty acids, acyl homoserine lactones or siderophores.*

*ii) Characterizing the molecular basis for degradation of pollutants, in particular mono- and polycyclic aromatic hydrocarbons, as well as halo-, sulfo- and nitroaromatics, in different bacteria isolated from the environment, both aerobic and anaerobic. We analyze the biodegradation pathways and their regulation, as well as the mechanisms for tolerance against these toxic compounds.*

*iii) Studying the response of bacterial communities to the presence of oil-derived contaminants by metagenomic approaches. The final objective is to characterize the functional diversity of the microbiota participating in this response and to identify the microorganisms and genes involved in biodegradation processes in the environment.*

*The use of the newly generated knowledge in different biotechnological approaches provides an added value to this research, with the accompanying benefit for society. As examples, we study the use of rhizosphere bacteria with biodegradation potential for soil bioremediation strategies; solvent-tolerant bacteria for the synthesis of added-value products; or strains of Pseudomonas with plant growth promoting or pathogen protection activities. Our group has developed several patents and from it has stemmed a biotechnology-based company (Biolliberis), operating in the environmental and agronomy sectors.*

*The group intends to maintain its educative vocation, routinely participating in training programs for PhD students from different organisms (CSIC, Plan Estatal, Junta de Andalucía), as well as in practice programs for technicians. Besides, members of the group are involved in different Masters programs from the universities of Granada, Malaga and Huelva. In the past 5 years 16 PhD theses have been defended within the group. In most cases they have resulted in a continuing scientific career or in the enrollment in R&D companies.*

*All this activity will continue to be reflected in scientific publications, press notes and appearances in different media, as part of the dissemination and divulgation objectives. During the past 5 years, the group has published over 25 book chapters, and around 90 research articles, most of them in SCI journals within the top 25% in their field in terms of impact factor. Among these activities, we have participated in numerous meetings, more than 30 times as invited speakers in international conferences. In parallel, the results from our research are made public through dedicated webpages, articles in local and national newspapers, or radio and TV interviews. Members of the*

*team take part in activities such as guided visits to the EEZ for students, scientific fairs, open-doors days, or exhibits at the Science Park in Granada.*

*Fulfilling these objectives will depend on the available economic and human resources, currently endangered due to the cuts and delays in the different calls and programmes.*

### **Personal de plantilla**

Regina M. Wittich. Profesor de Investigación

Tino Krell. Investigador Científico

Silvia Marqués Martín. Investigador Científico

Ana Segura Carnicero. Investigador Científico

Manuel Espinosa Urgel. Científico Titular

M<sup>a</sup> Isabel Ramos González. Científico Titular

Pieter Van Dillewijn. Científico Titular

M<sup>a</sup> Antonia Molina Henares. Técnico Especialista Grado Medio de OPIs

Jesús de la Torre Zúñiga. Ayudante de Investigación de OPIs

M<sup>a</sup> Angustias Reyes Franco. Personal Laboral

M<sup>a</sup> Luisa Travieso Huertas. Personal Laboral

Abdelali Daddaoua. Personal Indefinido no Fijo

Alicia García Puente. Personal Indefinido no Fijo

Patricia Marín Quero. Personal Indefinido no Fijo

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## **PROTECCIÓN VEGETAL**

### ***PLANT PROTECTION***

Dpto. Protección Ambiental

*Dpt. of Environmental Protection*

Área Científica: A4. Ciencias Agrarias

A4.3 Interacciones plantas/organismos/medioambiente

Disciplinas ERC: LS - LIFE SCIENCES

Industrial Leadership: 7. Other

7.1. Other

Societal Challenges: 2. Food security, sustainable agriculture, marine and maritime research and the bioeconomy

2.1. Sustainable agriculture and forestry

### **Descripción**

Desarrollo del manejo integrado de plagas en agroecosistemas. Caracterización de sistemas agrícolas sostenibles.

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*To develop integrated pest management (IPM) in agroecosystems. To characterize sustainable agricultural systems.*

### **Objetivos PA2014-2017**

1.- Profundizar en el conocimiento de la incidencia de los diferentes manejos agronómicos aplicados en el cultivo del olivo sobre la fauna auxiliar asociadas a las principales plagas.

2.- Evaluar las características biológicas y comportamiento de las principales especies depredadoras y parasitoides para potenciar su actividad beneficiosa

3.- Determinar la utilidad de la artropodofauna como bioindicadora de la sostenibilidad de las prácticas agronómicas aplicadas

El principal problema para alcanzar los objetivos es la reducida posibilidad de obtener recursos y personal debido al reducido número de convocatorias de proyectos de investigación y a la no resolución de los ya solicitados.

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*1.-To deepen in the knowledge about the effect of different olive agronomic managements on the main pests and their associated natural enemies.*

*2.-To assess the biological and behavioural traits of the main species of predator and parasitoids to promote their beneficial activity.*

*3.-To establish the usefulness of arthropods as sustainable agricultural management bioindicators.*

### **Personal de plantilla**

Mercedes Campos Aranda. Profesor de Investigación

Herminia Barroso Muñoz. Ayudante de Investigación de OPIs

María Luisa Fernández Sierra. Personal Laboral

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## RELACIONES PLANTA-SUELO

### ***PLANT-SOIL RELATIONSHIPS***

Dpto. Protección Ambiental

*Dpt. of Environmental Protection*

Área Científica: A4. Ciencias Agrarias

A4.3 Interacciones plantas/organismos/medioambiente

Disciplinas ERC: LS - LIFE SCIENCES

LS9 Applied Life Sciences and Non-Medical Biotechnology

Industrial Leadership: 4. Biotechnology

4.1. Boosting cutting-edge biotechnologies as future innovation drivers

Societal Challenges: 2. Food security, sustainable agriculture, marine and maritime research and the bioeconomy

2.1. Sustainable agriculture and forestry

### **Descripción**

La actividad científica del grupo de investigación tiene como fin generar conocimientos básico-teóricos y aplicados innovadores que contribuyan a la protección del suelo, cultivos vegetales y aguas subterráneas mediante el uso de tecnologías agrarias de bajo coste y el impulso de sistemas agrícolas por medio de alternativas ecológicas. Este objetivo se aborda desde una triple perspectiva: 1) el desarrollo de procesos biotecnológicos que favorezcan, el reciclaje y la valorización de residuos orgánicos e inorgánicos, 2) el desarrollo de tecnologías de bajo coste para la prevención y protección del suelo y aguas subterráneas frente a la contaminación puntual y difusa inducida por los contaminantes orgánicos y 3) el desarrollo de métodos para la evaluación y el mantenimiento de la biodiversidad en suelos de agroecosistemas convencionales y sostenibles.

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*The scientific activity of the research group is to contribute to the generation of new basic and applied knowledge which allow the protection of soils, crops and groundwater through the use of low-cost agricultural technologies and the promotion of sustainable development of agricultural systems by means of ecological alternatives. This overall goal objective is approached from a triple perspective: (i) the development of biotechnological processes that favour the recycling and recovery of organic and inorganic wastes, (ii) the development of low-cost technologies for the prevention and protection of soil and groundwater against punctual and diffuse pollution induced by*

*organic pollutants iii) to development of methods to evaluate and to maintain the biodiversity in sustainable agrosystems.*

### **Objetivos PA2014-2017**

Los objetivos generales y específicos a desarrollar por el grupo de investigación "Relaciones Planta-Suelo" en el PE 2014-17 conectan con los propuestos en los PE anteriores, pero a su vez constituyen un avance innovador en la reutilización de residuos orgánicos e inorgánicos, la protección de suelos, aguas y cultivos agrícolas para el desarrollo de sistemas agrícolas sostenibles.

1. Recuperación y valorización de residuos orgánicos e inorgánicos como insumos agrícolas con valor añadido

1.1. Desarrollar procesos de vermicompostaje, caracterizando la biodiversidad genética y metabólica de comunidades microbianas involucradas en ellos, y valorando la bioactividad microbiana de diferentes tipos de vermicomposts.

1.2 Producir abonos líquidos a partir de composts y vermicomposts evaluando su potencial fertilizante, antioxidante y biodegradable.

2. Desarrollo de tecnologías agrarias de bajo coste para minimizar la contaminación puntual y difusa inducida por contaminantes orgánicos e inorgánicos en suelos y aguas

2.1 Diseñar biotecnologías empleando residuos orgánicos e inorgánicos para reducir la contaminación de suelos y aguas, aislando y caracterizando microorganismos con capacidad para metabolizar contaminantes orgánicos

2.2. Desarrollar técnicas analíticas para evaluar la biodisponibilidad de plaguicidas y contaminantes orgánicos en diferentes compartimentos ambientales.

2.3. Generar, a partir de los residuos orgánicos e inorgánicos, matrices duales con capacidad para inmovilizar contaminantes orgánicos e inorgánicos como método de biorrecuperación de suelos contaminados de depuración (bioadsorbentes) de aguas residuales.

3. Conservación de la biodiversidad para la gestión sostenible de los agroecosistemas.

3.1. Mejora de la sostenibilidad ambiental asociada a la cadena agroalimentaria mediante el desarrollo de métodos de evaluación, el manejo de la biodiversidad y el uso de bioenmiendas.

La consecución de los objetivos propuestos se encontrará condicionada por dos problemas que afectan al sistema científico español, y a los que también se enfrenta el grupo de investigación: a) La reducción de la financiación, debido a los drásticos recortes producidos en los últimos años, por lo que la mayoría de las convocatorias de proyectos públicos o privadas se encuentran cerradas o dotadas de escasos recursos, b) la necesidad imperiosa de consolidar el personal científico formado en años anteriores, el cual, actualmente se encuentra en situación precaria o bien han tenido que abandonar su trabajo en el grupo de investigación.

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*The general and specific objectives of the research group "Plant-Soil" to be developed in the PE 2014-17 connect with those proposed in the previous PE, but, in turn, represent an innovative breakthrough in the reuse of organic and inorganic wastes, the protection of soil, water and crops and the development of sustainable agrosystems.*

*1. Recovery and reuse of organic and inorganic waste as value-added inputs for agriculture*

*1.1. To develop vermicomposting processes, characterizing the metabolic and genetic biodiversity of microbial communities involved in them, and assessing the microbial bioactivity of the obtained vermicomposts.*

*1.2 To develop and produce new liquid organic fertilizers –te- from composts and vermicomposts, evaluating its fertilizer, antioxidant and biodegrading capabilities.*

*2. Development of low-cost agricultural technologies to minimize the punctual and diffuse pollution point and nonpoint pollution induced by inorganic and organic contaminants in soils and waters*

*2.1 To design and validate biotechnologies using organic and inorganic wastes to reduce soil and water contamination, isolating and characterizing microorganisms capable of metabolizing organic contaminants.*

*2.2. Develop analytical techniques to evaluate the bioavailability of pesticides and other organic contaminants in different environmental compartments*

*2.3. To generate, from the organic and inorganic wastes, dual matrices with with capacity to immobilize organic and inorganic contaminants as method of bioremediation of polluted soils or as purification technique (bioadsorbentes) of wastewater.*

*3. Conservation of biodiversity for sustainable management of agroecosystems.*

*3.1. To improve the environmental sustainability associated with the food chain through the development of assessment methods, the management of biodiversity and the use of bioamendments*

*The achievement of the proposed objectives will be dependent on two severe problems affecting the Spanish scientific system, and also facing the research group: a) The reduction in funding due to the drastic cuts produced in recent years, since most of the calls for public or private projects are closed or are provided with limited economical resources, b) the urgent need for consolidating the scientific staff trained in previous years, which is currently in unstable jobs or have had to abandon its work in the research group.*

### **Personal de plantilla**

Emilio Benítez León. Investigador Científico

Rogelio Nogales Vargas-Machuca. Investigador Científico

Esperanza Romero Taboada. Investigador Científico

Celia Cifuentes Urién. Ayudante de Investigación de OPIs

Fernando Calvo Rivas. Personal Indefinido no Fijo

Beatriz Moreno Sánchez. Personal Indefinido no Fijo

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## **ANTIOXIDANTES, RADICALES LIBRES Y ÓXIDO NÍTRICO EN BIOTECNOLOGÍA Y AGROALIMENTACIÓN (ARNOBA)**

### ***ANTIOXIDANTS, FREE RADICALS AND NITRIC OXIDE IN BIOTECHNOLOGY AND AGRO-FOOD (ARNOBA)***

Dpto. Bioquímica, Biología Celular y Molecular de Plantas

*Dpt. of Signalling, Stress and Development in Plants*

Área Científica: A4. Ciencias Agrarias

A4.1 Agrobiotecnología y mejora vegetal

Disciplinas ERC: LS - LIFE SCIENCES

LS1 Molecular and Structural Biology and Biochemistry

Industrial Leadership: 4. Biotechnology

4.2. Biotechnology-based industrial processes

Societal Challenges: 2. Food security, sustainable agriculture, marine and maritime research and the bioeconomy

2.2. Sustainable and competitive agri-food sector for a safe and healthy diet

### **Descripción**

Estudio de la función de los antioxidantes, radicales libres y óxido nítrico en la fisiología de especies hortofrutícolas (pimiento, tomate, olivo, guisante, etc.) para el desarrollo de estrategias biotecnológicas que permitan una mejor explotación de las características nutricionales de dichas especies. Para abordar estos objetivos nuestro grupo colabora con empresas líderes en el sector agroalimentario y biotecnológico como son Syngenta Seeds, SA, Puleva Foods, SL, Deoleo, SA y Agrosol. Asimismo se lleva a cabo una investigación en Arabidopsis y guisante, como plantas modelo, para generar conocimiento que pueda ser útil en los objetivos aplicados de la actividad del grupo.

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*Study at cell and molecular levels of the role of antioxidants, free radicals and nitric oxide in the physiology of horticultural species (pepper, tomato, olive, pea, etc.) for the development of biotechnological strategies which allow a better exploitation of the nutritional features of these species. To address these objectives, our group collaborates with leader companies in the food and biotechnology sector such as Syngenta Seeds, SA, Puleva Foods, SL, Deoleo, SA and Agrosol. In addition, we carry out research in Arabidopsis and pea, as model plants, to generate basic science knowledge to be further used in the applied objectives of the group's activity.*

### **Objetivos PA2014-2017**

Este grupo representa la evolución de la sub-línea Antioxidantes y señalización celular por especies de oxígeno y nitrógeno reactivo (ROS y RNS) del anterior Plan Estratégico 2010-13. Sin renunciar al desarrollo de investigación básica, la actividad del grupo se orienta también a una investigación aplicada en pos de una transferencia de conocimiento hacia el tejido productivo. Luego de un periodo fecundo de generación de conocimiento, el grupo ha acumulado un cuerpo de doctrina con potencial explotable en los campos de la biotecnología y la agroalimentación.

Los pilares de la investigación del grupo son:

1. Estudio de la fisiología de frutos de interés agrícola. Se investiga la maduración y post-cosecha de frutos de pimiento, tomate y olivo, mediante el análisis de antioxidantes enzimáticos (catalasa, superóxido dismutasa, enzimas del ciclo ascorbato-glutation y NADP-deshidrogenasas) y no enzimáticos (ascorbato, glutatión, alfa-tocoferol, carotenoides, flavonoides, polifenoles). Igualmente se determina la participación del óxido nítrico (NO) y especies de oxígeno y nitrógeno reactivo (ROS y RNS, respectivamente) en dicho procesos fisiológicos. Se estudia, asimismo, la influencia de todas estas moléculas en los parámetros de calidad de los productos seleccionados. Para abordar este objetivo se emplean frutos completos o bien preparaciones de fracciones subcelulares, principalmente peroxisomas.

2. Función del NO y RNS en la germinación, desarrollo y estrés abiótico en plantas superiores. Se lleva a cabo la caracterización bioquímica y molecular de las dianas celulares endógenas (proteínas, lípidos y ácidos nucleicos) implicadas en los procesos de nitración y S-nitrosilación propiciados por RNS y el análisis de su participación en procesos de señalización celular, durante la germinación y el desarrollo, y de estreses abióticos (salinidad, arsénico, daño mecánico, baja y alta temperatura). Se emplean plantas modelo como Arabidopsis y guisante, pero también olivo, pimiento y girasol.

Uno de los aspectos a destacar es la investigación de cómo las RNS y ROS intervienen en los mecanismos de señalización y/o protección frente a estrés por arsénico en plantas de interés agrícola, y el uso de bio-marcadores que se inducen en las plantas en respuesta a este metaloide. Estos abordajes contribuirán al desarrollo de estrategias y herramientas de aplicación biotecnológica que permitan participar en la regulación de los procesos de germinación y desarrollo, así como la obtención de plantas más tolerantes frente a distintos estreses medioambientales abióticos.

3. Prospección de compuestos bioactivos naturales procedentes de productos hortofrutícolas con aplicaciones nutricionales y biotecnológicas. Dada la evolución del grupo, este objetivo se orienta a los sectores alimentario y biotecnológico. Se investigan nuevos componentes bioactivos y antioxidantes de tomate, aceituna y pimiento con efectos beneficiosos para la salud (capsicina, proteínas bioactivas, flavonoides, etc). Asimismo, en conexión con el sector productivo, nuestro grupo lleva a cabo la caracterización y selección de variedades de productos hortofrutícolas especialmente ricas en antioxidantes, con vistas a mejorar su competitividad en los mercados. Otro de los objetivos de este apartado es la producción de antioxidantes enzimáticos a partir de productos hortofrutícolas usando técnicas biotecnológicas para aplicaciones en dermofarmacia como ingredientes protectores bioactivos.

Amenazas a corto y medio plazo:

1-Ausencia de un proyecto científico estable y de financiación por parte de las agencias que regulan los programas de I+D+i

2-Laboratorios obsoletos, ubicados en un edificio de más de 40 años

3-Jubilación en dic-2013 de uno de los científicos del grupo.

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*This group represents the evolution of the sub-line “Antioxidants and cell signalling by reactive oxygen nitrogen species (ROS and RNS)” from the previous Strategic Plan 2010-13. Without refusing to fundamental research, the activity of the group also focuses on applied research towards a transfer of knowledge to the productive sector. After a fruitful period of knowledge generation, the group has accumulated a body of doctrine with exploitable potential in the fields of biotechnology and agro-food.*

*The pillars of our research are:*

*1. Study of the physiology of fruits of agricultural interest. The ripening and post-harvest is basically investigated in pepper, tomato, olive and others, by the analysis of enzymatic (catalase, superoxide dismutase, ascorbate-glutathione cycle, and NADP-dehydrogenases) and non-enzymatic (ascorbate, glutathione, alpha-tocopherol, carotenoids, flavonoids, polyphenols) antioxidants. Likewise, the involvement of nitric oxide (NO) and reactive oxygen and nitrogen species (ROS and RNS, respectively) in those physiological processes is also accomplished. The influence of these molecules in the quality parameters of the selected produces is analyzed as well. To address this objective, whole fruits, but also subcellular fractions, mainly peroxisomes, are used.*

*2. Role of NO and RNS in germination, development and abiotic stress in higher plants. The biochemical and molecular characterization of the endogenous cell targets (proteins, lipids and nucleic acids) involved in nitration and S-nitrosylation promoted by RNS is investigated, as well as the analysis of their participation in cell signalling processes during germination and development and in abiotic stresses (salinity, wounding, high and low temperature). Arabidopsis and pea are used as model plants, but also olive, pepper, and sunflower.*

*One of the aspects to be remarked in this objective is the study on how the ROS and RNS participate in the signalling mechanisms and/or protection against stress by*

*arsenic in plants of agricultural interest, and the use of bio-markers induced in plants in response to this metalloid. These approaches will contribute to the development of strategies and tools for biotechnological applications which allow modifying the regulation of the germination and development processes, as well as the selection of plants more tolerant to several environmental stresses.*

*3. Search for natural bioactive compounds coming from vegetable with nutritional and biotechnological applications. Due to the group's evolution, this objective is addressed to the nutritional and biotechnological sectors. New bioactive compounds and antioxidants from tomato, olive and pepper with beneficial effects for the health (capsaicin, bioactive proteins, flavonoids, etc.) are investigated. Likewise, in connection with the productive sector, our group carries out the characterization and selection of vegetable varieties especially rich in antioxidants, focused at improving their competitiveness in the markets. Another goal is the production of enzymatic antioxidants from vegetables using biotechnological approaches for their application in dermatological products as bioactive protecting ingredients.*

*Short and medium term threats:*

*1- Absence of a stable scientific project and financing on behalf of the agencies which promote the R + D + i policies.*

*2- Obsolete laboratories located in a more than 40-year-old building.*

*3- Retirement in Dec-2013 of one of the scientists of the group.*

#### **Personal de Plantilla**

José Manuel Palma Martínez. Profesor de Investigación

Francisco Javier Corpas Aguirre. Investigador Científico

Eduardo López-Huertas León. Investigador Científico

María Jesús Campos Ramos. Ayudante de Investigación de OPis

Tamara Molina Márquez. Personal Indefinido no Fijo

Carmelo Ruiz Torres. Personal Indefinido no Fijo

Luis Alfonso del Río Legazpi. Profesor de Investigación Ad honorem

## SEÑALIZACIÓN POR ESPECIES DE OXÍGENO Y NITRÓGENO REACTIVO EN SITUACIONES DE ESTRÉS EN PLANTAS

### REACTIVE OXYGEN AND NITROGEN SPECIES SIGNALING UNDER STRESS CONDITIONS IN PLANTS

Dpto. Bioquímica, Biología Celular y Molecular de Plantas

*Dpt. of Signalling, Stress and Development in Plants*

Área Científica: A4. Ciencias Agrarias

A4.2 Biología, bioquímica y fisiología vegetal

Disciplinas ERC: LS - LIFE SCIENCES

LS1 Molecular and Structural Biology and Biochemistry

Industrial Leadership: 4. Biotechnology

4.2. Biotechnology-based industrial processes

Societal Challenges: 2. Food security, sustainable agriculture, marine and maritime research and the bioeconomy

2.1. Sustainable agriculture and forestry

#### Descripción

Se estudia desde un punto de vista multidisciplinar, a nivel bioquímico, celular y molecular, los mecanismos implicados en la respuesta de la planta a distintos tipos de estrés abiótico (metales pesados, xenobióticos y sequía) y biótico (infección por *Pseudomonas*), con el objetivo de aplicar el conocimiento obtenido para la monitorización temprana del estrés y el diseño de estrategias de mejora vegetal. La investigación del Grupo se centra en dos líneas fundamentales: 1) El estudio de la función de las especies de oxígeno y nitrógeno reactivo (ROS y RNS) de origen peroxisomal como moléculas señal en la regulación de la expresión génica en respuesta a estrés. Con especial interés en establecer el papel de la dinámica de los peroxisomas en la regulación de la respuesta celular. 2) Diseño de estrategias de fito-remediación basadas en la selección de mutantes de *Arabidopsis* resistentes a metales pesados y su posterior uso biotecnológico en el desarrollo de especies de interés agrómico.

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*The mechanisms involved in plant responses to different types of abiotic (heavy metal, xenobiotic, drought) and biotic (pseudomonas infection) stress are studied from a multidisciplinary perspective at the biochemical, molecular and cellular level with the aim of applying the knowledge obtained to early stress monitoring and design of improved plant breeding strategies. The group focuses on two main lines of research: 1) the study of the function of peroxisomal ROS and RNS as signaling molecules in the*

*regulation of gene expression in response to stress. Particular attention will be paid to determining the role of peroxisomal dynamics in cell response regulation and 2) the design of phytoremediation strategies based on the selection of Arabidopsis mutants tolerant to heavy metals and their subsequent biotechnological application to developing species of agronomic interest.*

### **Objetivos PA 2014-2017**

El conocimiento de los mecanismos responsables de la percepción de estímulos externos y la especificidad de la respuesta celular a un determinado tipo de estímulo constituyen dos de los grandes retos de la biología vegetal. Para llevar a cabo este estudio se proponen los siguientes objetivos:

1. Estudio del papel de la dinámica de orgánulos y citoesqueleto en señalización y respuesta al estrés, tanto biótico como abiótico. Para abordar estos estudios disponemos del software, las líneas de Arabidopsis y la tecnología para estudiar el cross-talk entre orgánulos y la regulación de la dinámica de los mismos dependientes de ROS y NO en condiciones fisiológicas y de estrés. El estudio de los peroxisomas como sensores y efectores de la respuesta celular al estrés se aborda mediante el uso de técnicas sofisticadas de microscopía confocal y análisis de expresión de proteínas peroxisomales. Se dispone además de líneas de Arabidopsis que expresan biosensores de ROS asociados a peroxisomas y citosol para visualizar in vivo la producción de ROS en respuesta al estrés. La identificación de los componentes de la red de señalización que regulan la respuesta de estos orgánulos al estrés es también objeto de estudio mediante el uso de mutantes de Arabidopsis con niveles alterados de proteínas reguladoras, factores de transcripción y producción de ROS y NO. Además, se estudia la función de modificaciones postraduccionales (S-nitrosilación, nitración, oxidación y fosforilación) de proteínas en la regulación de la percepción de estrés y transducción de señales, así como el papel regulador de las fitohormonas ácido salicílico, etileno y ABA.

2. Identificación de genes esenciales en la tolerancia a distintos metales en suelos mineros contaminados para el diseño de estrategias de fito-remediación y recuperación de suelos degradados. Para ello se han seleccionado genes implicados en la tolerancia a metales pesados a partir de una colección de mutantes con inserción de T-DNA. A partir de los genes seleccionados se generarán plantas con niveles alterados de los mismos que se caracterizarán y evaluarán en cuanto a su fenotipo, crecimiento y capacidad para acumular metales en suelos mineros contaminados. Con los conocimientos adquiridos, se procederá a su posterior uso biotecnológico mediante el diseño de plantas de interés forestal y de utilidad en procesos de fito-remediación.

La consecución de estos objetivos se encuentra seriamente amenazada por distintos factores como consecuencia de la reducción drástica de los presupuestos dedicados a investigación. Esta situación afecta negativamente a la incorporación de estudiantes de Doctorado, contratación de Doctores y mejora de la deficiente infraestructura de nuestro Instituto.

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*The study of mechanisms involved in the perception of external stimuli and the specificity of cell responses to a particular type of stimulus constitute two major*

challenges in the field of plant biology. This study aims to achieve the following objectives:

1. To study the role of organelle and cytoskeleton dynamics in signaling and cell responses to stress, both biotic and abiotic. To carry out these studies, we have the appropriate software, Arabidopsis lines and the technology necessary to study cross-talk between organelles and the regulation of organelle dynamics dependent on ROS and NO under physiological and stress conditions. The study of peroxisomes as sensors and effectors of cell responses to stress is carried out using sophisticated confocal microscopy techniques and by analyzing peroxisomal gene expression. Arabidopsis lines expressing ROS biosensors associated with peroxisomes and cytosol are also available for in-vivo imaging of ROS production under stress conditions. The components of signaling networks involved in the regulation of peroxisomal responses to stress are also identified by using Arabidopsis mutants to show disturbances in regulatory proteins, transcription factors and ROS and NO production. The role of post-transductional modifications in proteins (S-nitrosylation, nitration, oxidation and phosphorylation) in the regulation of stress perception and signal transduction is also studied, as well as the regulatory role played by the phytohormones salicylic acid, ethylene and abscisic acid.

2. To identify essential genes for tolerance to different metals in polluted mining soils in order to design phytoremediation and recovery strategies for degraded soils. For this purpose, genes involved in metal tolerance have been selected from a collection of T-DNA Arabidopsis mutants. Plants with altered expression of selected genes will be obtained and characterized in terms of phenotype, growth rate and capacity to accumulate metals in contaminated mining soils. The knowledge acquired will be used for biotechnological purposes to design woody plants useful in relation to phytoremediation.

Achieving these objectives is under serious threat due to several factors as a result of the drastic reduction of budgets for research. This situation negatively affects the incorporation of PhD students, recruitment of Doctors and improving the deficient facilities from our Institute.

### **Personal de Plantilla**

Adela Olmedilla Arnal. Investigador Científico

Luisa María Sandalio González. Investigador Científico

María del Carmen Romero Puertas. Científico Titular

Juana Muñoz García. Técnico Especialista Grado Medio de OPIs

## **BIOLOGÍA REPRODUCTIVA DE PLANTAS**

### ***PLANT REPRODUCTIVE BIOLOGY***

Dpto. Bioquímica, Biología Celular y Molecular de Plantas

*Dpt. of Signalling, Stress and Development in Plants*

Área Científica: A4. Ciencias Agrarias

A4.2 Biología, bioquímica y fisiología vegetal

Disciplinas ERC: LS - LIFE SCIENCES

LS1 Molecular and Structural Biology and Biochemistry

Industrial Leadership: 4. Biotechnology

4.2. Biotechnology-based industrial processes

Societal Challenges: 2. Food security, sustainable agriculture, marine and maritime research and the bioeconomy

2.2. Sustainable and competitive agri-food sector for a safe and healthy diet

### **Descripción**

El grupo analiza desde una perspectiva multidisciplinar los procesos de reproducción sexual de las plantas, especialmente la gametogénesis masculina y femenina, la compatibilidad, la interacción polen-estigma y los mecanismos de atracción, fusión de gametos, y fertilización. Se investigan aspectos básicos y aplicados, esencialmente en el ámbito agronómico, nutricional y de salud (alergias).

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*The group analyzes plant sexual reproduction processes from a multidisciplinary point of view, particularly male and female gametogenesis, compatibility, pollen-stigma interaction, and the mechanisms of attraction, fusion of gametes and fertilization. Basic and applied aspects are investigated, mainly within the frame of an agronomic, nutritional and health (allergy) scope.*

### **Objetivos PA 2014-2017**

#### **OBJETIVOS GENERALES**

1) Identificar y caracterizar funcionalmente los productos génicos implicados en el desarrollo del polen y el pistilo, la receptividad estigmática, la germinación del polen y el crecimiento del tubo polínico, y las interacciones polen-pistilo. Estudiar las bases celulares y moleculares de la autoincompatibilidad y de los mecanismos de señalización implicados en la orientación del tubo polínico en el pistilo, con objeto de

optimizar la polinización, la fertilización, la calidad y la productividad en especies de interés agrícola y en especies modelo.

2) Estudiar los efectos de los factores ambientales adversos sobre la eficacia reproductiva y la producción en el olivo y otras especies de interés agronómico.

3) Determinar la variabilidad genética y funcional de las proteínas alergénicas del polen. Establecer las implicaciones del polimorfismo en la fisiología reproductiva de las plantas y en la evaluación clínica y la personalización de los tratamientos en pacientes alérgicos.

4) Caracterizar a nivel bioquímico y molecular las formas proteicas y lipídicas mayoritarias presentes tanto en los tejidos de la semilla como en distintos aceites de plantas de interés económico como el olivo, así como en los subproductos de su elaboración. Determinar su digestibilidad, alergenicidad y absorción intestinal, explorando usos adicionales que generen valor añadido.

#### OBJETIVOS ESPECÍFICOS

- Caracterizar el papel de las especies de oxígeno reactivo (ROS), del óxido nítrico (NO) y de los enzimas implicados en su metabolismo en la biología reproductiva de plantas con interés agronómico y con diferentes tipos de autoincompatibilidad polen-estigma.

- Identificar y caracterizar proteínas del polen y el pistilo implicadas en mecanismos de reconocimiento en el olivo y otras plantas modelo, analizando su función en el contexto de la incompatibilidad.

- Estudiar las proteínas y enzimas relacionados con la movilización de los lípidos de reserva (ej. caleosinas) en el polen. Implicaciones en la eficacia reproductiva y la producción en el olivo.

- Estudiar los efectos de la temperatura sobre el desarrollo del polen y su viabilidad y capacidad para germinar, y sobre el desarrollo y el número de óvulos/sacos embrionarios y su viabilidad en distintos cultivares de olivo.

- Buscar marcadores moleculares relacionados con el estrés por temperatura en los tejidos reproductivos del olivo mediante herramientas de transcriptómica y proteómica. Papel de las heat shock proteins en la eficiencia reproductiva.

- Analizar el polimorfismo molecular de las proteínas alergénicas del polen en cultivares de olivo y otras especies de interés alergogénico.

- Caracterizar funcionalmente el polimorfismo y la expresión génica diferencial de alérgenos relevantes en los órganos reproductivos.

- Determinar las implicaciones del polimorfismo alergénico en cuanto al diagnóstico y tratamiento de la alergia.

- Definir histológicamente las semillas del olivo y otras especies de interés



- Caracterizar a nivel bioquímico y molecular las formas proteicas mayoritarias y las actividades enzimáticas presentes en estas semillas.
- Caracterizar las formas proteicas presentes en aceites virgen y refinados, y en los subproductos de su elaboración.
- Ensayar la digestibilidad, alergenicidad y absorción intestinal de estas proteínas, y explorar usos adicionales de los subproductos.

El cumplimiento de estos objetivos no está garantizado debido a la actual situación de crisis económica e institucional. Tampoco se puede garantizar la continuidad de la estructura del grupo en términos de personal, financiación (incluidos los proyectos en marcha), ni las técnicas y equipamientos disponibles, o las inversiones previstas o potenciales.

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### MAIN OBJECTIVES

*1) Identify, characterize and perform functional analyses of the gene products involved in pollen and pistil development, the establishment of stigmatic receptivity, pollen germination, pollen tube growth and pollen-pistil interactions. Study the cell and molecular basis of self-incompatibility and the signaling mechanisms involved in pollen tube guidance through the pistil, with the purpose of optimizing pollination, fertilization, quality and productivity of plant species of agronomic interest as well as in model species.*

*2) Study the effects of adverse environmental factors on both reproductive efficiency and yield in the olive tree and other plants of agronomical interest*

*3) Determine genetic and functional variability of pollen allergenic proteins. Establish the implications of polymorphism in plant reproductive physiology and in the clinical assessment and personalization of treatments for allergic patients.*

*4) Characterize at the biochemical and molecular levels the major forms of proteins and lipids present in the seed tissues and oils from plants of economical interest like the olive tree, as well as in by-products generated during their elaboration. Determine their digestibility, allergenicity and intestinal absorption, exploring additional uses able to generate added value.*

### SPECIFIC OBJECTIVES

*-To characterize the role of Reactive Oxygen Species (ROS), nitric oxide (NO) and the enzymes involved in their metabolism in the reproductive biology of plants with agronomical interest and different types of self-incompatibility pollen-stigma.*

*- Identify and characterize pollen and pistil proteins involved in recognition mechanisms in the olive tree and other plant model species, analyzing their function in the frame of the different self-incompatibility models already described.*

*- Study proteins and enzymes involved in storage lipid mobilization (e.g. caleosins, TAG, lipases) in pollen. Implications in reproductive efficacy and yield in the olive.*

- *Study the effects of temperature upon pollen development and its viability and ability to germinate, and on the development and number of ovules/embryo sacs and their viability in different olive cultivars.*
- *Search for molecular markers involved in temperature stress in the olive reproductive tissues by means of transcriptomic and proteomic tools. Role of heat shock proteins in reproductive efficiency.*
- *Analyze molecular polymorphism of allergenic proteins in pollen from different olive cultivars and other species of allergogenic interest.*
- *Characterize at the functional level the polymorphism and differential gene expression of relevant allergens in reproductive organs.*
- *Determine the implications of allergen polymorphism in allergy diagnosis and treatment*
- *Define histologically the seeds from the olive tree and other plant species of interest.*
- *Characterize at the biochemical and molecular levels the major protein forms and the enzyme activities present in these seeds.*
- *Characterize the protein forms present in virgin and refined olive oils, and in the subproducts of its elaboration.*
- *Assay digestibility, allergenicity and intestinal absorption of these proteins, and explore additional uses for these subproducts.*

*Fulfilment of the objectives described above is not guaranteed under the present economic and institutional situation. Same applies to the current structure of the group in terms of personnel, funding (even on-going projects and contracts), techniques and equipment available or foreseen/potential investments.*

### **Personal de Plantilla**

Juan de Dios Alché Ramírez. Investigador Científico.

Antonio Jesús Castro López. Científico Titular

M<sup>a</sup> Isabel Rodríguez García. Profesor de Investigación Ad honorem

## HOMEOSTASIS IÓNICA Y TRANSPORTADORES DE MEMBRANA

### ION HOMEOSTASIS AND MEMBRANE TRANSPORTERS

Dpto. Bioquímica, Biología Celular y Molecular de Plantas

*Dpt. of Signalling, Stress and Development in Plants*

Área Científica: A4. Ciencias Agrarias

A4.1 Agrobiotecnología y mejora vegetal

Disciplinas ERC: LS - LIFE SCIENCES

LS1 Molecular and Structural Biology and Biochemistry

Industrial Leadership: 4. Biotechnology

4.2. Biotechnology-based industrial processes

Societal Challenges: 2. Food security, sustainable agriculture, marine and maritime research and the bioeconomy

2.1. Sustainable agriculture and forestry

#### Descripción

Se investiga la funcionalidad de transportadores implicados en la homeostasis de Na<sup>+</sup> y K<sup>+</sup> y sus proteínas reguladoras de Arabidopsis y tomate con el fin de evaluar su potencial biotecnológico en la mejora de uso del agua, nutrición del potasio y tolerancia a la salinidad.

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*We use an integrated approach to study the biochemical and molecular mechanisms of ion homeostasis in plants in order to develop biotechnological applications to improve salt tolerance, mineral nutrition and water use efficiency in crop plants.*

#### Objetivos PA 2014-2017

Investigar, desde un enfoque integrado, los mecanismos bioquímicos y moleculares de la homeostasis iónica en plantas, con el fin de desarrollar aplicaciones biotecnológicas implicadas en la tolerancia salina y en el aumento de la eficiencia en la nutrición mineral y del uso del agua en plantas de interés agronómico. La identificación y la función de los genes que codifican a sistemas de transporte de Na<sup>+</sup>, K<sup>+</sup> y H<sup>+</sup> y sus proteínas reguladoras (NHX, SOS, CHX, CCX, HKT, NhaD and KEA) son objeto de investigación en sistemas modelo heterólogos (E. coli, levadura y Arabidopsis) y en plantas de interés agronómico (tomate). Para lograr este propósito nos servimos del análisis funcional in vitro e in vivo. Los enfoques in vitro conllevan la purificación y la reconstitución de proteínas de membrana en liposomas, para la determinación de su actividad de transporte, mientras que el análisis funcional in vivo se basa

principalmente en uso de mutantes y en experimentos de sobreexpresión y silenciamiento génico (RNAi) en Arabidopsis y tomate.

#### Problemas

El principal problema viene derivado de las dificultades actuales de financiación del CSIC y los recortes presupuestarios de I+D por parte del MINECO, que han supuesto un retraso en la apertura y resolución de la convocatoria de proyectos, así como en algunos casos el incumplimiento de los plazos para aportar la dotación presupuestaria de proyectos concedidos de fondos regionales. Todo ello ha repercutido en los recursos humanos del grupo y las posibilidades de mantener el personal formado debido a la paralización de contratación en el CSIC. Esta situación se agrava debido a la ausencia de programas de becas FPU y la supresión de los programas JAE del CSIC. En relación al espacio nuestros laboratorios están ubicados en un edificio antiguo y poco funcional.

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*We use an integrated approach to study the biochemical and molecular mechanisms of ion homeostasis in plants in order to develop biotechnological applications to improve salt tolerance, mineral nutrition and water use efficiency in crop plants. The identification and function of transport systems of Na<sup>+</sup>, K<sup>+</sup> and H<sup>+</sup> and their regulatory proteins (NHX, SOS, CHX, CCX, HKT, NhaD and KEA) are investigated in model systems (yeast and Arabidopsis) and crop plants (tomato). For this purpose we use in vitro and in planta functional analysis. In vitro approaches imply membrane protein purification and reconstitution in liposomes, whereas in planta analysis is mainly based on gene overexpression and silencing (RNAi) experiments (Arabidopsis and tomato).*

*The main difficulties are imposed by the present situation in the CSIC and budgets cuts in R&D from the competent Ministry (MINECO). This has caused delays in the opening and resolution of research funding calls. Additionally, research funds of already approved proposals have not been released on time. Budget cuts have had important consequences on human resources of our research group making it impossible to retain or hire highly qualified personnel. The situation has become even more critical due to the withdrawal of several fellowship programmes (FPU, JAE) and shortage in programmes like Juan de la Cierva and Ramón y Cajal.*

*Apart from this, other problems are derived from our laboratories located in not quite functional buildings.*

#### **Personal de Plantilla**

Andrés Belver Cano. Científico Titular

Raquel Olías Sánchez. Científico Titular

M<sup>a</sup> del Pilar Rodríguez Rosales. Científico Titular

Cornelis Venema. Científico Titular

Isabel Gaspar Vidal. Ayudante de Investigación I+D+i

María Elena Sánchez Romero. Personal Laboral

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## REGULACIÓN REDOX, SEÑALIZACIÓN POR AZÚCARES Y RESPUESTA A ESTRÉS BIÓTICO Y ABIÓTICO DEL PROCESO FOTOSINTÉTICO

### *REDOX REGULATION, SUGAR SIGNALLING AND RESPONSE AGAINST BIOTIC AND ABIOTIC STRESS OF THE PHOTOSYNTHETIC PROCESS*

Dpto. Bioquímica, Biología Celular y Molecular de Plantas

*Dpt. of Signalling, Stress and Development in Plants*

Área Científica: A4. Ciencias Agrarias

A4.2 Biología, bioquímica y fisiología vegetal

Disciplinas ERC: LS - LIFE SCIENCES

LS1 Molecular and Structural Biology and Biochemistry

Industrial Leadership: 7. Other

7.1. Other

Societal Challenges: 2. Food security, sustainable agriculture, marine and maritime research and the bioeconomy

2.1. Sustainable agriculture and forestry

### **Descripción**

Se estudia la regulación en plantas de sistemas antioxidantes y la señalización por azúcares en el metabolismo de carbohidratos así como los mecanismos vegetales de tolerancia a estrés biótico y abiótico mediante técnicas bioquímicas, moleculares, proteómicas y de imagen.

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*We study the regulation of antioxidant systems in plants and sugar signaling in carbohydrate metabolism and the mechanisms of plants tolerance to biotic and abiotic stress by biochemical, molecular, proteomic and imaging techniques.*

### **Objetivos PA 2014-2017**

La regulación redox es una característica esencial de los cloroplastos y las mitocondrias en la que las tiorredoxinas (Trxs), proteínas implicadas en el intercambio disulfuro/ditiol, juegan un papel fundamental. Ambos orgánulos son esenciales en la respuesta a estrés biótico y abiótico de la planta. Partiendo de estas premisas, el grupo aborda el estudio de: A.-La señalización por azúcares y la regulación redox de las enzimas implicadas en el metabolismo carbonado a través de las Trxs, así como el análisis del papel de estas enzimas en el balance sacarosa/almidón de plantas . B.- El papel de las Trxs, peroxirredoxinas (Prxs) y sulfirredoxinas (Srxs) en la señalización postraduccional durante el estrés oxidativo.C.- El uso de técnicas de imagen no

invasivas (fluorescencia y termografía) para el seguimiento de situaciones de estrés biótico y abiótico.

Los resultados obtenidos en los últimos años se resumen en: A.- Se ha descubierto una nueva isoforma plastidial de fructosa-1,6-bifosfatasa (cpFBPasa2) en plantas y se han localizado Trxs cloroplastídicas en tejidos heterotróficos. B.- Se tienen evidencias de que las Trxs, Prxs y Srxs podrían estar implicadas en los procesos de señalización postraduccionales. Se ha demostrado que la forma sobreoxidada de la Prx IIF mitocondrial es regenerada mediante una Srx usando como agente reductor la Trx. C.- Se han desarrollado métodos de seguimiento de infecciones por patógenos virales y bacterianos mediante captura de imágenes de fluorescencia multiespectral (roja, azul, verde) y termografía. Se han evaluado los cambios en el proteoma cloroplastídico y en el sistema antioxidante de la planta inducidos por los patógenos anteriores.

Los objetivos definidos para cada campo son:

A.1.- Analizar el papel de las tres fructosa-1,6-bifosfatasas (FBPasas), 2 cloroplastídicas y una citosólica, de plantas en la síntesis y distribución de los azúcares durante el metabolismo del carbono y en situaciones de estrés. Evaluar su potencial aplicación biotecnológica para mejorar el contenido de sacarosa o almidón en cultivos de interés agrícola destinados a la alimentación o a la producción de combustible.

A.2.- Desarrollar estudios básicos sobre el papel de los azúcares, no solo como fuente de carbohidratos para el desarrollo de las plantas sino también como moléculas señalizadoras en el control de los procesos metabólicos.

A.3.- Identificar la función y las dianas de las Trxs cloroplastídicas implicadas en procesos de regulación redox post-traducciona, tanto en tejidos fotosintéticos como heterotróficos.

B.1.- Identificar proteínas mitocondriales diana de Srx, susceptibles de glutationilación junto con el patrón de proteínas mitocondriales capaces de glutationalizarse.

B.2. ¿Valorar el papel de la Srx en la regulación de la glutationilación/desglutinationilación de la 2-Cys Prx cloroplastídica y Prx IIF mitocondrial y determinar los aminoácidos implicados en esta actividad.

B.3.- Identificar los cambios en el patrón de proteínas mitocondriales glutationalizadas en plantas control y knockout en Srx, en condiciones de estrés salino.

C.1.- Evaluar el impacto de infecciones por patógenos (virus, bacterias y hongos) en el metabolismo primario y secundario de la planta.

C.2.- Desarrollo de métodos de diagnóstico presintomático de estrés biótico y abiótico mediante técnicas de imagen como fluorescencia (roja y multiespectral) y termografía. Uso de estas técnicas para la evaluación de mutantes de la planta resistentes a estrés y de patógenos afectados en su nivel de virulencia.

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*Redox regulation is an essential characteristic of chloroplasts and mitochondria where thioredoxins (Trxs), proteins involved in the exchange disulfide/dithiol, play a key role.*

Both organelles are very important in the plant response against biotic and abiotic stress.

In this frame, the objectives of our research are:

A.- Study the sugar signalling and redox regulation of the enzymes involved in the carbon metabolism through Trxs and the role of these enzyme in the control of the sucrose/starch balance in plants.

B.- Investigation of the role of Trxs, peroxiredoxins (Prxs) and sulfiredoxins (Srxs) in the post-translational signalling during oxidative stress

C.- Use of non-invasive imaging techniques (thermography and fluorescence) for diagnosis of biotic and abiotic stress.

Results obtained in the last years can be summarized in: A.- Finding of a new plastidic isoform of fructose-1,6-biphosphatase 2 and chloroplastidic Trxs in heterotrophic tissues. B.- Evidences that Trxs, Prxs and Srxs could be involved in post-transductional signalling processes and that Prx IIF is regenerated from its overoxidized form by Srx, using as reducing agent Trx. C.- Development of new methods for detection of viral and bacterial infection in plants using thermal and fluorescence (blue, green and red) imaging. Evaluation of the pathogen-induced changes in the chloroplast proteome and antioxidant system of the host plant.

The future objectives for each research line are:

A. 1- To analyze of the function of the two plastidial and the cytosolic FBPases in the synthesis and distribution of sugars during C metabolism, as well as under stress situations. And evaluate the potential biotechnological application to improve either the sugar or starch content in crop plants for food or biofuels.

A.2. - To identify new sugar signalling pathway in plants.

A.3. - To identify the function and targets of chloroplastidic Trxs involved in post-translational redox regulation in photosynthetic and heterotrophic tissues.

B.1. - To identify glutathionylated targets of Srx in the mitochondria, as well as mitochondrial proteins capable of glutathionylation.

B.2. - To study the role of Srx in the regulation of glutathionylation/deglutathionylation of chloroplastic 2-Cys Prx and mitochondrial Prx IIF, and determination of the amino acids involved in this activity.

B.3. - To identify the changes in the pattern of mitochondrial glutathionylated proteins in control plants and knockout in Srx, under salt stress.

C.1.- To evaluate the impact of pathogens (virus, bacteria and fungi) in the primary and secondary metabolism of the host plant.

C.2.- Development of imaging methods (thermography, multispectral fluorescence and kinetic of red fluorescence) for phenotyping, mutant (from plants and pathogens) characterization and presymptomatic detection of biotic and abiotic stress.

## **Personal de Plantilla**

Matilde Barón Ayala. Investigador Científico

Juan José Lázaro Paniagua. Investigador Científico

Mariam Sahrawy Barragán. Investigador Científico

Antonio Jesús Serrato Recio. Científico Titular

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## **PRODUCCIÓN DE PEQUEÑOS RUMIANTES**

### ***SMALL RUMINANTS PRODUCTION***

Dpto. Fisiología y Bioquímica de la Nutrición Animal

*Department of Physiology and Biochemistry of Animal Nutrition*

Área Científica: A4. Ciencias Agrarias

A4.4 Producción y sanidad animal

Disciplinas ERC: LS - LIFE SCIENCES

LS9 Applied Life Sciences and Non-Medical Biotechnology

Industrial Leadership: 4. Biotechnology

4.3. Innovative and competitive platform technologies

Societal Challenges: 2. Food security, sustainable agriculture, marine and maritime research and the bioeconomy

2.2. Sustainable and competitive agri-food sector for a safe and healthy diet

## **Descripción**

La actividad del grupo está orientada al desarrollo de sistemas de producción de rumiantes sostenibles, eficientes, con un mínimo impacto ambiental y que generen productos de calidad nutritiva y saludables para el consumidor, teniendo en cuenta el bienestar animal.

Las investigaciones que el grupo lleva a cabo se centran en la Nutrición del Rumiante y tratan de desarrollar estrategias alimenticias que permitan disminuir el coste de la dieta, mantener la salud del animal y optimizar la fermentación ruminal. La identificación y estudio de los mecanismos de acción de los microorganismos del



rumen, implicados en procesos de especial importancia como la metanogénesis (formación de metano) y la biohidrogenación (transformación de ácidos grasos insaturados en saturados), forman también parte de la actividad investigadora del grupo.

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*The research group aims to develop production systems for ruminants which are sustainable, efficient, with minor environmental impact, yielding high nutritive quality and consumer-healthy products without compromising animal welfare.*

*The activities focus on the nutrition of the ruminant and work on develop feeding strategies to lower the cost of the diet and paying special attention on the optimization of the ruminal fermentation. Identifying the main mechanisms of action of those rumen microorganisms involved in methane production and fatty acids biohydrogenation are key areas of work in the group.*

### **Objetivos PA 2014-2017**

La actividad del grupo se enmarca en áreas prioritarias del H2020: "Climate change and energy sustainability", "waste" y "blue growth"

Los objetivos de la actividad científica del grupo para los próximos años son los siguientes:

1. Valoración nutritiva de materias primas convencionales y no convencionales (subproductos, destríos, algas) como estrategias para reducir el coste de la ración en rumiantes, que sean saludables para el animal y que permitan optimizar la fermentación ruminal.

El coste de la alimentación representa alrededor del 70-80% del coste total de producción. Su disminución es esencial para rentabilizar la producción animal y el uso de material primas no convencionales puede contribuir de manera importante a la consecución de ese objetivo.

El suministro al rumiante de dietas que incluyen subproductos agroindustriales, destríos de cosechas o algas pueden aportar un interesante valor añadido a la salud del animal y su bienestar así como a la calidad de carne, leche y derivados lácteos. Los compuestos secundarios y otros, como los ácidos grasos, presentes en esas materias primas pueden aportar propiedades antioxidantes o antimetanogénicas y pueden también modular la biohidrogenación de ácidos grasos permitiendo obtener alimentos funcionales de origen animal. Por otro lado, la reducción de las emisiones de metano en rumiantes es esencial para minimizar el impacto ambiental de la producción animal dado su gran potencial como gas con "efecto invernadero" .

2. Estudio de los efectos y mecanismos de acción de una serie de aditivos (extractos de plantas, aceites esenciales, aditivos sintéticos) y probióticos sobre el aprovechamiento de nutrientes, la fermentación y la microbiota ruminal, especialmente en aspectos relacionados con la metanogénesis y la biohidrogenación.

3. Estudio del potencial de tecnologías in vitro para simular la fermentación ruminal, en distintas condiciones experimentales, y de la posibilidad de reducir el uso de animales en experimentación

4. Estudio del papel del ecosistema microbiano del rumen en la respuesta digestiva del animal hospedador en relación a la dieta que se consume. Estudio de intervenciones nutricionales en los primeros días de vida del animal para dirigir la colonización microbiana del rumen con objeto de obtener animales más eficientes. Esta línea contempla el estudio de los distintos factores implicados en la íntima relación que existe entre el animal y el microbioma del rumen, como el sistema inmune o el manejo del animal y su madre en el período de pre-destete.

El desarrollo de la actividad del grupo en el periodo de este PE se verá comprometido por una serie de limitaciones en cuanto a:

- Personal y gestión: Un cuidador y un gestor, con formación sanitaria y en bienestar animal son esenciales para mantener las instalaciones del animalario y los animales en las condiciones que establece la nueva normativa en cuanto a uso de animales en experimentación.

- Equipamiento. También las principales necesidades del grupo se centran en el animalario. Se requiere una mejora de las instalaciones en cuanto a las condiciones ambientales e higiénicas (aislamiento, ventilación, sombra/refugios, vallados perimetrales, bebederos y comederos) y de espacio adicional.

- Financiación: la disponibilidad de fondos será indudablemente reducida durante este periodo aunque el grupo ha solicitado varios proyectos de investigación nacionales, bilaterales y europeos.

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*The activity is part of H2020 priority areas: " Climate change and energy sustainability" "waste " and "blue growth"*

*The objectives of the scientific activity for the coming years are the following:*

*1. Nutritional evaluation of conventional and unconventional (By-products,wastes, seaweeds) feedstuffs as strategies to reduce the cost of ruminants feeding, healthy for the animal and able to optimize rumen fermentation .*

*The cost of food accounts for about 70-80% of the total cost of production. To reduce feeding cost is now essential to the profitability of animal production and the use of unconventional diet ingredients could contribute very much to achieve thist objective.*

*The supply to ruminant of diets including by--products, wastes or algae can bring an interesting added value to the animal's health and welfare and the quality of meat, milk and dairy products. Secondary compounds and other plant componets such asfatty acids, can provide antioxidant and antimethanogenic properties and may also modulate fatty acid biohydrogenation in the rumen allowing the production of functional foods from ruminants. On the other hand, the reduction of methane emissions in ruminants is essential to minimize the environmental impact of animal production given its huge potential as a gas with "greenhouse effect".*

*2. Study of the effects and mechanisms of action of a number of additives (plant extracts, essential oils, synthetic compounds) and probiotics on the utilization of nutrients, ruminal fermentation and microbiota, especially in areas related to the methanogenesis and the biohydrogenation.*

3. *Study of the potential of in vitro technologies to simulate rumen fermentation in different experimental conditions and the possibility of reducing the use of experimental animals*

4. *Study of the role played by the rumen microbial ecosystem on the digestive efficiency of the host animal in relation to its diet. Study of the nutritional intervention applied on the early life of the animals to manipulate the microbial colonisation of their rumen to obtain more efficient animals. This research includes the study of the different factors involved in the high animal-microbiome specificity such as the immune system development and the nutritional management of the offspring and does during the pre-weaning period.*

*The development of the group's activities in the period of this EP will be compromised by a number of limitations in terms of:*

*- Staff and Management: A caretaker and manager with animal welfare and health training are essential to run animal housing facilities and animals under the conditions required by the new with regulations regarding use of animals in experimentation*

*- Equipment: The main needs of the group will focus on the animals management. Enhanced facilities regarding environmental and hygienic conditions (isolation, ventilation, shade / shelter, fencing perimeter, watering and feeding) and extra space are required.*

*- Financing: the availability of obtaining funds will undoubtedly be reduced during this period although the group has applied for several national, bilateral and European research projects.*

#### **Personal de Plantilla**

Eduarda Molina Alcaide. Profesor de Investigación

A. Ignacio Martín García. Científico Titular

David R. Yáñez Ruiz. Científico Titular

Alejandro Muñoz Martínez. Ayudante de Investigación de OPIs

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#### **BIODISPONIBILIDAD DE MINERALES**

#### **BIOAVAILATIBITY OF MINERALS**

Dpto. Fisiología y Bioquímica de la Nutrición Animal

*Department of Physiology and Biochemistry of Animal Nutrition*

Área Científica: A7. Ciencias y Tecnologías de Alimentos

## A7.1 Alimentos funcionales y Nutrición

Disciplinas ERC: LS - LIFE SCIENCES

LS4 Physiology, Pathophysiology and Endocrinology

Industrial Leadership: 7. Other

7.1. Other

Societal Challenges: 2. Food security, sustainable agriculture, marine and maritime research and the bioeconomy

2.2. Sustainable and competitive agri-food sector for a safe and healthy diet

### Descripción

La línea de investigación del grupo se ubica en la interacción Dieta-Salud y su actividad se enfoca hacia la nutrición y metabolismo mineralo-proteico en el contexto de la nutrición experimental, humana y animal.

Contempla la digestibilidad y metabolismo de los nutrientes, así como las repercusiones sobre el status nutritivo, en dependencia de factores propios del individuo y de la dieta que los aporta. La investigación se dirige hacia el conocimiento de la influencia de los tratamientos térmicos de los alimentos en la biodisponibilidad de los nutrientes. A la vez, se analizan previsibles repercusiones de su consumo sobre la salud: efecto sobre la respuesta al estrés oxidativo y su posible contribución al desarrollo de enfermedades degenerativas.

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*The research line is focused on the interaction between diet and health, with particular attention to mineral and protein nutrition in the context of human and animal nutrition. This research line examines, on the one hand, the digestibility and metabolism of nutrients, and on the other, the effects on nutritional status, analysing the influence of individual factors and those related to the diet consumed.*

*Current research activity is mainly centred on the influence of heat treatment on foods on nutrients bioavailability. In addition, we are examining the possible effects of processing-derived-compounds on health, in areas such as the response to oxidative stress and the possible contribution to the development of degenerative diseases.*

### Objetivos PA 2014-2017

Contribuir al conocimiento básico orientado de la digestibilidad y metabolismo mineralo-proteico en dependencia de factores propios del individuo y de su dieta, tratando de profundizar en la relación dieta-salud. Actualmente se plantea:

- Estudiar la influencia y mecanismos de acción de compuestos originados en la Reacción de Maillard (PRMs) sobre la biodisponibilidad de nutrientes, estrés oxidativo, metabolismo y funcionalidad de hueso, etc.

- Contribuir al conocimiento de la absorción de PRMs y de sus posibles efectos metabólicos en prevención de enfermedades degenerativas óseas que afectan a hombres y animales.
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*The main objective of this research line is contribution to the knowledge of the digestibility and metabolism of minerals and protein, in relation to specific factors from the individual and those from the diet, trying to deepen the diet-health relationship.*

*Currently, there are the following partial objectives:*

- *To study the effects and mechanism of action of compounds originating from the heating reactions (the Maillard reaction products, PRMs) on nutrient bioavailability, oxidative stress, metabolism and functionality of bone, etc..*
- *To contribute to the knowledge of the absorption of PRMs and their metabolic effects in preventing bone degenerative diseases affecting humans and animals*

### **Personal de Plantilla**

Isabel Seiquer Gómez-Pavón. Científico Titular

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## **NUTRICIÓN ANIMAL**

### **ANIMAL NUTRITION**

Dpto. Fisiología y Bioquímica de la Nutrición Animal

*Department of Physiology and Biochemistry of Animal Nutrition*

Área Científica: A4. Ciencias Agrarias

A4.4 Producción y sanidad animal

Disciplinas ERC: LS - LIFE SCIENCES

LS9 Applied Life Sciences and Non-Medical Biotechnology

Industrial Leadership: 7. Other

7.1. Other

Societal Challenges: 2. Food security, sustainable agriculture, marine and maritime research and the bioeconomy

2.2. Sustainable and competitive agri-food sector for a safe and healthy diet

## Descripción

Actividad centrada en el estudio de la utilización de nutrientes y energía para la realización de funciones fisiológicas específicas en monogástricos y su aplicación en sistemas de producción animal, basados en razas autóctonas, sostenibles y respetuosos con el medio ambiente. Adicionalmente, se estudiarán los efectos y mecanismos de acción de sustancias con actividad biológica, susceptibles de ser utilizados en el desarrollo de los sistemas de producción mencionados.

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*The activity will focus on nutrient and energy utilization in specific physiologic processes of monogastric animals. It is intended to use this knowledge in sustainable and environmentally friendly animal production systems based on landraces, native breeds. Additionally, the effects and mechanisms of action of biologically active substances intended to be used in the aforementioned animal production systems will be explored.*

## Objetivos PA 2014-2017

La actividad del grupo va encaminada al estudio de la utilización de los nutrientes y la energía por el organismo animal y a la identificación de procesos y compuestos específicos que intervienen en la respuesta metabólica a la ingestión de alimentos.

Estas actividades se llevarán a cabo con razas ganaderas autóctonas, esencialmente porcinas, que presentan una mayor adaptación a las condiciones de producción local y dan lugar a productos de calidad, con identidad regional reconocida y apreciados por el consumidor. De esta forma también se contribuirá al mantenimiento y expansión de estas razas locales. Por otra parte, se ajustarán de forma precisa los sistemas de alimentación empleados a las necesidades nutricionales propias de estas razas, persiguiendo con ello que los sistemas de producción sean más eficientes y generen un menor impacto ambiental. Adicionalmente, se estudiará el empleo como ingredientes potenciales para la elaboración de dietas prácticas subproductos locales de origen agroindustrial. Estas propuestas, que esencialmente recoge y amplía la actividad que el grupo viene realizando durante los últimos años, puede enmarcarse plenamente en el programa Food Security, sustainable agriculture, marine and maritime research and the bio-economy, recogidos en Horizonte 2020. Como objetivos específicos podemos señalar:

- a) ampliar la base de datos sobre necesidades nutricionales de razas porcinas locales de la que actualmente dispone el grupo, con información sobre nuevas razas y variedades porcinas autóctonas, fundamentalmente del tronco Ibérico.
- b) estudiar los efectos biológicos y los mecanismos de acción de sustancias con actividad biológica, presentes en los alimentos o incorporadas a ellos, fundamentalmente los relacionados con la eficiencia en el uso de nutrientes, y la calidad y propiedades saludables de los productos de origen animal.
- c) explorar el empleo de subproductos locales de origen agroindustrial como fuente adicional de aminoácidos y energía en la dietas de porcino.

La consecución de estos objetivos a corto y medio plazo está sujeta, de una parte, a la superación o alivio de la actual situación de crisis económica general, que ha dado lugar a un detrimento sustancial de los fondos destinados a investigación, pero también a otros factores específicos. Entre ellos destacamos, por sus consecuencias directas sobre la actividad científica del grupo, la carencia de personal técnico de apoyo fijo. Además, para el desarrollo de los experimentos que implican la consecución de los objetivos descritos contamos en la actualidad con dos importantes limitaciones: la carencia en el centro de personal técnico experto en el cuidado y mantenimiento de animales de experimentación, y de instalaciones adecuadas para la realización de estos experimentos, pues las existentes son insuficientes para poder llevar a cabo proyectos de investigación y contratos con empresas. A todo ello se une el éxodo a centros de reconocido prestigio internacional al que se han visto obligados los doctores formados en el grupo los últimos años, situación muy deseable y necesaria en el periodo de formación de un científico, pero que, lamentablemente, las circunstancias actuales van a forzar a que se torne en definitiva, con la consecuente pérdida de capital humano que esto supone para los grupos de investigación y para el CSIC.

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*The activity of the team is focused on the study of energy and nutrient utilization in the monogastric animal and on the identification of processes and specific compounds involved in the metabolic response to feed intake.*

*Such activity will be carried out on native breeds, particularly on local porcine breeds – known to have a wide genetic variation- which show a high adaptability to local production systems and give rise to high-quality products with a regional identity and highly appreciated at the market. They, however, show comparatively lower productivity than the modern, high yielding, conventional breeds. In this way, a contribution to the preservation and development of the diversity of local breeds will also be made. On the other hand, the efficiency of livestock production systems will be optimized by accurately defining the nutritional requirements of these local breeds and by increasing the quality and nutritional value of their products, while decreasing the environmental footprint associated. Whenever possible, local by-products will be involved in practical feeding and production systems.*

*This proposal, which essentially is a step on the current activity of our research group, can be considered within the frame of the program Food Security, sustainable agriculture, marine and maritime research and the bio-economy from the Horizon 2020. Specific objectives are:*

*a) to widen our current data base on nutritional requirements of native porcine breeds with additional information on new native strains, mainly linked to the Iberian stem.*

*b) to study the biological effects and mechanism of action of substances with biological activity present in feedstuffs or incorporated to them. Among these, we will pay particular attention to those which may alter the efficiency of nutrient utilization and the quality and healthy properties of animal products.*

*c) to explore the use of local by-products as ingredients in practical balanced diets.*

*The achievement of these objectives in the short- and medium-term is, first of all, conditioned to surpassing the actual shortage of funds for research purposes derived from the economic crisis. Nevertheless, there are other factors involved. Among them, particular importance should be given to the lack of technical permanent staff. In addition to this, two important limitations constrain our activities: lack of specialized staff for handling and caring of experimental animals, along with the limited facilities to carry out large animal experiment. Our current facilities are a bottle neck limiting our capacity to develop research projects and contracts. An additional issue is that all of the doctors trained in the group during the last years are now working abroad in research centers of reference or outstanding companies. This fact evidences their high qualification and competence but, at the same time, implies a great loss of human resources for us and for the CSIC.*

### **Personal de Plantilla**

José Fernando Aguilera Sánchez. Profesor de Investigación

Rosa María Nieto Liñán. Investigador Científico

Ignacio Fernández-Fígares Ibáñez. Científico Titular

Manuel Lachica López. Científico Titular

Luis Lara Escribano. Técnico Especialista Grado Medio de OPIS

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## **SALUD GASTROINTESTINAL**

### ***GASTROINTESTINAL HEALTH***

Dpto. Fisiología y Bioquímica de la Nutrición Animal

*Department of Physiology and Biochemistry of Animal Nutrition*

Área Científica: A4. Ciencias Agrarias

A4.4 Producción y sanidad animal

Disciplinas ERC: LS - LIFE SCIENCES

LS9 Applied Life Sciences and Non-Medical Biotechnology

Industrial Leadership: 7. Other

7.1. Other

Societal Challenges: 2. Food security, sustainable agriculture, marine and maritime research and the bioeconomy



## 2.2. Sustainable and competitive agri-food sector for a safe and healthy diet

### Descripción

La actividad del grupo se centra en el estudio de las interacciones entre la composición química de la dieta y determinados parámetros fisiológicos y saludables del organismo que la consume. Así, se estudian aspectos como la utilización digestiva y metabólica de nutrientes, y los efectos fisiológicos a nivel local (intestino) o sistémico de fracciones químicas de los alimentos (proteínas, carbohidratos, fibra, etc.). Se presta especial atención al estudio de los mecanismos de acción y efectos biológicos, tanto de carácter nutricional como no-nutricional, de sustancias activas presentes en los alimentos o añadidos a la dieta (prebióticos, inhibidores de proteasas, agentes antibacterianos), particularmente en relación con los efectos sobre la composición de la microbiota digestiva. El objetivo final es mejorar el estado sanitario, la productividad, la sostenibilidad y el impacto medioambiental de las explotaciones animales, así como colaborar en el diseño una alimentación más saludable.

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*The group's activity focuses on the study of the interactions between the chemical composition of the diet and certain physiological and health parameters. Thus, issues such as digestive and metabolic utilization of nutrients, and the physiological effects at both local (intestine) or systemic levels of chemical fractions of foods (proteins, carbohydrates, fiber, etc.) are studied. Special attention is paid to the study of the mechanisms of action and nutritional and/or non-nutritional biological effects of active substances in food or added to the diet (prebiotics, protease inhibitors, antibacterial), particularly in relation with the effects on the digestive microbiota composition. The ultimate goal is to improve health, productivity, sustainability and environmental impact of farm animals and help design a healthier diet.*

### Objetivos PA 2014-2017

Los objetivos del grupo Salud Gastrointestinal (AGR259) se refieren fundamentalmente a los recogidos en los diversos proyectos vigentes y en los que han sido recientemente solicitados.

La actividad 1 del grupo se relaciona con el estudio de la utilización digestiva y metabólica de nutrientes por medio de la evaluación de los efectos fisiológicos a nivel local (intestino) o sistémico de fracciones químicas de los alimentos (proteínas, carbohidratos, fibra, etc.). En esta actividad se encuadran los objetivos correspondientes a 2 proyectos vigentes: PET2008-0311 (Efectos biológicos de proteínas del guisante) y AGL2011-26353 (Propiedades anti-proliferativas de los inhibidores Bowman-Birk de leguminosas en modelos celulares de colon. Identificación de serin proteasas como dianas terapéuticas). Dichos objetivos son:

1.1. estudiar la utilización nutricional, efectos biológicos y comportamiento digestivo de proteínas (leguminas, vicilinas, inhibidores de proteasas) del guisante (*Pisum sativum*);

1.2. caracterización por medio de técnicas moleculares de la microbiota intestinal en animales alimentados con proteínas de guisante;

1.3. identificar y caracterizar serín proteasas, procedentes de distintas líneas celulares cancerígenas de colon así como aquellas derivadas de tumores colorrectales inducidos en rata, que pudieran ser dianas terapéuticas de los inhibidores Bowman-Birk;

1.4. dilucidar las bases moleculares responsables de las variaciones en su actividad biológica frente a serín proteasas involucradas en procesos cancerígenos en colon;

La actividad 2 se centra en el estudio de los mecanismos de acción y efectos biológicos, tanto de carácter nutricional como no-nutricional, de sustancias activas presentes en los alimentos o añadidos a la dieta (prebióticos, inhibidores de proteasas, agentes antibacterianos). Una atención particular se presta a los efectos de estas sustancias activas sobre la composición de la microbiota digestiva. Esta actividad está sustentada por 2 proyectos vigentes: AGR2011-7626 (Propiedades prebióticas in vivo de oligosacáridos procedentes de la leche de cabra), y AGL2012-32894 (Evaluación de aditivos antimicrobianos y estudio de la correlación entre la composición de la microbiota digestiva y parámetros fisiológicos y productivos en broilers). Dentro de esta actividad se encuadra también la participación en la solicitud del proyecto europeo no. 605995 (Use of natural ingredients in feeds for the reduction of Salmonella incidence in the poultry business) dentro del programa FP7-SME-2013. Los objetivos relacionados con esta actividad son:

2.1. determinar el perfil detallado de los oligosacáridos presentes en la leche de cabra a lo largo del periodo de lactación;

2.2. evaluar la supervivencia digestiva y el efecto prebiótico in vivo (rata) de los oligosacáridos de la leche de cabra, así como su capacidad para modular la microbiota digestiva en el tracto gastrointestinal (ileon, ciego y colon).

2.3. evaluar el efecto de la incorporación de derivados industriales de la alicina del ajo y de los dianhídridos de fructosa (DAFs) sobre la población de especies tanto patógenas (*Salmonella* spp, *Campylobacter jejuni*, *Clostridium perfringens*) como potencialmente patógenas (*Enterobacteriaceae*, *E. coli*) en broilers;

2.4. estudiar la correlación entre las variaciones en la composición de la microbiota digestiva y determinados parámetros fisiológicos, sanitarios y productivos en broilers.

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*The objectives of the group "Gastrointestinal Health" (AGR259) relate primarily to those referred in the various ongoing projects and in those recently submitted.*

*Activity 1 is related to the study of the digestive and metabolic utilization of nutrients through the evaluation of the physiological effects at both local (gut) or systemic levels of food or food fractions (proteins, carbohydrates, fiber, etc.). Two current projects address this specific task: PET2008-0311 [Biological Effects of pea (*Pisum sativum*) proteins] and AGL2011-26353 (Anti-proliferative properties of Bowman-Birk inhibitors of legumes in colon cell models. Identification of serine proteases as therapeutic targets). The specific objectives are:*

1.1. *To study of the nutritional utilization, biological effects and protein digestive behavior of isolated pea proteins (leguminas, vicilins, protease inhibitors);*

1.2. *Characterization by using molecular techniques of the intestinal microbiota composition in animals fed pea proteins;*

1.3. *Identification and characterization of serine proteases from various colon cancer cell lines, as well as those derived from colorectal tumors induced in rats which could be therapeutic targets Bowman-Birk inhibitor;*

1.4. *To elucidate the molecular basis responsible for variations in biological activity against serine proteases involved in processes of colon cancer;*

*Activity 2 is focused on the study of mechanisms of action and nutritional or non-nutritional biological effects of active substances present in food or added to the diet (prebiotics, protease inhibitors, antibacterial substances). Particular attention is paid to the effects of these active substances on the gastrointestinal microbiota composition. This activity is supported by two current projects: AGR2011-7626 (In vivo prebiotic properties of oligosaccharides from goat's milk), and AGL2012-32894 (Evaluation of antimicrobial additives and study of the correlation between the composition of the gastrointestinal microbiota and physiological and productive parameters in broilers). A participation in a European project (Use of natural ingredients in feeds for the reduction of Salmonella incidence in the poultry business- submitted) within the program FP7-SME-2013 also fits within this activity. The objectives related to this activity are:*

2.1. *To determine the chemical profile of the oligosaccharides present in goat milk during the lactation period;*

2.2. *To evaluate the survival and prebiotic effect in vivo (rat) of the oligosaccharides of goat milk, as well as their ability to modulate the microbiota composition of the gastrointestinal tract (ileum, cecum and colon).*

2.3. *To evaluate the effect of the incorporation to broilers diets of industrial derivatives of garlic allicin and fructose dianhydrides (DAFs) on the proportions pathogenic (Salmonella spp, Campylobacter jejuni, Clostridium perfringens) or potentially pathogenic (Enterobacteriaceae, E. coli) bacteria;*

2.4. *To study the correlation between variations in the composition of the gastrointestinal microbiota and certain physiological, productive and health parameters in broilers.*

### **Personal de Plantilla**

Luis Ángel Rubio San Millán. Investigador Científico

Alfonso Clemente Gimeno. Científico Titular

Jesús M<sup>a</sup> Vielba Villegas. Personal Laboral

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## GRUPO DE PASTOS Y SISTEMAS SILVOPASTORALES MEDITERRÁNEOS

### GRASSLAND AND MEDITERRANEAN SILVOPASTORAL SYSTEMS

Área Científica: A4. Ciencias Agrarias  
A4.3 Interacciones plantas/organismos/medioambiente

Disciplinas ERC: LS - LIFE SCIENCES  
LS8 Evolutionary, Population and Environmental Biology

Industrial Leadership: 7. Other  
7.1. Other

Societal Challenges: 2. Food security, sustainable agriculture, marine and maritime research and the bioeconomy  
2.2. Sustainable and competitive agri-food sector for a safe and healthy diet

#### Descripción

Investigaciones sobre las bases científicas de las relaciones pasto-herbívoro en las que sustentan la protección de los recursos botánicos y la gestión de los sistemas agro-silvo-pastorales mediterráneos.

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*Research on the scientific basis of grass-herbivore relationships in which support the protection of plant resources and the management of agro-forestry-pastoral Mediterranean.*

#### Objetivos PA 2014-2017

- Científicos:

Proporcionar conocimientos básicos sobre:

- i) los elementos florísticos constituyentes de los pastos naturales mediterráneos;
- ii) los procesos ecológicos y ecofisiológicos que rigen sus relaciones con los herbívoros que los aprovechan
- iii) métodos de evaluación de su oferta forrajera y receptividad ganadera.

-- Transferencia:

iv) desarrollar herramientas, experiencias demostrativas, y proporcionar criterios de decisión, transferibles a la gestión y conservación de los sistemas silvopastorales mediterráneos y espacios naturales protegidos.

- Síntesis DAFO y Amenazas a estos objetivos:

El presente grupo, liderado por un único investigador de plantilla (doctor ingeniero de montes), documenta una trayectoria científica de más de 30 años en I+D forestal: una disciplina casi inédita, históricamente, en el CSIC, que en nuestros días muestra su creciente proyección en multitud de aspectos críticos de la conservación del medio y consecuencias del cambio global. Es decir, una trayectoria cuyo sentido se ha visto cada vez más fortalecido por las demandas de nuestra sociedad (gestión de recursos y espacios naturales, control de la desertificación, amenazas de pérdida de diversidad, consecuencias del abandono agrario, usos y cambios de uso del suelo, riesgos de incendios, etc.). Demandas a las que el grupo ha venido respondiendo con relevantes contratos, proyectos, experiencias demostrativas, know haw, y tareas de formación. Una de las más recientes transferencias del grupo (proyecto RAPCA) ha recibido el máximo premio nacional de lucha contra incendios (Batefuegos de Oro 2012, modalidad de prevención).

Fruto de esta capacidad de transferencia, tal reducido grupo (un científico titular, un técnico especializado superior y una investigadora en situación de “indefinida”) se ha mantenido durante los últimos años en los máximos de captación de fondos de la EEZ. Redundando en ello, las dos evaluaciones externas recibidas en los dos P.E. anteriores, lo identifican como “un grupo pequeño en una línea estratégica importante”, pero “necesitado de consolidación”. A pesar de ello, dicha valoración ha sido ambas veces desoída y hoy el resultado es la existencia de un pequeño grupo, necesitado de consolidación, en una línea acreditada con máximos de captación de fondos, a las puertas de su desaparición (el I.P está a 3 años de la jubilación).

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- *Scientists:*

*Provide basic knowledge on:*

*i) floristic elements constituents of Mediterranean natural pasture;*

*ii) ecological and ecophysiological processes governing its relations with the herbivores*

*iii) methods of evaluating their livestock forage and carrying capacity*

- *Transfer:*

*iv) develop tools, pilot experiences, and provide decision criteria for the management and conservation of Mediterranean silvopastoral systems and protected natural areas.*

- *Synthesis SWOT and Threats to these objectives.:*

*This group, led by only one staff member researcher (doctor in forestry engineer), documents a scientific career of over 30 years in R & D on forestry: a discipline almost unprecedented, historically, in CSIC, which today shows an increasing projection in many critical aspects of environmental conservation and consequences of global change. That is, a path whose meaning has been increasingly strengthened by the demands of our society (management of natural spaces and resources, control of desertification, threats of loss of biodiversity, consequences of agricultural abandonment, changes in land use, fire hazards, etc.). These are claims to which the*

*group has been responding with relevant contracts, projects, pilot experiences, know-how, and training tasks. One of the most recent group transfers (project RAPCA) has received the highest national award on Firefighting (Batefuegos de Oro, 2012, prevention modality).*

*The result of this transfer capability, such a small group (a scientist, an advanced specialized technician, and a researcher who has a permanent contract) has been maintained in recent years in the maximum fundraising of the EEZ. In fact, the two external evaluations received in the two previous Strategic Plans identify it as "a small group in an important strategic line of research" but "in need of consolidation." Nevertheless, this assessment has been both times unheeded and today the result is the existence of a small group, in need of consolidation, in accredited line of research, with maximum fundraising, at the gates of his disappearance (the IP is three years of retirement).*

### **Personal de Plantilla**

José Luis González Rebollar. Científico Titular

Ana Belén Robles Cruz. E. Técnicos Superiores Especializados de OPIS

M<sup>a</sup> Eugenia Ramos Font. Personal Indefinido no Fijo