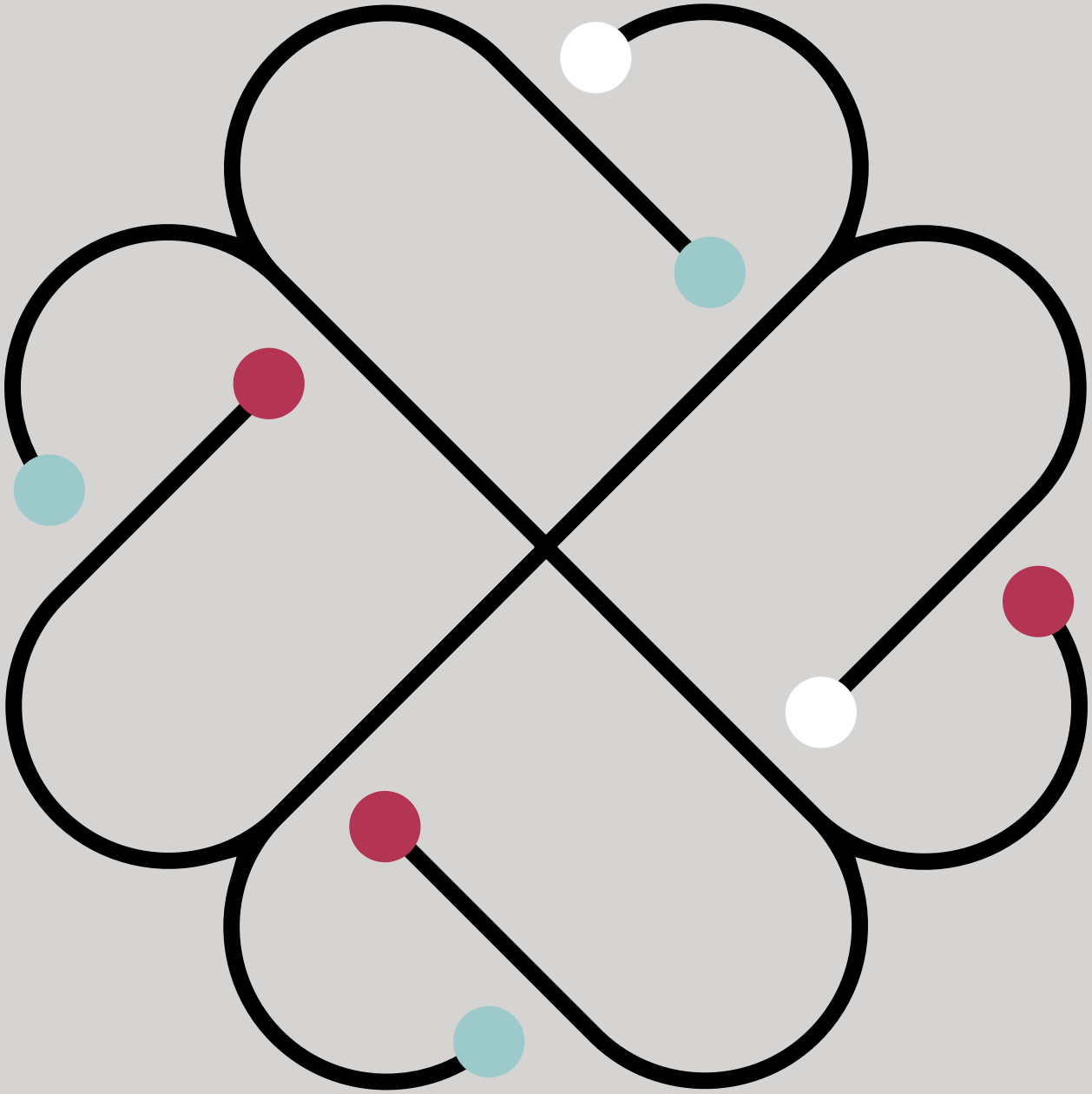
Activity report 2018

IRTA



Activity report 2018

IRTA

Letter from the President

Teresa Jordà, Minister of Agriculture, Livestock, Fisheries and Food of the Government of Catalonia and the IRTA President

2018 was marked by a change in the leadership of IRTA. After being led by Josep M. Monfort for 10 years, and his personal decision to leave his position, an international selection process began to choose a new director for the institute. This selection was carried out with transparency and rigour and finally, in July 2018, the Board of Directors chose Josep Usall as this institute's new director general.

IRTA is the research and technology transfer branch of the Catalan Ministry of Agriculture, Livestock, Fisheries and Food (DARP), and plays a key role in dealing successfully with the challenges faced by Catalan society. Together, with a national vision, we must respond to the needs of consumers and promote our productive framework, whilst guaranteeing the sustainability of our environment.

I would also like to point out that, in 2018, IRTA and DARP began a new phase in their relations. Now, both the needs and the potential of the two institutions are more closely aligned than ever. These links and workspaces should help improve the incorporation of research into business and help promote the competitiveness of the Catalan agri-food sector. However, in the field of administration too, both IRTA and DARP must promote research, innovation and the transfer of agri-food knowledge of this country's public sector.

We need territorial management that brings our country to life and also allows it to live. The Catalan agri-food sector plays a key role within the Catalan economy as a whole. It is a cornerstone for restoring territorial balance, sustainability and the impetus of our country.

In order to achieve these two major goals, it is essential to coordinate the transfer of technology, knowledge, research and innovation in the sector, so that it can be even more competitive and sustainable. Indisputably, therefore, the future of the Catalan countryside involves IRTA, and also a guarantee that public policies can adapt to the global changes we are currently experiencing.

Hble. Sra. Teresa Jordà
Minister of Agriculture, Livestock, Fisheries and Food of the Government of Catalonia

Letter from the Director General

Dr. Josep Usall Rodié
Director General of the Institute of Agri-food Research and Technology [Institut de Recerca i Tecnologia Agroalimentàries, IRTA] of the Government of Catalonia

In 2018, IRTA entered a new phase. On 18 July 2018, and after a long selection process, the IRTA's Board of Directors chose me as the institute's new director general, an appointment that fills me with pride and, above all, with a sense of responsibility. After forming part of our institute as a researcher for 26 years, as its leader now my priority is to do all I can to improve the level of excellence of our research and innovation alongside our agri-food sector, whilst at the same time ensuring its future viability.

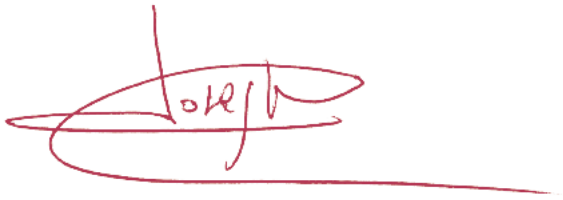
We live in a constant changing world, increasingly globalised and competitive, in which research and innovation are essential for this country's agriculture, livestock breeding, fisheries and its agri-food industry. Therefore, now, more than ever, our institute must adapt to the current changes and anticipate the future ones, so as to continue to offer the agri-food sector opportunities in this globalised market. We face them with courage and the determination to maintain the expertise that for over three decades has allowed us to help improve the quantity, security and quality of the food that reaches our homes from across the globe.

It was also a year in which our scientific expertise was recognised by the CERCA Institution (Research Centres of Catalonia), which gave us the top rating in the assessment for 2013-2017. CERCA valued the quality of our scientific production, the resource management, the capacity for innovation,

the transfers carried out, our research institute's forward-looking approach and how well it fits into the Catalan and international scientific sector. This recognition was the result of the talents and the efforts of the over 800 professionals who make up our team and whom I want to thank for their hard work. I would like to encourage them to continue on this path of constant improvement and of serving our agri-food sector and society in general.

I would also like to acknowledge the work carried out by the previous director general, Josep M. Montfort, and to thank him and his management team for all they did over the last 10 years, succeeding in the hard task of overcoming the global economic crisis, maintaining and consolidating IRTA as a point of reference, not only at home, but also worldwide. It is thanks to their work and that of all those who make up our institute, that IRTA can continue to undertake our main mission with confidence and determination: promoting an agri-food sector that is socially and economically prosperous and sustainable.

Dr. Josep Usall Rodié
Director General of IRTA



2018

Without a doubt, the event that had the greatest impact on IRTA in 2018 was the appointment of a new director general and the resulting organisational changes. In July, Josep Usall was appointed as the new director general, taking over from Josep Maria Monfort, who had led the institute since 2008. Soon after that, a new scientific direction was appointed and the first changes to the organisational structure began, which were completed early in 2019.

One of the main aims of the new phase is to promote research excellence, committing to attracting and retaining talent, multidisciplinarity and collaboration with centres and universities, but also to strengthening relations with the business sector and Catalan organisations. In this respect, in 2018 we continued to expand and reinforce partnerships with the sector and with national and international research institutes and signed agreements with bodies such as the National Food Institute of Thailand, the BonÀrea Corporació and the Zhejiang Academy of Agricultural Sciences (China).

In terms of **research**, 2018 saw several important achievements: we completed the composition of our Scientific Advisory Board, we were awarded one of the top qualifications in the assessment carried out by the CERCA Institution, which endorses us as a centre of excellence, and the Centre for the Development of Industrial Technology (CDTI) report ranks us among the 20 top public research centres in Spain with the highest uptake of grants for the Horizon 2020 Programme, which showcases the efforts made by our researchers and our management team.

Our 18 research programmes are carrying out over 100 research projects –some with great potential impacts such as a possible vaccine for the African swine fever virus– and in 2018 we started several very important projects such as MedAID, to promote Mediterranean aquaculture, Monlight, to combat a fungus that causes great losses in the fruit sector, or Circular Agronomics, which aims to increase the recovery and recycling of nutrients throughout the agri-food chain at a European level. Moreover, IRTA is participating in three research projects that were selected in 2018 to receive funding from the TV3 Marathon Foundation.

However, this research work takes on its full meaning when we can turn it into innovation for the agri-food sector, a process that necessarily involves the close collaboration of all the players in the sector: companies, cooperatives, producer and exporter associations, etc. One basic element of this collaboration are the institute's **R+D technologies and infrastructures**, which were reorganised in 2018 in order to be used by the sectoral players, so that they can carry out proof of concept studies on new products and processes. These are areas such as the IRTALab in Monells, with pilot plants that combine all the phases of the value chain of different foods and areas that facilitate meetings between producers and technology manufacturers.

In terms of **innovation**, 2018 was without a doubt an extremely important year: we completed the preparation of the IRTA Animal Welfare Certificate, in order to initiate it in 2019; we celebrated the 25th anniversary of the Porc d'Or Awards, introducing significant improvements to productivity and quality; we took on the organisation of the Fòrum Carni ("Meat Forum"), which highlighted Catalan producers' extremely high level of innovation; we created new courses (oil assessment), we increased the participation in those we had already consolidated (technology and post-harvest handling; meat products); and we added 15 new demonstration activities and 24 new operational groups to those already running, entailing the active collaboration of almost 200 players in the sector.

The 2018 report ends with a compilation of activities that we carried out to publicise IRTA's research and innovation work, but above all to raise **public awareness** about the great challenges that we are facing. These are social challenges of great significance, such as the ability to guarantee sufficient healthy food and to feed everyone, and to have agricultural production systems that are sustainable both from an economic and an environmental point of view, or the reduction or mitigation of climate change. These are the basic messages of the exhibitions (LIFE Migratoebre), talks (Barcelona Festival of Science, Science Week), informative articles and reports (Feeding on future - *Mengem futur*) that we carried out and published in 2018. In short, it is a matter of being committed, and of encouraging the whole agri-food sector to be committed, to building a better world for future generations.

Organisation chart

SCIENTIFIC AND STRATEGIC MANAGEMENT

Director Jordi Garcia Mas

Scientific Coordination Team
Jordi Garcia Mas, Sara Bover and Maria Devant

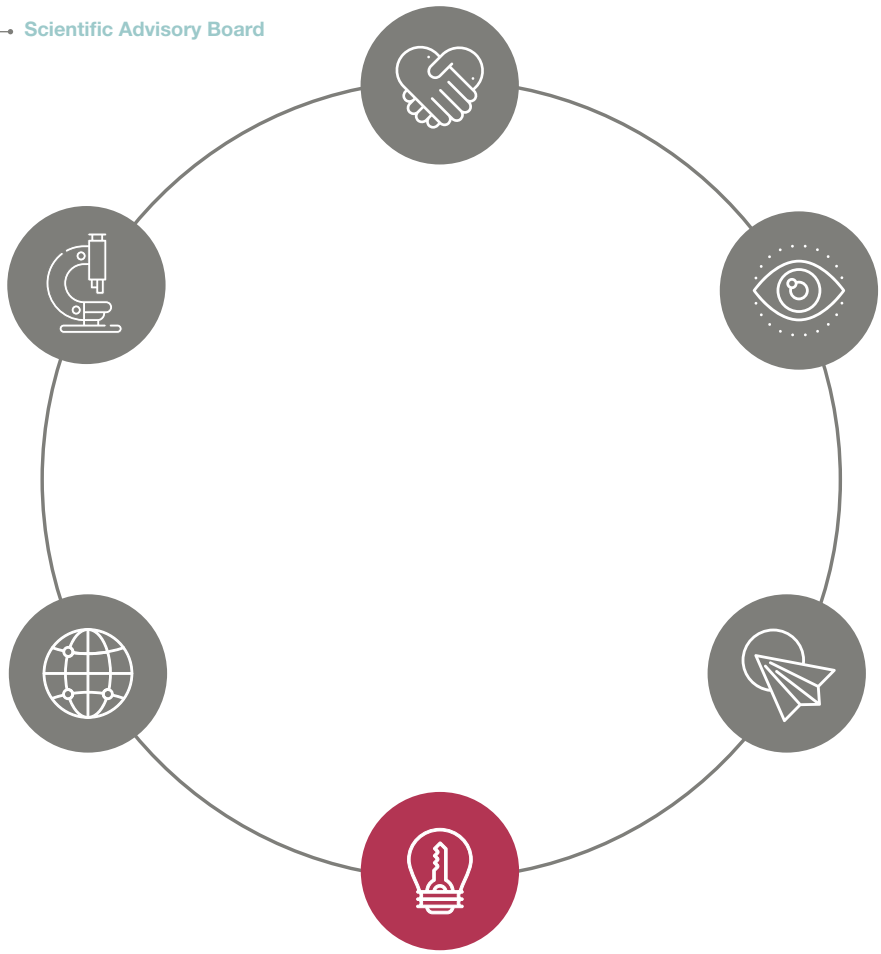
Strategic Development
Coordinator Anna Pallí

Documentation

Coordination of laboratories

Communication

Scientific Advisory Board



INTERNATIONAL RELATIONS MANAGEMENT

Director Eliecer López

GENERAL MANAGEMENT

Director Josep Usall

Board of Directors

In force since 13 September 2018

CORPORATE SERVICES MANAGEMENT

Director Joan Manel Albacete

Human Resources Management
Directora Montse Satorra

Legal Services
Head Miquel Portals

Centres

Administration and Finance Management
Director Jordi de la Cuesta

Information Technologies and Communication
Head Josep Solé

RESEARCH AND INNOVATION DEVELOPMENT MANAGEMENT

Director Simó Alegre

Projects and Contracts Office

Animal Production Area
Area Manager Carles Rosell

Food Industries Area
Area Manager J.M. Albacete
Assistant Manager
M. Dolors Guàrdia

Valorisation and Strategic Projects
Coordinador Agustí Fonts

Plant Production Area
Area Manager Simó Alegre
Assistant Manager Rosa Altisent

Sustainability in Agrosystems Transversal Area
Area Manager Ralph Rosenbaum

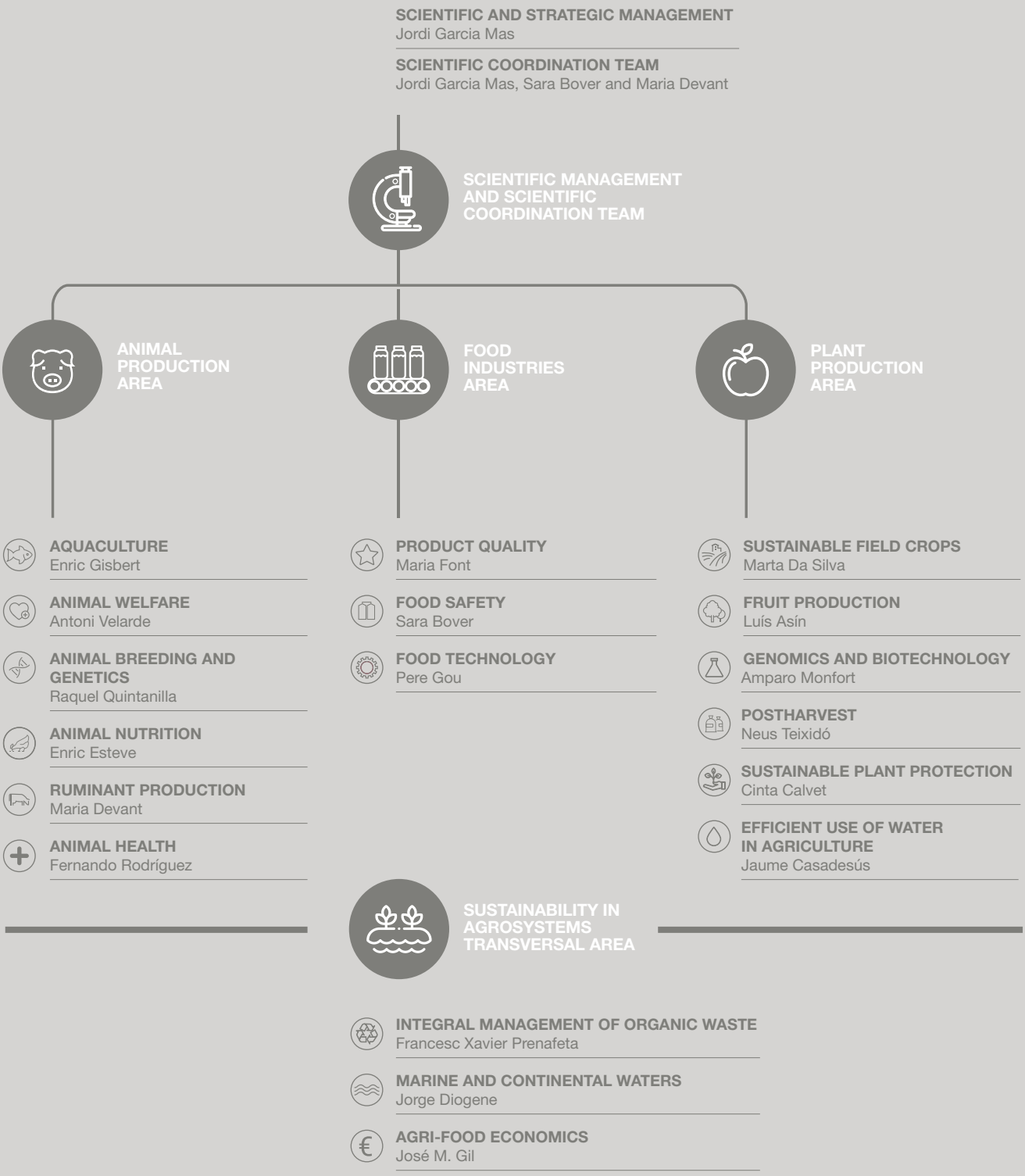
INSTITUTIONAL RELATIONS AND TECHNOLOGY TRANSFER MANAGEMENT

Directora Rosa Cubel

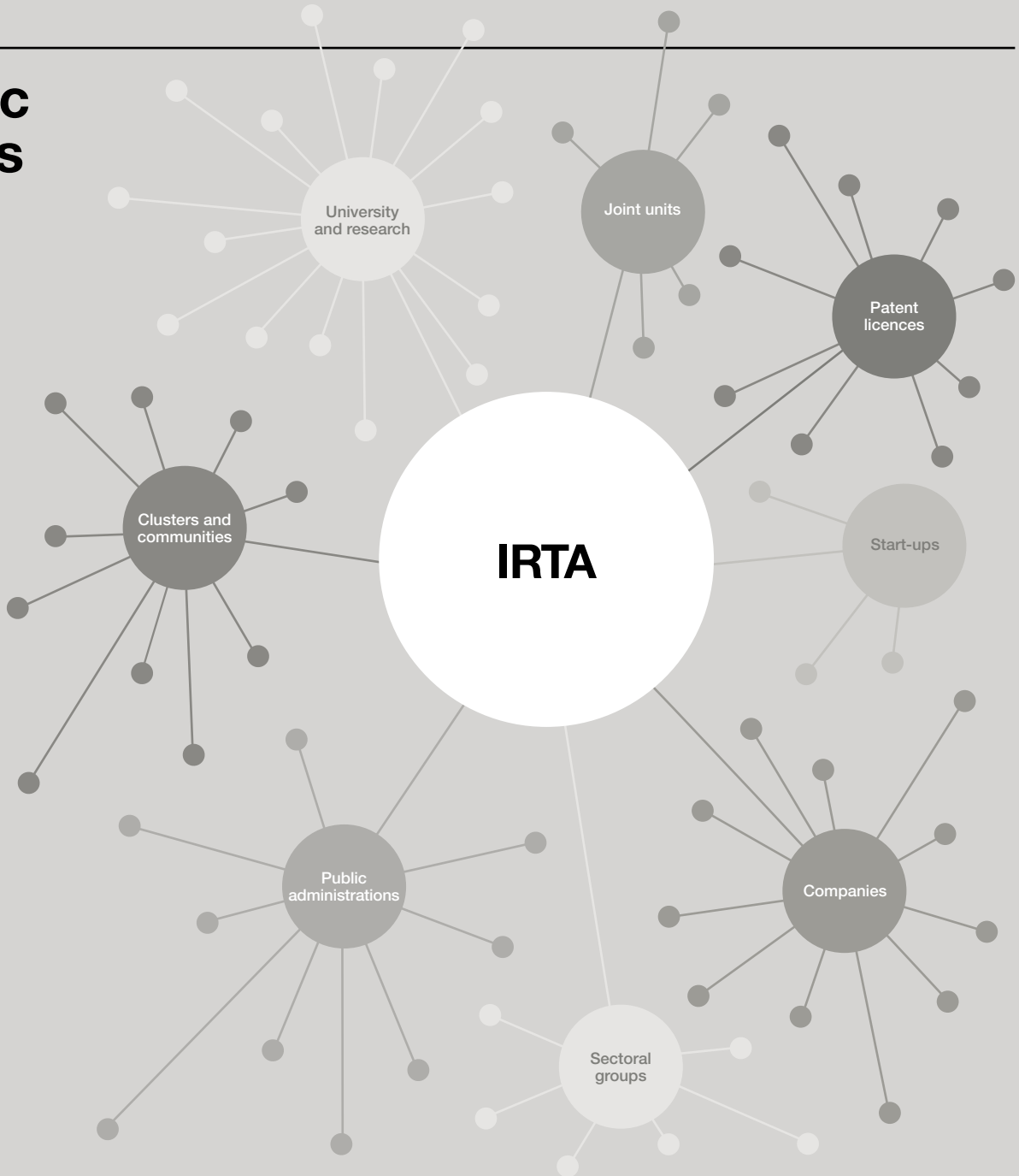
GOVERNING BODIES
General management
Chair
Board of Directors

ADVISORY BODIES
Scientific Advisory Board
Advisory Board

Scientific structure



Strategic relations



01. Companies

AKO, Danone, Lidl, Kelloggs, Ordesa, Zoetis, BASF, Eurosemillas, BonÀrea, Almeriplant.

02. Sectoral groups

FIAB, ANAFRIC, FECIC, FCAC, Interporc, Amprogapor, ANOVE.

03. Joint units

Codorniu, Planasa, Ilerfred, Fitó, Ordesa.

04. Clusters and communities

FOOD+i, Comunitat RIS3CAT Innoàpat, FOODNEXUS, Clúster Oleícola de Catalunya, Foodservice, INNOVI, FEMAC, Packaging Clúster, INNOVACC, Catalan Water Partnership, Food&Nutrition Cluster.

05. University and research

CERCA, PRUAB, Universitat de Girona, Universitat Rovira i Virgili, Universitat de Barcelona, Universitat de Lleida, Universitat Politècnica de Catalunya, Universitat Autònoma de Barcelona, Agrotecnio, UDavis, INCAVI, INIA, CSUC, BiB, Plant and Food Research.

06. Start-ups

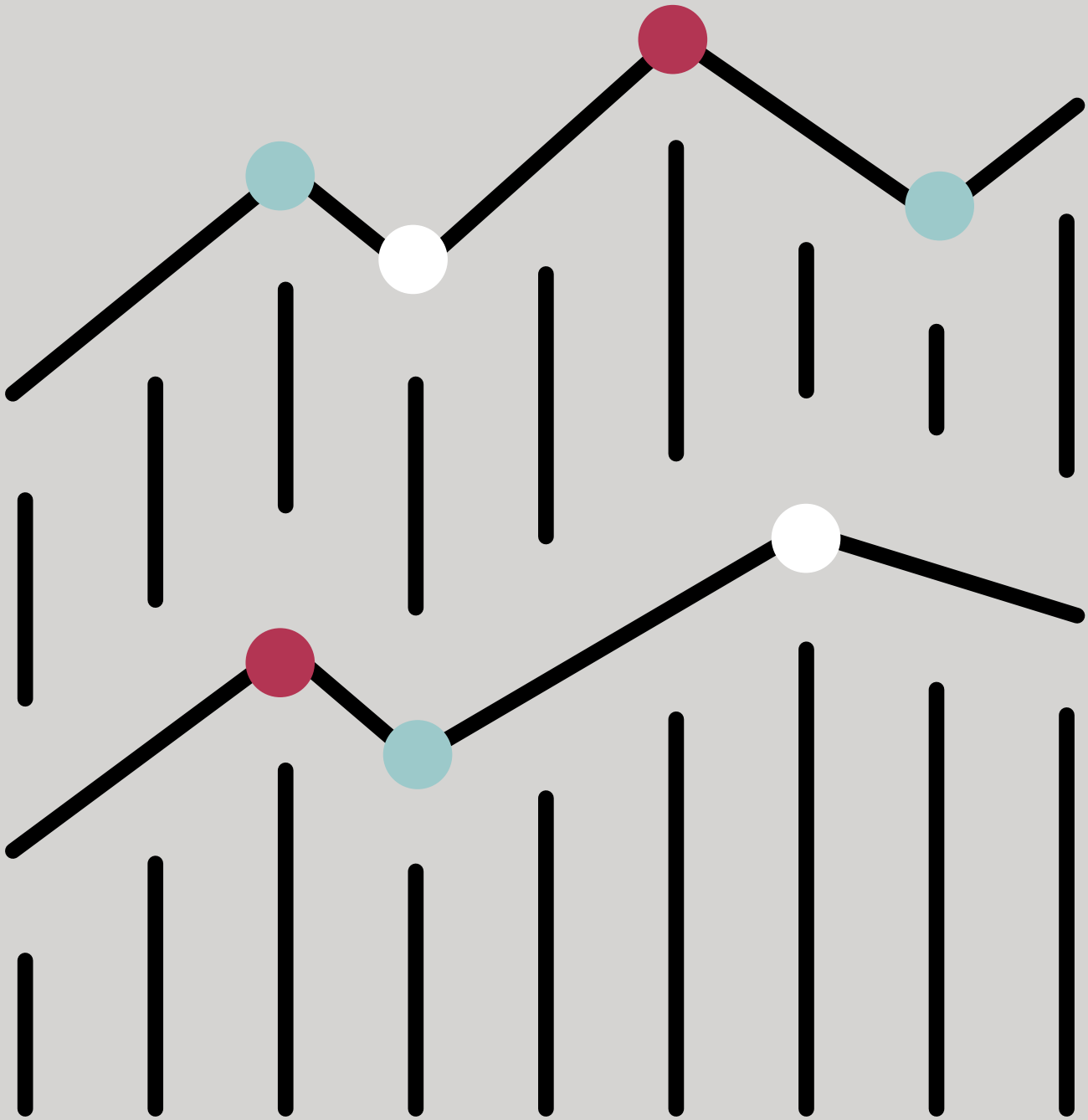
Nanopack, Specipig, Fruit Futur.

07. Public administrations

DARP, Prodeca, ACCIÓ, Ajuntament de Barcelona, Ajuntament de Lleida, Diputació de Barcelona, Diputació de Girona, Diputació de Lleida, MAPAMA, Departament d'Empresa i Coneixement.

08. Patent licences Plant Breeder's Titles (TOV)

Agromillora, Casa Tarradellas, Palacios, Eurosemillas, Roser, Sia, Metalquimia, Almeriplant, Millis Evangelos, BETA FIDAN DOKU KULTURU ISLAH ARGE ZIR., LTD.STI, Ekiz Fidançilik, Viveros Sunnyridge, Unlimited Group, Viveros Productora SA, Almeriplant.

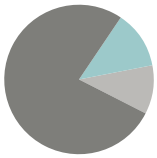


IRTA
in figures

0

Human resources

Own and associated staff



645
105
088
838

- IRTA's own staff
- Associated staff
- PhD students – researchers undergoing training

Gender

343
302
645

- Women
- Men

Rank

459
186
645

- Support Staff
- RDT Staff

Training

088
033
121

- Research staff undergoing training
- Students

The staff members undergoing training are made up of researchers and students of 9 different nationalities.

Foreigners

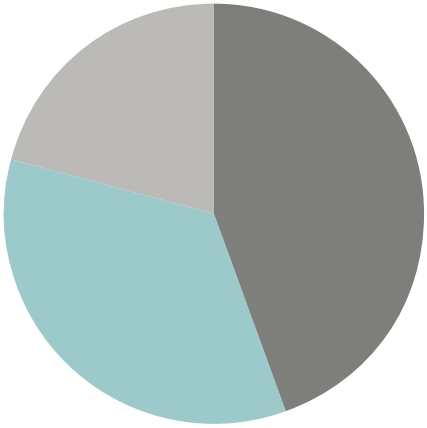
6% of the institute's own staff is made up of foreigners of 20 different nationalities.

838 people

Economic activity

Number of clients

Catalan clients	236 / 44,6%
Clients from the rest of Spain	183 / 34,6%
International clients	110 / 20,8%
Total	**529**



- Catalan clients
- International clients
- Clients from the rest of Spain

15,8 M€
Income for contracts and services

984
Contractual activities

Finance

Income

- **33,6%** Structural contribution from the Government of Catalonia **14.959.241 €**
- **27,2%** Research and innovation projects **12.110.396 €**
- **35,5%** Contracts and services with companies **15.827.868 €**
- **3,7%** Other income **1.650.270 €**

44.547.775 €

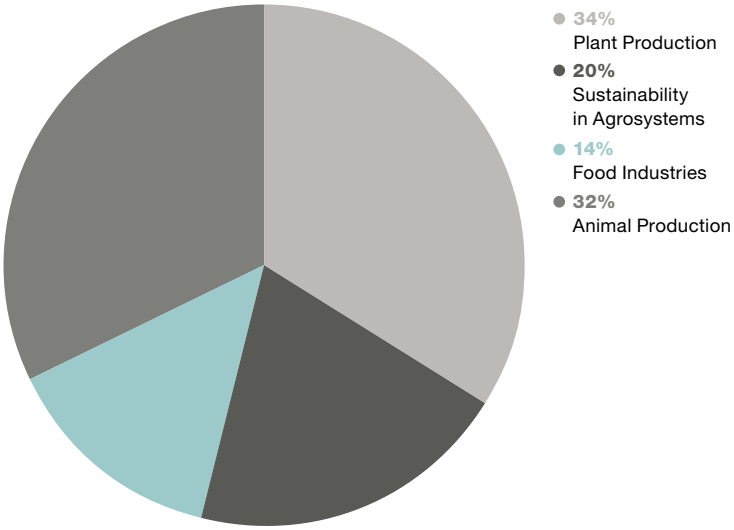
Technology transfer and communication

46.919
Participants

78%
in Catalonia

882
Transfer activities

Activities by areas



Typology of activities

Workshops	344
Transfer activities	297
Technical courses	100
Field experiments	69
Sectoral courses	41
Visits by external staff	25
Technical missions	6

Mentions in the press

2.402

Scientific production

Scientific articles in Science Citation Index journals

377 scientific articles

76%
Articles published in Q1 journals

68%
Articles with international co-authors

263
Lectures and communications in congresses

11
Books and book chapters

15.835
Citations (of all the IRTA researchers' articles in 2018)

21
Doctoral theses

Technical production

Technical and outreach publications

159

International activity

IRTA has 286 ongoing projects and contracts abroad.

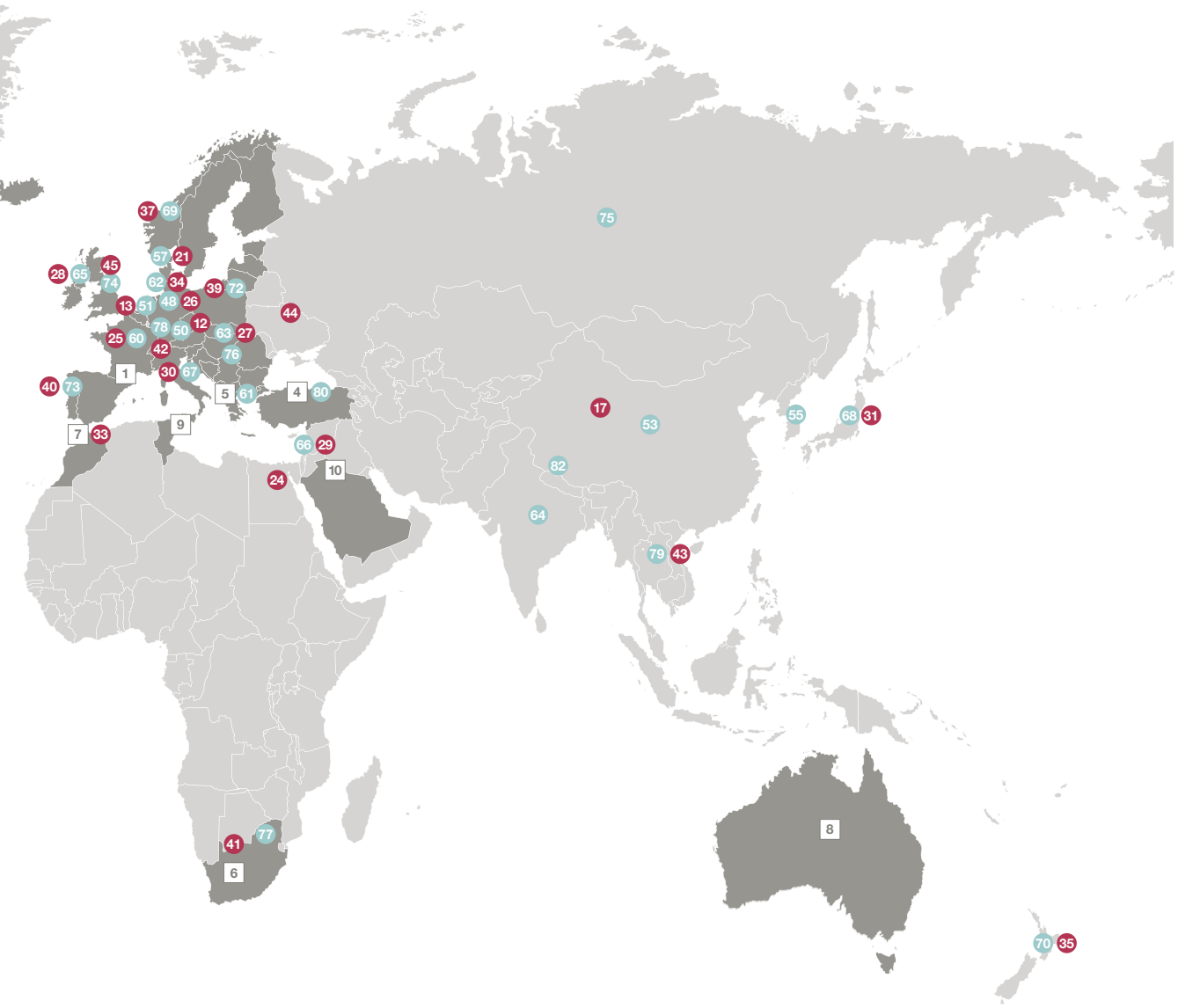
In 2018, we were able to generate new business with foreign companies to the value of 5.8M€, including research contracts, technical assistance, services, fundraising activities and intellectual property exploitation agreements in the form of patents and licences for plant varieties.

Plant material licences

01. European Union
02. Argentina
03. Chile
04. Turkey
05. Greece
06. South Africa
07. Morocco
08. Australia
09. Tunisia
10. Saudi Arabia

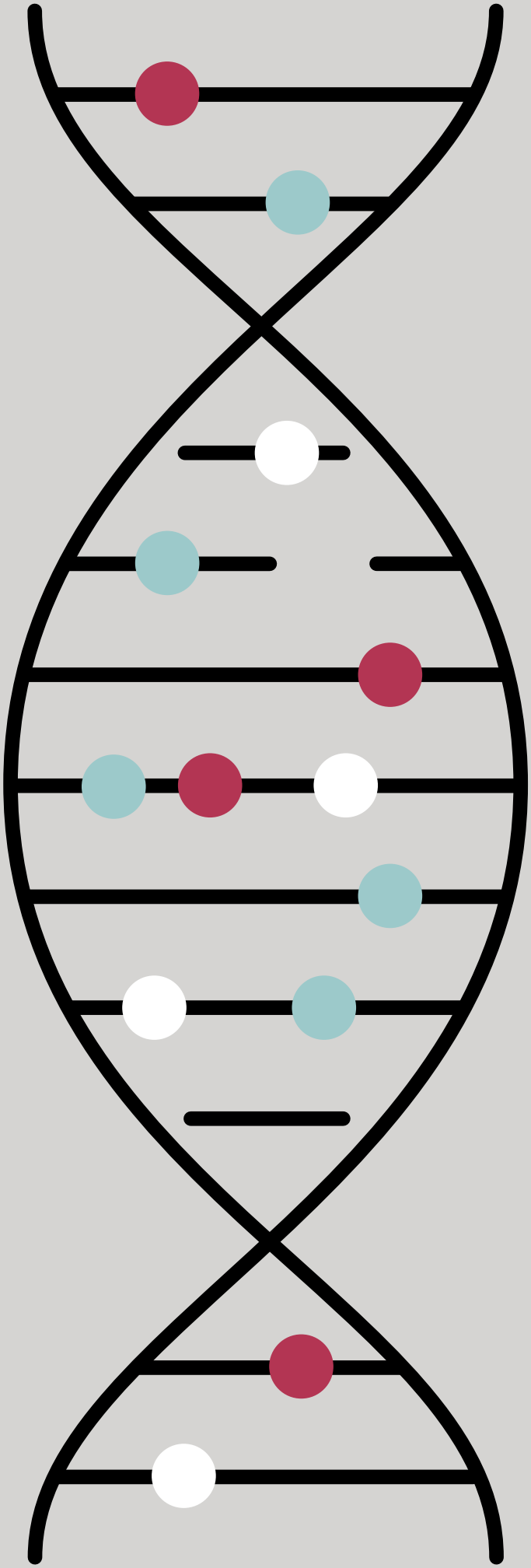
Agreements

11. Argentina
12. Austria
13. Belgium
14. Brazil
15. Canada
16. Chile
17. China
18. Colombia
19. Costa Rica
20. Cuba
21. Denmark
22. Dominican Republic
23. Ecuador
24. Egypt
25. France
26. Germany
27. Hungary
28. Ireland
29. Israel
30. Italy
31. Japan
32. Mexico
33. Morocco
34. The Netherlands
35. New Zealand
36. Nicaragua
37. Norway
38. Peru
39. Poland
40. Portugal
41. South Africa
42. Sweden
43. Thailand
44. Ukraine
45. United Kingdom
46. United States
47. Uruguay



Contracts

48. Germany
49. Argentina
50. Austria
51. Belgium
52. Chile
53. China
54. Colombia
55. South Korea
56. Costa Rica
57. Denmark
58. Ecuador
59. United States
60. France
61. Greece
62. The Netherlands
63. Hungary
64. India
65. Ireland
66. Israel
67. Italy
68. Japan
69. Norway
70. New Zealand
71. French Polynesia
72. Poland
73. Portugal
74. United Kingdom
75. Russia
76. Serbia
77. South Africa
78. Switzerland
79. Thailand
80. Turkey
81. Uruguay
82. Nepal



Research
R+D Infrastructures
Innovation
Society

1

1.0

A new structure to promote the quality of research

The change of director general led to several changes in IRTA's management structure in 2018, including my appointment as Scientific and Strategic Management Director, with the task of reinforcing and increasing the quality of the research that is carried out in our institution.

As the main innovation in this new Scientific Management structure, I would like to highlight the creation of the Scientific Coordination Team, which comprises Sara Bover, Maria Devant and the scientific director.
This new organisation will allow us to gain a deeper, direct insight into the research that is carried out at IRTA. The Scientific Coordination Team will visit IRTA's programmes during the first term of 2019 in order to get to know the researchers and the lines of research they are working on. At the same time, a Strategic and Scientific Committee has been created, which will be responsible for discussing and agreeing on the different proposals and actions that we shall carry out in this new phase.
The first actions undertaken at the end of 2018 include several changes to the scientific structure, which has allowed us to consolidate the Animal Production, Plant Production and Food Industries areas and to create a new Sustainability in Agrosystems Transversal Area. At the same time, we started to prepare the 2020-2023 Strategic Plan, which will be our roadmap for the next few years. It will be finalised during the first term of 2019. One of the major challenges facing us in the next few years is the generational renewal of our researchers, and we shall make sure that this is carried out as well as possible, incorporating and promoting the most

talented individuals. We shall also make significant changes to the promotion procedure for RDT staff, we shall increase the number of researchers undergoing training and the number of collaborations with other research agents in our environment, basically universities and research centres.

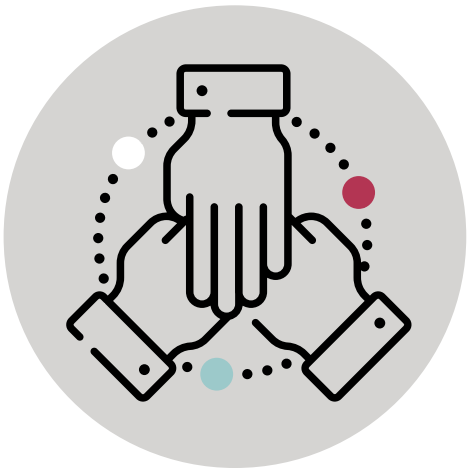
We should also highlight several scientific indicators from 2018, which you can find summarised in this report. A total of 377 scientific articles have been published in indexed journals (SCI), 76% of which being in journals in the first quartile; IRTA's scientific production has received over 15,000 citations; on 31 December 2018, there were 88 PhD students; we have been awarded five H2020 projects and 17 MINECO/RTA projects presented in the 2018 calls for proposals; a total of 29 PhD students, two Ramon y Cajal researchers/Doctores INIA, and two Juan de la Cierva researchers have joined IRTA.

Finally, IRTA's activity during the period 2013-2017 was assessed by the CERCA Institution (Centres de Recerca de Catalunya), and we were awarded the highest qualification, confirming the fact that our institute is a point of reference in agri-food research within our country. This success, the result of the hard work carried out by the previous management team and all the IRTA staff, spurs the new Scientific Director on to tackle this new phase enthusiastically, in order to achieve a qualitative leap forward in our research.

Jordi Garcia Mas
IRTA Scientific Director

▶ The Scientific Advisory Board ensures that IRTA maintains the highest standards in its research and makes the maximum impact with its innovation.

The Scientific Advisory Board completed



With the appointment in 2018 of the expert in the area of Sustainability in Agrosystems, **Pippa Heylings**, director and founder of Talking Transformation, the composition of IRTA's Scientific Advisory Board was completed. This body was renewed in 2017, in order to assess IRTA's global track record, so as to identify new opportunities or aspects to improve upon and suggest actions that could be carried out to achieve this. In addition to Heylings, the committee is made up of the following individuals: **Ruben Echeverría**, the Director General of the International Centre for Tropical Agriculture [Centro Internacional de Agricultura Tropical, CIAT], with headquarters in Colombia; Professor **Achim Dobermann**, Director of the Rothamsted Research (United Kingdom); Professor **Lluís Ferrer**, researcher in the Veterinary Faculty of the UAB, of which he was once Dean (1994-1998) before becoming Vice-rector of Research (1998-2002) and Rector of the UAB (2002-2009); and **Declan Troy**, Assistant Director of Research at Teagasc (Irish Agriculture and Food Development Authority).

Animal production

Of the 50 or so research projects that were carried out within the Animal Production area in 2018, the project that stands out due to its importance and impact is Mediterranean Aquaculture Integrated Development [Desenvolupament Integrat de l'Aqüicultura Mediterrània, **MedAID**], an H2020 project, whose aim is to increase the competitiveness and sustainability of fish farming in the Mediterranean along the entire value chain.

The IRTA **Aquaculture** Programme spearheads *Work Package 1* of MedAID, which involved the preparation in 2018 of a detailed analysis of the sustainability of fish farming in the Mediterranean, with the comprehensive collection of data from 9 countries (Croatia, Egypt, Spain, France, Greece, Italy, Tunisia, Turkey and Cyprus), holistically integrating animal-rearing, health, economic, social and governance aspects. The results of this study, which reveal a very complex, diverse sector that will need to focus on modernisation and coordination in the next few years, were presented at a workshop carried out at IRTA's facilities in Sant Carles de la Ràpita in January 2019.

Moreover, the **Animal Health** programme has continued to work hard at attempting to develop a **vaccine for the African swine fever virus** (ASFV), one of the greatest health challenges facing the livestock sector worldwide. At the end of 2018, ASFV was not only found in all Eastern European countries, including the states neighbouring the European Union, it had also reached Belgium and affected 17 provinces of China, the world's largest pig producer. Alongside the Severo Ochoa Molecular Biology Centre and with the collaboration of the industry, IRTA-CReSA is working on an attenuated vaccine for ASF, which is expected to reach the market in 5-10 years. In 2018, it also continued to collaborate with the US Department of Agriculture (USDA) within the framework of the agreement (2017-2019) established to test strains developed in the USA in the IRTA-CReSA biosecurity facilities, which since 2017 has been an OIE (World Organisation for Animal Health) reference laboratory for research into and the control of pig diseases. ›

▶ Within the framework of the MedAID programme, we carried out a detailed analysis of the sustainability of fish farming in the Mediterranean.

Research to obtain a vaccine for African swine fever is one of the major projects being focused on by the Animal Production area.

▼ The 10th European Symposium of Porcine Health Management (ESPHM), organised by IRTA, brought together over 1,900 delegates.

European Symposium of Porcine Health Management

IRTA-CReSA organises the 10th European Symposium of Porcine Health Management

From 9 -11 May 2018 the 10th European Symposium of Porcine Health Management (ECPHM) was held in the Palau de Congressos de Catalunya, in Barcelona, and brought together over 1,900 delegates from 55 countries. The event was organised by IRTA-CReSA, along with the European College of Porcine Health Management (ECPHM) and the European Association of Porcine Health Management (EAPHM).

The main subjects focused on during the symposium were the cost of diseases, African swine fever, biosecurity and the management of large litters. In addition to nine lectures, the congress included 50 oral communications on different subjects and 390 poster presentations.

The Animal Health programme is working on finding a vaccine for ASF

In 2018, both projects forming part of the research into a vaccine for ASF received funding from the Government of Sweden and the Spanish Ministry of the Economy and Competitiveness. Moreover, at the end of 2018, the application for an H2020 project that will be led by IRTA was closed, with an international consortium with research bodies and companies on four continents. IRTA-CReSA is one of the world's referents in research into ASF, as can be seen by their participation in nine international conferences in 2018, the indexed and informative articles published, and the four doctoral theses that are being prepared within the programme.

In 2018, nine **new projects** were started in the Animal Production area. More specifically, the Animal Health programme initiated two different projects funded by the European Food Safety Authority (EFSA) to improve the alignment and exchange of information between the member states: **Hotline**, to harmonise the information on transmissible animal diseases and make it comparable across the entire European Union; and **G-Raid**, focused on improving and standardising the systems to assess the risks of infectious diseases.

The **SCRA ZOO ECJ** project, started in January 2018, is studying a possible causal link between Creutzfeldt-Jackob disease and scrapie, a neurodegenerative disease that affects sheep and goats. They also began work on the **E-PCV3** project, an attempt to assess the potential impact of the porcine circovirus PCV3 identified in 2017, in order to develop new diagnostic tools and methods of prevention and control.

Two more projects that were started in 2018 also focus on the pig sector: The objective of the **Pigbiota** project, implemented by the Animal Breeding and Genetics programme, is to study the microbioma and its interaction with pig genetics in order to make molecular predictions of the efficiency and the robustness of the animals, and the **Nutritional foetal programming in swine**, part of the Anima Nutrition programme, which aims to improve the efficiency of sows and the immune response of piglets through nutrition.

Meanwhile, the Ruminant Production programme launched the **SmartCow** project, a concerted effort by 14 entities from nine European countries to integrate infrastructures and thereby increase the capacities for research and innovation in the cattle sector.

Within the **Aquaculture** programme, the **Figeal** project was launched, which studies the genetic and physiological basis that explains the differences in growth rates observed in clam families and species, and the **Solesperm** project, which investigates the molecular basis of spermiogenesis in the flatfish Senegalese sole.

Finally, we should highlight the activities carried out in 2018 within the **LIFE Migratoebre** project, aimed at ensuring the recovery of migratory fish and the management of the final stretch of the River Ebre. In addition to the different educational and awareness-raising activities (see *Society* section), at the end of August, the ultrasound receivers that had been installed along the river and in the Ebre Delta were replaced by new ones, which will allow signals to be detected from the surface, thereby facilitating the monitoring of the migration of the controlled species. In September, in collaboration with the team led by Professor Fernando Cobo from the University of Santiago de Compostela, a study was carried out on the sea lamprey population in view of a potential project to reintroduce this species, and in November a new European eel marking campaign was conducted.

From 10-14 December 2018, technicians from the LIFE Migratoebre project participated in the Fish Passage Conference in Albury (Australia), where they presented the initial results of the assessment of fish movements using ultrasound telemetry in the lower stretch of the River Ebre.□

► Representatives of the 36 projects funded by the TV3 Marathon on infectious diseases. IRTA is participating in three of them.

TV3 Marathon Foundation Projects

IRTA is participating in three research projects funded by the TV3 Marathon Foundation

In November 2018, it was revealed that 36 projects had been selected to receive funding from the money raised by the 2017 TV3 Marathon, devoted to infectious diseases. IRTA, through its Animal Health and Ruminant Production programmes, is participating in three of these research projects.

More specifically, Dr. Fernando Rodríguez, from IRTA-CReSA, forms part of the team that is working to develop a potential second-generation **vaccine that will be more effective at treating hepatitis A and E**. He will be responsible for testing the new vaccine on pig models.

The second project aims to investigate **the risks to public health of atypical and emerging prions**, which are responsible for diseases transmitted from animals to humans, and doctors Enric Vidal, from IRTA-CReSA, and Juan Carlos Espinosa, from CISA-INIA, will perform bioassays on transgenic mice in the Priocat laboratory of IRTA-CReSA, which has biosecurity characteristics that are unique in Catalonia.

The third project aims **to fight infections associated with vascular catheters, which are caused by microorganisms that are multi-resistant to antibiotics**. The laboratory of the IRTA Ruminant Production programme is participating in this project, which is led by Dr. Anna Arís and Dr. Elena Garcia-Fruitós, who are in charge of the design and production of molecules with broad-spectrum antimicrobial activity that will be combined with a hydrogel to cover catheters and avoid them being colonised by the microorganisms that cause infections.

Each of these projects was awarded around 400,000 euros by the TV3 Marathon Foundation.

Plant production

The Monlight project studies new strategies to combat the fungus that causes brown rot in stone fruits.

▼ In 2018, the Weeds project was carried out to detect weeds resistant to herbicide in rice fields across Spain.

The **Monlight** project, funded by the EU FEDER programme, through the Spanish Ministry of Science and Innovation, and promoted by the Postharvest programme, stands out from all those started in 2018 in the area of Plant Production due to its potential impact. The aim of this project is to study the interaction between the fungus *Monilinia laxa*, the stone fruit and the environment. Next-generation sequencing of transcriptomes (RNA) techniques will be used to determine which genes are related to the fungus' capacity for infection and the fruit's defence response. The effects of different types and intensities of light on the interaction between the fungus and the fruit will also be studied.

The fungus *M. laxa*, which proliferates above all in hot, humid climates, is responsible for brown rot that affects various stone fruits such as the apricot, the peach and the cherry, and causes the fruit sector huge financial losses. Monlight's ultimate goal is to learn more about the fruit's natural defence strategies, in order to develop biological products to combat this fungus.

During 2018, the Plant Production area started another seven new projects. In the Postharvest programme, it also launched **Escalpe**, a two-year project to study the main physiological and biochemical processes that lead to the appearance and development of superficial scald (skin disease) in pears. The Fruit Production programme, meanwhile, received new funding from the Ministry of Science and Innovation for the promotion of its long-term programme for the **genetic improvement of almond tree varieties**. The Sustainable Field Crops programme started the **Weeds project**, which detects and monitors weeds that are resistant to herbicides in rice fields across Spain, in order to design new, more efficient and sustainable control measures.

The other three projects started in 2018 are linked to improvements in irrigation and the use of water. **Go Horta Reg**, promoted by the Sustainable Plant Protection programme, aims to rationalise the use of water in orchard crops, combining innovative strategies to reduce irrigation with the application of mycrorrhizal-forming fungi. Meanwhile, the Efficient Use of Water in Agriculture programme launched the **PECT Baix Ter** programme, an information system designed to facilitate and promote precision irrigation in the Baix Ter (Lower Ter) region, and the **Ridecored** programme, a network that aims to disseminate the results of the Rideco-Consolider project (2011-2013), which generated 50% of the entire Spanish scientific production on irrigation and that, according to international reviews, represented the greatest joint research effort on deficit irrigation in the world. The objective of the project is to facilitate information between research groups participating in the Rideco project and to promote new joint initiatives.

Of the projects launched in previous years, we should highlight the fact that in the framework of **Agrimax** (2016-2020), a project focused on the valorisation of agriculture waste, in November 2018 a pilot plant in northern Italy became operational, recycling waste from tomatoes and cereals to produce bio-based compounds, such as lycopene, ferulic acid, cutin and hydrocompost. Moreover, a survey was begun to find out the social perception in Europe of the use of bio-products for packaging and food.

Programme to improve fruit tree varieties for hot climates

The programme to improve fruit tree varieties for hot climates (Hot Climate Programme) chooses a business partner for its new varieties of apple and pear

After 15 years of joint work on research and development, at the end of 2018 IRTA, Fruit Futur and Plant & Food Research selected Turners and Growers (T&G) as the company to market at an international level the new varieties of apple and pear adapted to hot climates, created through genetic improvements within the framework of the Hot Climate Programme (HCP).

The HCP was started in 2002 by IRTA and Plant & Food Research with the aim of developing new varieties of apples and pears that can adapt to increased temperatures resulting from climate change, which are already causing problems with traditional varieties: less red colouration, burning by the sun, soft pulp textures and a higher incidence of deterioration during storage.

In 2003, Fruit Futur, an economic interest group formed by Actel, Fruits de Ponent, Nufri, Poma de Girona and IRTA, joined the project as an expert in the commercial production of apples and pears in Catalonia, and as a party with a potential interest in these varieties.

The programme uses fruit germplasm from New Zealand and Spain to create new varieties, which maintain an excellent quality and high fruit colouration in conditions of high temperatures and a lack of water.

T&G Global, the selected business partner, has been responsible for programmes as successful in developing fruit on a global scale as Envy®, Jazz® or Pacific Rose®.

The Hot Climate Programme has created apple and pear varieties resistant to climate change.

The Horta.net programme will promote more sustainable and healthier vegetable production, with improvements to pest control and the use of fertilisers.

► Fruita.net published seven new studies in 2018, four of which were on pests that affect apples.

We improve the technological basis in the fruit and vegetable sectors.

Fruit.net Horta.net

Fruit.net and Horta.net, two benchmark programmes for improving the Catalan agricultural sector and increasing its sustainability

2018 marked the launch of the Horta.net programme, created in 2017 and promoted by the Catalan Ministry of Agriculture, Livestock, Fisheries and Food and IRTA, which aims to promote the incorporation of improvements into the technological basis of the Catalan horticultural sector.

More specifically, the programme focuses on developing sustainable production systems, applying improvements to the areas of pest, disease and weed control and the use of fertilisers. It also wants to encourage networking between the different agents involved in order to facilitate the implementation of the innovations.

Horta.net —like Fruit.net, which has similar objectives, focusing on the fruit sector— uses as tools the publication of studies on technological improvements in the programme's topics, validation activities in commercial properties of the improvements identified in the studies, and the organisation of seminars and technology transfer activities.

In 2018, the Horta.net technical and management committees were formed; a survey was conducted with horticultural holdings in 13 regions in Catalonia to find out the current plant protection product and fertilisation situation. Moreover, eight studies were carried out on various

research projects and tests on pest control. The Virtual Office of the RuralCat programme was also created, and two technical workshops were organised, in Cabrils on 23 November to present the 2018 studies, and in Santa Susanna on 27 November to present Horta.net to the sector.

Meanwhile, in 2018 the Fruit.net programme, which started eight years ago, published seven new studies, four of which were on apple pests and three on peach/nectarine pests.

Food Industries

IRTA's experience in the use of advanced technologies for ageing beef is one of the assets it contributes to projects such as **DietaPYR2** and **Alberapastur**, both started in January 2018 and focusing on the Pyrenean beef sector. More specifically, DietaPYR2, coordinated by the University of Zaragoza and with the participation of entities in Andorra, France and Spain, encourages cross-border collaboration to promote innovations in the value chain –from beef production to its consumption– above all for native Pyrenean breeds. The projects focuses on three main areas:

→ The transfer of technological innovations to livestock breeding to improve the management and productivity of pastoral systems.
→ The increasing of the value of the beef produced, promoting its nutritional qualities, new cuts and innovations in the ageing process, generating and identifying differentiating elements that will boost its commercial potential.
→ The creation of an environmental education network on the specific features of the beef cattle breeding activity linked to biodiversity and the Pyrenees.

IRTA focuses its activities on the project, above all on the second of these areas. In the Alberapastur project, IRTA leads the activities aimed at increasing the value of the Albera cattle breed –native to the Pyrenees and said to be threatened with extinction– and at improving the quality of its meat.

In 2018, many active programmes that started the previous year continued. These include **Microal3**, developed with the Institute of Natural Products and Agrobiology (IPNA-CSIC) and the research group on the Toxicology and Safety of Chemical and Biological Agents of the Veterinary Faculty at the Complutense University of Madrid (TOXIAQBI-UCM). The aim of the project is to identify and characterise new extracts and protein hydrolysates based on marine biota (marine bacteria, microalgae and macroalgae) with antimicrobial activity, in order to apply them in the agri-food sector.

In mid 2018, the **NIR Low Cost** project was completed. It allowed for the assessment of the capacity of a low-cost, portable, near-infrared (NIR) spectral

IRTA has a great deal of experience in the use of advanced technologies for ageing beef, which it contributes to the DietaPYR2 and Alberapastur projects.

▶ The DietaPYR2 project promotes cross-border collaboration for innovation in the beef cattle value chain.

▶ Pocket-sized NIR sensors allow for the low-cost monitoring of the sausage drying process and the quality of the products.

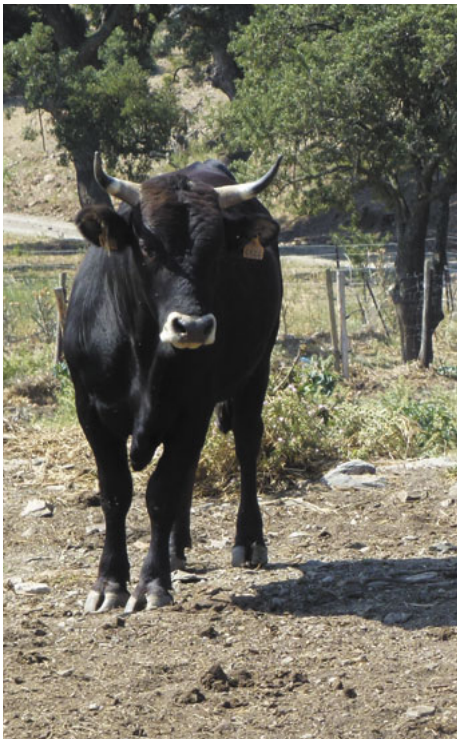
The use of radiofrequency (RF) allows for a 50% reduction in the processing time of cooked ham.

sensor, in order to measure the parameters of the processing and quality of dried meat products. The NIR spectra on the surface and insides of different dried meat products (cured, dried pork sausages such as fuet, llonganissa, llom, xoriço, etc.) were associated with their water content and the activity of the latter during the production process.

The five companies participating in the project were pleased with the results obtained and implemented this NIR sensor in the monitoring and control of their drying processes. The shared use of an Internet platform also began with the NIR calibre models, and other new companies showed an interest in using the platform models and adding new ones. This technology represents a great opportunity for the sector, which can have new systems to control the processing and the quality of the products at a reduced cost. The results of the project are expected to be transferred to other food sectors.

The **RF-Cooking of Ham** project also ended in 2018. It studied the application of radiofrequency (RF) technology in the preparation of cooked ham. The combination of RF and steam cooking allowed high-quality cooked ham to be obtained. The results obtained showed that it is possible to reduce the processing time by 50% without any negative effect on the quality or the security of the product.

Finally, we should mention the implementation in April 2018 of the **Inprocarsa** network, which is expected to promote research into microbiological safety and the development of healthy characteristics of the main meat derivatives produced in Spain. The network allows the previous Consolider project to continue and aims to act as a permanent forum for the flow and exchange of ideas between research groups specialised in meat products, along with the associations and companies in the meat sector, in order to deal with new research and innovation challenges, disseminate the scientific knowledge generated and promote the training of researchers specialising in meat products.



Sustainability in agrosystems

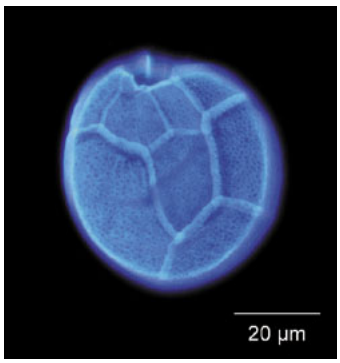
The inaugural meeting of the **Circular Agronomics** project, an initiative with European funding, was held on 27 and 28 November 2018. The project brings together companies, research centres and universities from 10 countries. It aims to increase the recovery and recycling of nutrients throughout the agri-food chain at a European level, and thus reduce the environmental impact of agriculture, livestock farming and the food industry.

Circular Agronomics, coordinated by the Integrated Organic Waste Management programme, applies the principles of the circular economy in order to reduce and reincorporate residual phosphorous and nitrogen into the production chain, mainly from fertilisers and slurry, and also to increase the carbon retention of the soil. With a high experimental and demonstration component, the project promotes the implementation of six pilot tests in various parts of Europe, including Catalonia. Here, work on precision feeders for calves at the IRTA experimental farm in Monells (EVAM) is being carried out in order to reduce the emission of greenhouse gasses, and to convert pig slurry into biogas and fertilisers. The consortium that develops this project is led by IRTA and made up of 18 institutions in 10 countries.

In the same line of work, in November 2018 the **Nutri2Cycle** project was launched. It aims to create more efficient and sustainable farm business models for nutrient recovery and recycling. The project, promoted by 19 organisations in 12 European countries, aims to improve the recovery of nitrogen and phosphorous in farms through the creation of more synergies between animal breeding and crop production.

In 2018, the Marine and Continental Waters programme implemented two new projects linked to research on toxins produced by marine algae and microorganisms, which can enter the human food chain through fish consumption, a line of research that IRTA has been following for a long time now. More specifically, two projects have been launched: the **Algatax** project, which studies toxic microalgae and their associated toxins, responsible for human poisoning and environmental damage; and the **CiguaSensing** project that aims to develop bioanalytical devices for the rapid and profitable detection of the microorganism *Gambierdiscus* spp. and the ciguatoxins it produces. ›

► The Circular Agronomics project applies the principles of circular economy in order to recover waste products from fertilisers and slurry.



Ciguatoxins are responsible for food poisoning that affects 50,000 people each year.

The Pactores project studies the potential bottlenecks for the viability of pastoral communities in the Mediterranean.

Indeed the **research into ciguatoxins and the resulting food poisoning**, which affects 50,000 people each year across the globe, is an ambitious research project that began in 2016 and will continue until 2020. It is funded by the **European Food Safety Authority** (EFSA). A great deal of work was carried out in this project in 2018. It is coordinated by the Carlos III Health Institute (ISCIII), which is responsible for the epidemiological study. The University of Vigo is also participating and is responsible for the characterisation of the ciguatoxins and the production of standards. IRTA, meanwhile, is focusing on evaluating the presence of ciguatoxins in food of marine origin and in the environment, and assessing the risk of poisoning.

The Food Economy programme, through the Center for Agro-food Economics and Development, CREDA-UPC-IRTA, is leading the **Pactores** project, which began in January 2018 and will last for three years. It analyses the potential bottlenecks in the viability of pastoral communities in the Mediterranean, considering the socio-economic, environmental and political dimensions. The project is also trying to identify best practices that can be shared by the communities affected. CREDA is responsible for the socio-economic *Work Package*, which will estimate the social demand for the services offered by the pastoral ecosystems and will analyse the value chain of their products. In Catalonia, more specifically, the project will study the pastoral systems in the Pallars regions (Jussà and Sobirà).

Noble pen shell reservoir in Sant Carles de la Ràpita

◀ Within the framework of the Pactores project, CREDA will study the social demand for the services provided by pastoral systems.

The captive breeding of the noble pen shell in the Ebre Delta may be of key importance for the survival of this species.

In Sant Carles de la Ràpita, IRTA has a noble pen shell reservoir to guarantee the survival of this species

The noble pen shell (*Pinna nobilis*) is a bivalve endemic to the Mediterranean and the shell can reach lengths of over 1 metre. However, despite its size, it is in danger of extinction. A parasitic protozoan, *Haplosporidium* pinnae, possibly with the help of a mycobacterium, is affecting the populations in a generalised manner, causing mortality rates of up to 100%. The coasts of Andalusia, the Murcia region, the Valencian Community, the Balearic Isles and Catalonia have been seriously affected, and the disease is also starting to be noticed on the coasts of other countries such as Tunisia, France, Turkey and Greece.

The potential effects of the disappearance of the noble pen shell are not known, but it is a species that filters water, improves its quality, and its shell provides a hard substrate on which a large number of invertebrates and algae bloom.

Therefore, IRTA has been working for years to conserve the noble pen shell. In 2018, at its centre near Sant Carles de la Ràpita, it set up a **reservoir for 100 individuals**, within the framework of a holding programme funded by the Spanish Ministry of Agriculture, Fisheries and Food. Other participants in this programme are IFAPA (Andalusia), the Research Institute for the Environment and Marine Science of Alicante, the Spanish Institute of Oceanography, and the Oceanographic in Valencia.

The recovery of the noble pen shell populations depends, to a large extent, on the possibilities of breeding this species in captivity. However, individuals of this species have never been kept in captivity for such a long time, so the experiment will also represent a challenge and an attempt to determine the ideal conditions for holding them and avoiding the appearance of infectious outbreaks, like those caused by the bacterium *Vibrio mediterranei*, which often leads to mass mortality events in captive individuals.

Scientific production and open access

In 2018, IRTA committed to an *Open Access* policy for scientific publications by our researchers. Our Open Access policy aims to disseminate the knowledge generated at the institution and make it **available to the public for the benefit of science and society** in general. The **institutional repository, Pubpro**, is the instrument used to achieve this goal, thereby increasing the visibility, impact and dissemination of the publications. Pubpro collects, organises, preserves and disseminates our institute's scientific and technical outputs (repositori.irta.cat).

Another step forward in this line materialised in 2018 and consisted of IRTA joining the **Research Portal of Catalonia** [Portal de la Recerca de Catalunya, PRC], after signing a collaboration agreement with the Consortium of University Services of Catalonia [Consorci de Serveis Universitaris de Catalunya, CSUC]. We were the second Catalan research centre to join this portal. Until recently, only universities had made their outputs available via this tool. We joined PRC in order to give greater visibility to the IRTA's scientific, technical and outreach production and make a bigger impact.

We shall now highlight which of IRTA's 377 SCI publications in 2018 are of greatest importance for each of the institute's 18 programmes.□

In 2018, IRTA's researchers published over 370 articles in indexed scientific journals.

Publications

Animal Production Area

Animal Breeding and Genetics

→ Ramayo-Caldas, Y., Ballester, M., Sánchez, J., González-Rodríguez, O., Revilla, M., & Reyer, H. et al. (2018). Integrative approach using liver and duodenum RNA-Seq data identifies candidate genes and pathways associated with feed efficiency in pigs. *Scientific Reports, 8*(1). doi: 10.1038/s41598-017-19072-5

→ Velasco-Galilea, M., Piles, M., Viñas, M., Rafel, O., González-Rodríguez, O., Guivernau, M., & Sánchez, J. (2018). Rabbit Microbiota Changes Throughout the Intestinal Tract. *Frontiers In Microbiology, 9*. doi: 10.3389/fmicb.2018.02144

Animal Nutrition

→ Takahashi, M., McCartney, E., Knox, A., Francesch, M., Oka, K., & Wada, K. et al. (2018). Effects of the butyric acid-producing strain Clostridium butyricum MIYAIRI 588 on broiler and piglet zootechnical performance and prevention of necrotic enteritis. *Animal Science Journal, 89*(6), 895-905. doi: 10.1111/asj.13006

→ Torres-Pitarch, A., McCormack, U., Beattie, V., Magowan, E., Gardiner, G., & Pérez-Vendrell, A. et al. (2018). Effect of phytase, carbohydrase, and protease addition to a wheat distillers dried grains with solubles and rapeseed based diet on in vitro ileal digestibility, growth, and bone mineral density of grower-finisher pigs. *Livestock Science, 216*, 94-99. doi: 10.1016/j.livsci.2018.07.003

Aquaculture

→ Toldrà, A., Andree, K., Bertomeu, E., Roque, A., Carrasco, N., & Gairín, I. et al. (2018). Rapid capture and detection of ostreid herpesvirus-1 from Pacific oyster Crassostrea gigas and seawater using magnetic beads. *PLOS ONE, 13*(10), e0205207. doi: 10.1371/journal.pone.0205207

→ Chauvigné, F., Parhi, J., Ducat, C., Ollé, J., Finn, R., & Cerdà, J. (2018). The cellular localization and redistribution of multiple aquaporin paralogs in the spermatic duct epithelium of a maturing marine teleost. *Journal Of Anatomy, 233*(2), 177-192. doi: 10.1111/joa.12829

Ruminant Production
→ Bach, A., Guasch, I., Elcoso, G., Chaucheyras-Durand, F., Castex, M., & Fàbregas, F. et al. (2018). Changes in gene expression in the rumen and colon epithelia during the dry period through lactation of dairy cows and effects of live yeast supplementation. *Journal Of Dairy Science, 101*(3), 2631-2640. doi: 10.3168/jds.2017-13212
→ Gifre-Renom, L., Cano-Garrido, O., Fàbregas, F., Roca-Pinilla, R., Seras-Franzoso, J., & Ferrer-Miralles, N. et al. (2018). A new approach to obtain pure and active proteins from Lactococcus lactis protein aggregates. *Scientific Reports, 8*(1). doi: 10.1038/s41598-018-32213-8

Animal Welfare
→ Casal, N., Font-i-Furnols, M., Gispert, M., Manteca, X., & Fàbrega, E. (2018). Effect of Environmental Enrichment and Herbal Compounds-Supplemented Diet on Pig Carcass, Meat Quality Traits, and Consumers' Acceptability and Preference. *Animals, 8*(7), 118. doi: 10.3390/ani8070118
→ Dalmau, A., Areal, B., Machado, S., Pallisera, J., & Velarde, A. (2018). Does the location of enrichment material affect behavior and dirtiness in growing female pigs?. *Journal Of Applied Animal Welfare Science, 22*(2), 116-126. doi: 10.1080/10888705.2018.1443816

Animal Health
→ Fernández-Aguilar, X., Gottschalk, M., Aragon, V., Càmara, J., Ardanuy, C., & Velarde, R. et al. (2018). Urban Wild Boars and Risk for Zoonotic Streptococcus suis, Spain. *Emerging Infectious Diseases, 24*(6), 1083-1086. doi: 10.3201/eid2406.171271
→ Napp, S., Chevalier, V., Busquets, N., Calistri, P., Casal, J., & Attia, M. et al. (2018). Understanding the legal trade of cattle and camels and the derived risk of Rift Valley Fever introduction into and transmission within Egypt. *PLOS Neglected Tropical Diseases, 12*(1), e0006143. doi: 10.1371/journal.pntd.0006143

Plant Production Area

Postharvest
→ Sánchez-Torres, P., Vilanova, L., Ballester, A., López-Pérez, M., Teixidó, N., Viñas, I., Usall, J., González-Candelas, L. and Torres, R. (2018). Unravelling the contribution of the Penicillium expansum PeSte12 transcription factor to virulence during apple fruit infection. *Food Microbiology, 69*, pp.123-135.
→ Iglesias, M., Echeverría, G., Viñas, I., López, M. and Abadias, M. (2018). Biopreservation of fresh-cut pear using Lactobacillus rhamnosus GG and effect on quality and volatile compounds. *LWT, 87*, pp.581-588.

Fruit Production
→ Lordan, J., Alins, G., Àvila, G., Torres, E., Carbó, J., Bonany, J., & Alegre, S. (2018). Screening of eco-friendly thinning agents and adjusting mechanical thinning on 'Gala', 'Golden Delicious' and 'Fuji' apple trees. *Scientia Horticulturae, 239*, 141-155. doi: 10.1016/j.scienta.2018.05.027
→ Ninot, A., Howad, W., Aranzana, M., Senar, R., Romero, A., & Mariotti, R. et al. (2018). Survey of over 4, 500 monumental olive trees preserved on-farm in the northeast Iberian Peninsula, their genotyping and characterization. *Scientia Horticulturae, 231*, 253-264. doi: 10.1016/j.scienta.2017.11.025

Sustainable Field Crops
→ Lopes, M., Royo, C., Alvaro, F., Sanchez-Garcia, M., Ozer, E., & Ozdemir, F. et al. (2018). Optimizing Winter Wheat Resilience to Climate Change in Rain Fed Crop Systems of Turkey and Iran. *Frontiers In Plant Science, 9*. doi: 10.3389/fpls.2018.00563
→ Soriano, J., Villegas, D., Sorrells, M., & Royo, C. (2018). Durum Wheat Landraces from East and West Regions of the Mediterranean Basin Are Genetically Distinct for Yield Components and Phenology. *Frontiers In Plant Science, 9*. doi: 10.3389/fpls.2018.00080

Sustainable Plant Protection
→ Castaño, C., Lindahl, B., Alday, J., Hagenbo, A., Martínez de Aragón, J., & Parladé, J. et al. (2018). Soil microclimate changes affect soil fungal communities in a Mediterranean pine forest. *New Phytologist, 220*(4), 1211-1221. doi: 10.1111/nph.15205
→ Solà, M., Riudavets, J., & Agustí, N. (2018). Detection and identification of five common internal grain insect pests by multiplex PCR. *Food Control, 84*, 246-254. doi: 10.1016/j.foodcont.2017.08.002

Genomics and Biotechnology
→ Lü, P., Yu, S., Zhu, N., Chen, Y., Zhou, B., & Pan, Y. et al. (2018). Genome encode analyses reveal the basis of convergent evolution of fleshy fruit ripening. *Nature Plants, 4*(10), 784-791. doi: 10.1038/s41477-018-0249-z
→ Foster, T., & Aranzana, M. (2018). Attention sports fans! The far-reaching contributions of bud sport mutants to horticulture and plant biology. *Horticulture Research, 5*(1). doi: 10.1038/s41438-018-0062-x

Efficient Use of Water in Agriculture
→ Bellvert, J., Adeline, K., Baram, S., Pierce, L., Sanden, B., & Smart, D. (2018). Monitoring Crop Evapotranspiration and Crop Coefficients over an Almond and Pistachio Orchard Throughout Remote Sensing. *Remote Sensing, 10*(12), 2001. doi: 10.3390/rs10122001
→ García-Tejera, O., López-Bernal, Á., Orgaz, F., Testi, L., & Villalobos, F. (2018). Are olive root systems optimal for deficit irrigation?. *European Journal Of Agronomy, 99*, 72-79. doi: 10.1016/j.eja.2018.06.012

Food Industries Area

Food Technology
→ Comaposada, J., Marcos, B., Bou, R., & Gou, P. (2018). Influence of surfactants and proteins on the properties of wet edible calcium alginate meat coatings. *Food Research International, 108*, 539-550. doi: 10.1016/j.foodres.2018.04.002
→ Muñoz, I., Gou, P., Picouet, P., Barlabé, A., & Felipe, X. (2018). Dielectric properties of milk during ultra-heat treatment. *Journal Of Food Engineering, 219*, 137-146. doi: 10.1016/j.jfoodeng.2017.09.025

Product Quality
→ Xiberta, P., Bardera, A., Boada, I., Gispert, M., Brun, A., & Font-i-Furnols, M. (2018). Evaluation of an automatic lean meat percentage quantification method based on a partial volume model from computed tomography scans. *Computers And Electronics In Agriculture, 151*, 365-375. doi: 10.1016/j.compag.2018.06.019
→ Aluwé, M., Aaslyng, M., Backus, G., Bonneau, M., Chevillon, P., & Haugen, J. et al. (2018). Consumer acceptance of minced meat patties from boars in four European countries. *Meat Science, 137*, 235-243. doi: 10.1016/j.meatsci.2017.11.034

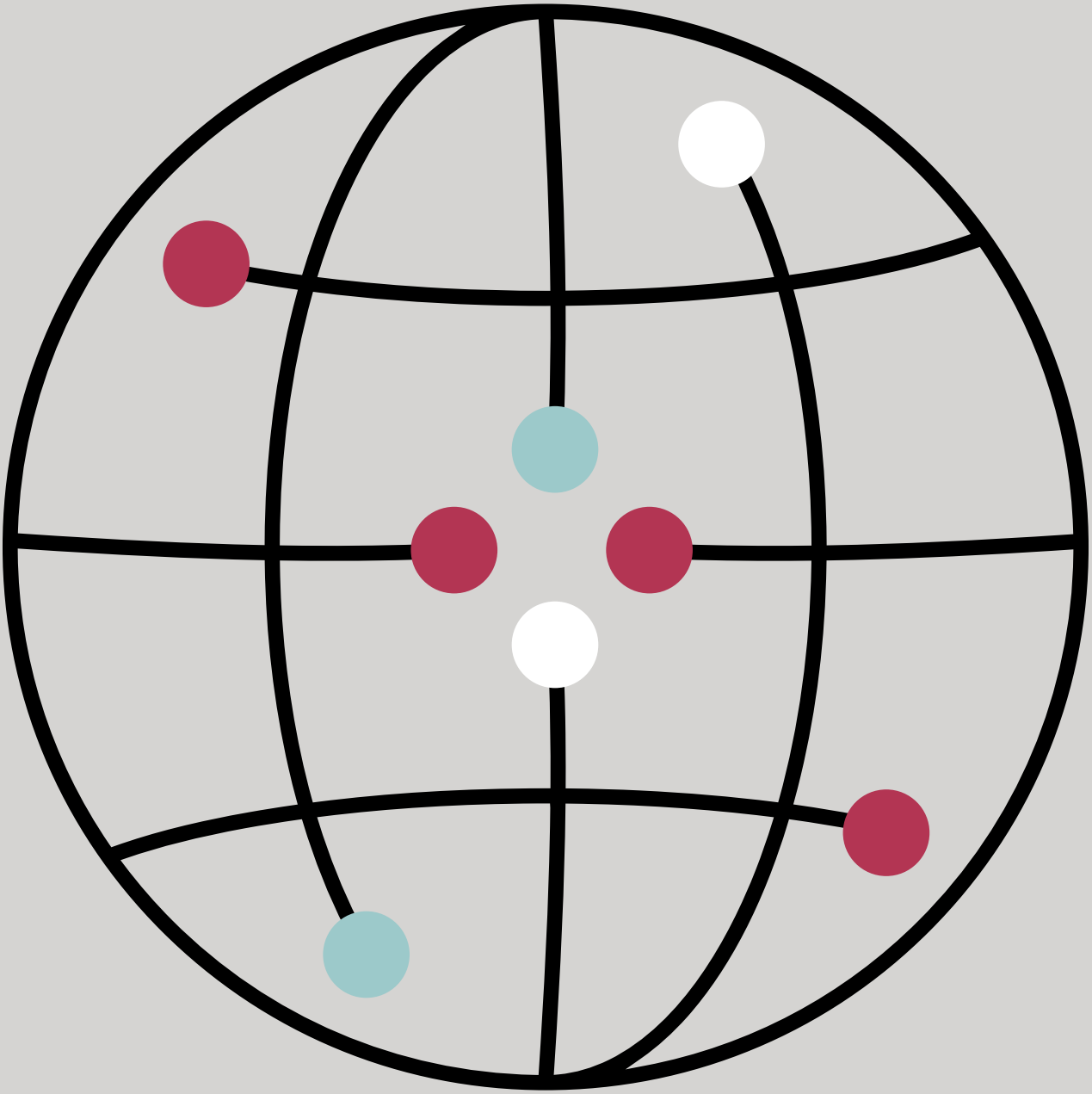
Food Safety
→ Martín, B., Bover-Cid, S., & Aymerich, T. (2018). MLVA subtyping of Listeria monocytogenes isolates from meat products and meat processing plants. *Food Research International, 106*, 225-232. doi: 10.1016/j.foodres.2017.12.052
→ Picouet, P., Gou, P., Hyypiö, R., & Castellari, M. (2018). Implementation of NIR technology for at-line rapid detection of sunflower oil adulterated with mineral oil. *Journal Of Food Engineering, 230*, 18-27. doi: 10.1016/j.jfoodeng.2018.01.011

Sustainability in Agrosystems Transversal Area

Integrated Organic Waste Management
→ Kamilaris, A., & Prenafeta-Boldú, F. (2018). Deep learning in agriculture: A survey. *Computers And Electronics In Agriculture, 147*, 70-90. doi: 10.1016/j.compag.2018.02.016
→ Ruiz-Sánchez, J., Campanaro, S., Guivernau, M., Fernández, B., & Prenafeta-Boldú, F. (2018). Effect of ammonia on the active microbiome and metagenome from stable full-scale digesters. *Bioresource Technology, 250*, 513-522. doi: 10.1016/j.biortech.2017.11.068

Marine and Continental Waters
→ Vasselon, V., Bouchez, A., Rimet, F., Jacquet, S., Trobajo, R., & Corniquel, M. et al. (2018). Avoiding quantification bias in metabarcoding: Application of a cell biovolume correction factor in diatom molecular biomonitoring. *Methods In Ecology And Evolution, 8*(4), 1060-1069. doi: 10.1111/2041-210x.12960
→ Leonardo, S., Kilcoyne, J., Samdal, I., Miles, C., O'Sullivan, C., Diogène, J., & Campàs, M. (2018). Detection of azaspiracids in mussels using electrochemical immunosensors for fast screening in monitoring programs. *Sensors And Actuators B: Chemical, 262*, 818-827. doi: 10.1016/j.snb.2018.02.046

Agri-food Economics
→ Diaz-Ruiz, R., Costa-Font, M., & Gil, J. (2018). Moving ahead from food-related behaviours: an alternative approach to understand household food waste generation. *Journal Of Cleaner Production, 172*, 1140-1151. doi: 10.1016/j.jclepro.2017.10.148
→ Varela, E., Verheyen, K., Valdés, A., Soliño, M., Jacobsen, J., & De Smedt, P. et al. (2018). Promoting biodiversity values of small forest patches in agricultural landscapes: Ecological drivers and social demand. *Science Of The Total Environment, 619-620*, 1319-1329. doi: 10.1016/j.scitotenv.2017.11.190



Research
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Innovation
Society

2

2.0

Within the framework of the organisational changes that the new Management has started to promote, and with the aim of increasing collaboration with companies to encourage innovation in the agri-food sector, during 2018 IRTA's R+D infrastructures were reorganised significantly.

A centralised coordination structure was created, in order to gain a global vision of the capacities and to enable these infrastructures to stop being an internal resource for research and to become a catalogue of services for the sector. It is a question of using a unique, cutting-edge network of technological infrastructures to help achieve innovation and meet company requirements, ensuring that it is capable of satisfying the increasingly high levels of administrative demands and quality.

With this reorientation in the use of infrastructures, we showcase the knowledge and capacities of our technical and research staff and, at the same time, address a growing market demand, with companies that require increasing numbers of living labs to test their innovative products.

An outstanding example of this new focus is IRTALab, an area for co-innovation serving the agri-food technological sector, which, in addition to making IRTA's experimental centres and pilot plants available, promotes meetings and collaboration between the producers of all kinds of food and the technology manufacturers and suppliers.

Cutting-edge technology to serve the sector

One of the objectives in 2018, in line with new approach of making IRTA's R+D infrastructures open to the sector, was to promote the services of **IRTALab**, which makes its facilities in Monells (Girona) available to the agri-food sector in order for innovation pilot tests to be carried out there. These installations integrate the entire value chain of the food production process. It is a centre for new processing technologies measuring 4,100 m^2, where technology manufacturers can validate their equipment and perform demonstrations, and product manufacturers can carry out tests to guarantee the investment or to validate ingredients, without having to interfere with their production lines. The IRTALab works to increase the use of these installations as an external pilot plant by both national and international companies and to facilitate interaction and collaboration between IRTA's researchers and companies' technical teams to accelerate the arrival of innovations on the market.

Another of IRTA's reference infrastructures is the **Monells Cattle Farm** [Estació de Vacum de Monells, EVAM], a centre for the comprehensive study of the dairy sector, from production (cattle, forage…) to the consumer. This facility, opened in 2017, allows for the testing of improvements in the management of cattle farms –such as for example the composting-bed demonstration project, developed in 2018 to study improvements in the welfare of the animals–, but also to test innovations in the production of dairy products. In November 2018, this infrastructure hosted the meeting of the European thematic network on 4D4F (Data Driven Dairy Decisions for Farmers), which focuses its work on the use of technologies and sensors that can be used in farms in order to improve decision-making. ›

The IRTALab offers companies its food technology pilot plants to test their innovations.

Laboratories

4.954,42 m2

23,91% test bed surface area

Field stations

380 ha

Experimental field stations
344 ha of its own agricultural experimentation (92%)

Greenhouses

19.197 m2

surface area of greenhouses

Farms and animals

15.489 m2

facilities for land animals
(pigs, poultry, cattle, rabbits, sheep/goats)

3.800 m2 / 675 m3

facilities for fish and molluscs

Capacity for housing land animals
(all species) 23.269
Animals in rotation 92.014

Capacity for housing fish: 220.000
Animals in rotation 421.000 fish and 47.000 molluscs

Pilot plants

7.843 m2

of pilot plants

Pilot slaughterhouse + cutting room
Pilot processing plant + auditorium
New technologies pilot plant
IRTA-Ordesa mixed unit pilot plant
Dairy products and liquids pilot plant
Oil pilot plant
Animal feed factory
Cheese factory
Experimental winery
Organic waste management pilot plant
New fruit conservation technologies pilot plant
Microorganism production and formulation pilot plant
Fruit classification, preparation and packaging pilot plant
Minimally processed (pre-prepared) fruit development pilot plant
Pre-cooked fruit pilot plant
Wetlands
Composting plant

IRTA-CReSA renews their accreditation as a Unique Scientific and Technical Infrastructure (ICTS).

Finally, it should be noted that in November 2018, the Spanish Ministry of Science, Innovation and Universities' Science, Technology and Innovation Council approved the new Map of Unique Scientific and Technical Infrastructures (ICTS), which includes 29 major infrastructures with a total of 62 operational nodes.

One of the main infrastructures for research into animal health and zoonotic diseases—any disease or infection of animal origin that can be passed on to humans— that has renewed it accreditation is the **Network of High Biosafety Laboratories** [Red de Laboratorios de Alta Seguridad Biológica, RLSAB], made up of the IRTA-CReSA and CISA-INIA (Madrid) nodes.

IRTA-CReSA, which has a biosafety level 3 Biocontainment Unit, of which there are only 15 in Spain, is a World Organisation for Animal Health (OIE) Reference Centre for classical swine fever (CSF) and a collaborating centre with this organisation to control emerging pig diseases. IRTA-CReSA is also a member of the following consortia: Infravec2 (Infrastructures for insect disease vector research and control), Transvac (European Network of Vaccine Research and Development), ZAPI (Zoonoses Anticipation and Preparedness Initiative), ZIKAlliance (global alliance for the prevention and control of the Zika virus) and VetBioNet (Veterinary Biocontained facility Network).◘

IRTA-CReSA has renewed its accreditation as a Unique Scientific and Technical Infrastructure (ICTS).

► EVAM, the Monells Cattle Farm, is one of IRTA's reference infrastructures.

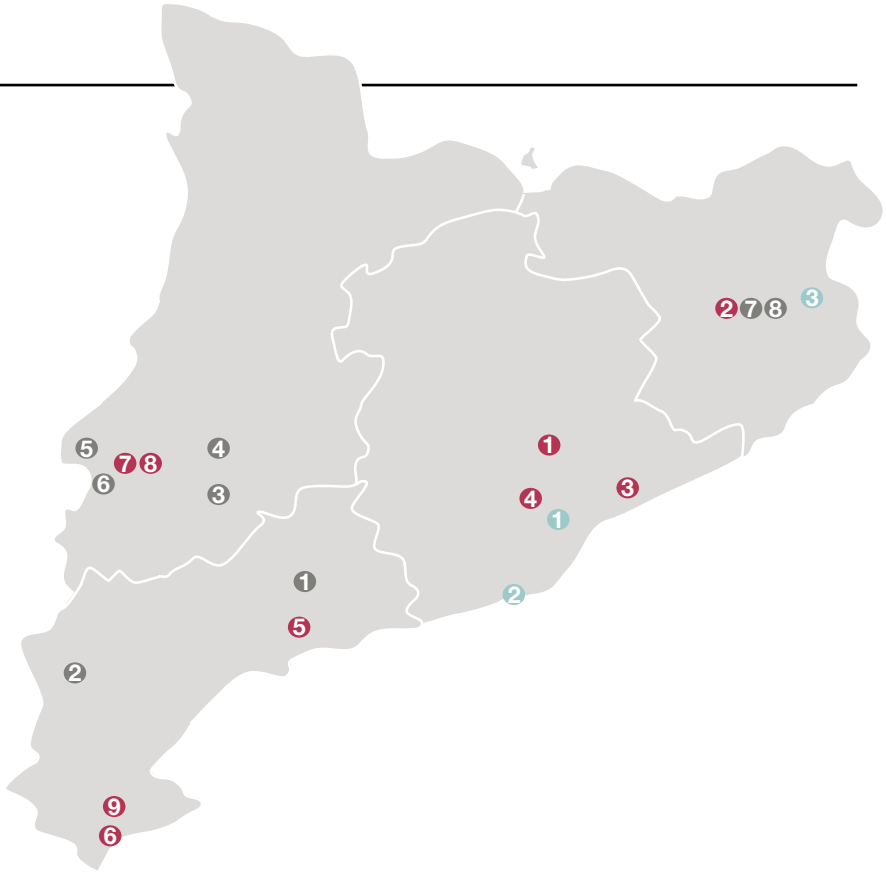
Strategic collaboration agreement with AKO

IRTA and AKO collaborate in industrial refrigeration

One successful case within the framework of the IRTALab project is the strategic collaboration agreement, signed in June 2018, between IRTA and the company AKO, a leader in commercial and industrial refrigeration technology, and winner of the Secartys 2017 award for the most innovative company.

Within the framework of this agreement, AKO has supplied cutting-edge refrigeration and cold-chain equipment and solutions to Building A of the IRTA Centre in Monells (Girona), which the institute uses for its research activities and to carry out joint projects with AKO and other companies. Transfer and training activities are also carried out with companies interested in food conservation processes and food safety.

Our centres



Experimental field stations and farms

Valls Experimental Farm 1

Programmes: Animal Nutrition and Animal Health.
Carrer Licoristes, 42,
43800 Valls, Tarragona

Gandesa field station 2

Support staff: 1
Programmes: Fruit production.
Carretera de Gandesa a Vilalba, km. 2 – 43780 Gandesa

Borges Blanques field station 3

Programmes: Fruit production
Finca La Pujada, Camí de les Verdunes, s/n. 25400 - Les Borges Blanques

Mollerussa field station 4

Support staff: 3
Programmes: Fruit Production, and Efficient Use of Water in Agriculture.
Ctra. Mollerussa-Torregrossa Km. 1.5. 25230 Mollerussa

Gimenells field station 5

Support staff: 9
Programmes: Fruit Production, Sustainable Field Crops and Efficient Use of Water in Agriculture.
C/Roques Blanques s/n.
25112 Gimenells

Alcarràs Experimental Farm 6

Support staff: 5
Programmes: Animal Breeding and Genetics, Animal Nutrition, Animal Welfare, Ruminant Production and Animal Health.
Partida Montagut, s/n.
25180 Alcarràs. Lleida

EVAM Monells Cattle Farm 7

Support staff: 8
Programmes: Ruminant Production.
Finca Camps i Armet.
E-17121 Monells. Girona

Pig Control and Assessment (CAP) 8

Support staff: 10
Programmes: Animal Breeding and Genetics.
Veïnat de Sies s/n E-17121 Monells. Girona

Own centres

Torre Marimon 1

Research staff: 26
Support staff: 102
Staff undergoing training: 10
Corporate Services and Programmes: Fruit Production, Genomics and Biotechnology, Integral Organic Waste Management, Animal Breeding and Genetics, Ruminant Production.
Ctra. C-59, Km. 12,1. 08140
Caldes de Montbui. Barcelona

Monells (buildings A and B) 2

Research staff: 25
Support staff: 40
Staff undergoing training: 16
Programmes: Product Quality, Food Safety and Food Technology.
Finca Camps i Armet.
E-17121 Monells. Girona

Cabrils 3

Research staff: 11
Support staff: 28
Staff undergoing training: 6
Programmes: Sustainable Plant Protection, Genomics and Biotechnology, Integrated Management of Organic Waste.
Ctra. de Cabrils, Km 2.
08348 Cabrils. Barcelona

CReSA. Animal Health Research Centre 4

Research staff: 26
Support staff: 57
Programmes: Animal Health.
Edifici CReSA. Campus Universitat Autònoma de Barcelona.
08193 Bellaterra. Barcelona

Mas Bové 5

Research staff: 14
Support staff: 48
Programmes: Fruit Production, Animal Breeding and Genetics, Animal Nutrition and Animal Welfare.
Ctra. de Reus - El Morell, Km. 3,8. 43120 Constantí. Tarragona

Sant Carles de la Ràpita 6

Research staff: 19
Support staff: 37
Staff undergoing training: 11
Programmes: Aquaculture, Marine and Continental Waters.
Ctra. Poble Nou, Km 5,5. 43540
Sant Carles de la Ràpita. Tarragona

Fruitcentre 7

Research staff: 19
Support staff: 61
Staff undergoing training: 12
Programmes: Fruit Production, Postharvest, Efficient Use of Water in Agriculture, Animal Breeding and Genetics.
Parc Científic i Tecnològic Agroalimentari de Lleida

Agronomists 8

Research staff: 9
Support staff: 12
Research staff undergoing training: 3
Programmes: Sustainable Field Crops, Sustainable Plant Protection, Animal Breeding and Genetics.
Av. Alcalde Rovira i Roure, 191. 25198 Lleida

Ebre Field Station 9

Research staff: 4
Support staff: 9
Staff undergoing training: 1
Programmes: Sustainable Field Crops, Fruit Production, Sustainable Plant Protection
Ctra. Balada, Km 1. 43870
Amposta. Tarragona

Associated centres

Centre for Research in Agricultural Genomics (CRAG) 1

CSIC IRTA consortium centre
UAB UB
Programmes: Genomics and Biotechnology
Campus UAB. Edifici CReSA.
Bellaterra. 08193 Cerdanyola del Vallès. Barcelona

CREDA Center for Agro-food Economics and Development 2

IRTA UPC consortium centre
Programme: Agri-food Economics.
Mediterranean Technology Park.
Edifici CReSA. C/ Esteve Terrades, 8. 08860 Castelldefels. Barcelona:

Mas Badia Field Station 3

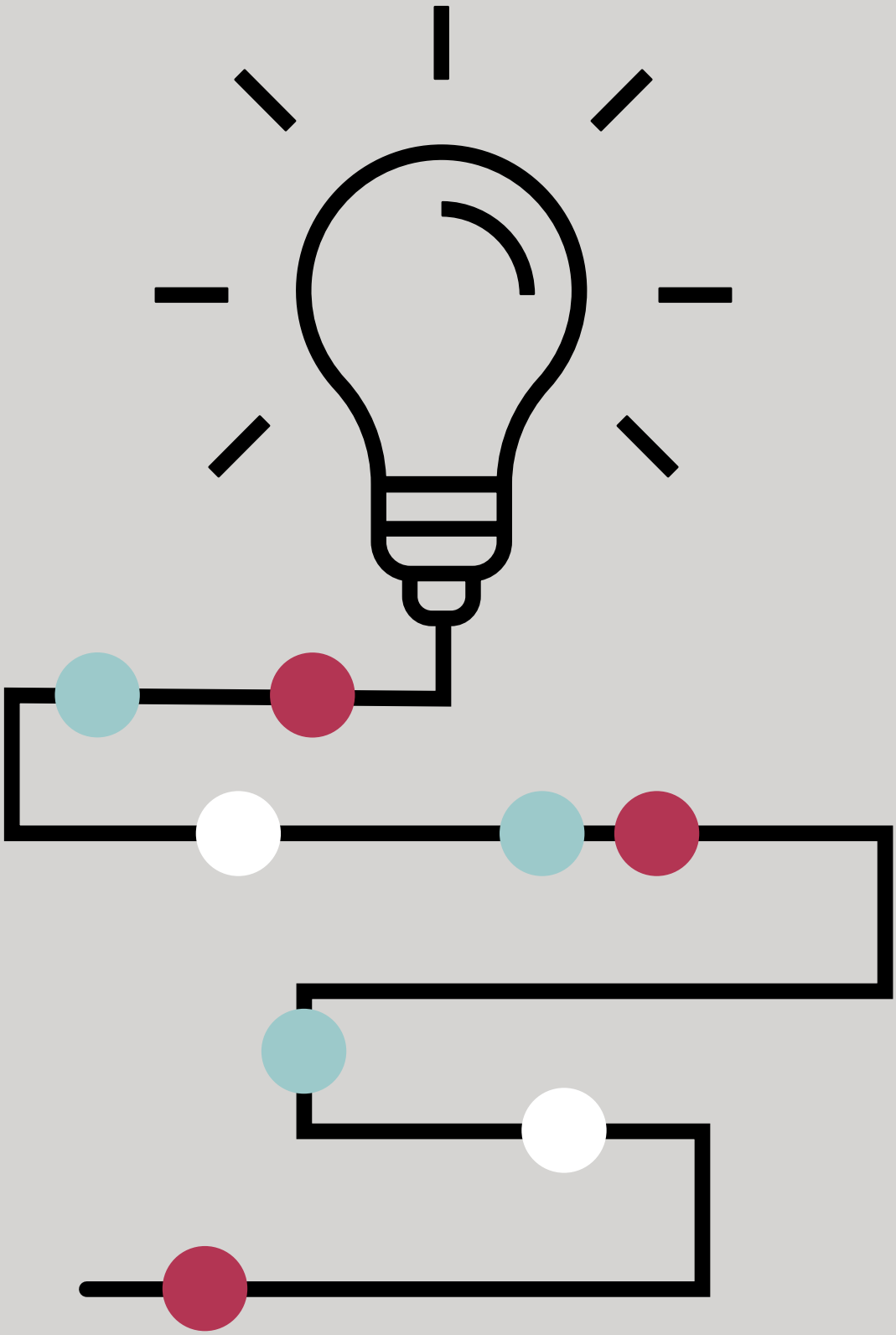
IRTA Mas Badia Foundation consortium centre
Programmes: Sustainable Field Crops, Fruit Production, Postharvest, Sustainable Plant Protection.
Mas Badia. 17134 La Tallada d'Empordà. Girona

Overview of the centres

Own centres	9
Network centres	3
Experimental field stations and farms	8

Territory

Locations in the territory	20
Barcelona	5
Tarragona	5
Girona	4
Lleida	6



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Innovation
Society

3

3.0

The knowledge transfer to the agri-food sector to make it more competitive and sustainable gives all its meaning to our research work. For IRTA, it is a priority to collaborate with companies and other players in the sector in order to introduce innovations that improve the yield of agricultural and livestock-breeding holdings, which allow healthier food to be produced that is safer for human consumption and that enables us to tackle global challenges such as climate change by promoting the principles of the circular economy in the agri-food sector.

2018 was an exceptional year in this respect, because we were able to see the extraordinary results of long work processes. We saw how, 14 years on, a European research project on animal welfare, which began in 2004, has become a new certification that will be managed by IRTA; we celebrated the 25th anniversary of the Porc d'Or Awards and we were able to measure the growth of the pig sector and its productivity thanks to a research tool, the BDporc database, which has become an incentive for innovation and management improvements. In 2018, we also celebrated the 25th anniversary of the Rice Open Field Day, which brings together the Terres de l'Ebre producers, cooperatives and companies linked to the sector. For the first time we organised the Fòrum Carni ("Meat Forum"), a reference workshop for the sector, focusing on innovation: and we organised various international courses, all aimed at using the knowledge generated by IRTA to serve sectoral players.

The demonstration activities and the operational groups play a key role in this area.

Reaping the rewards of knowledge transfer

In 2004, the European programme Welfare Quality® was implemented, in order to develop standards at a European level to assess the welfare of farm animals, as well as information systems and practical strategies for improving it. IRTA's Animal Welfare programme was an active partner in the project and promoted the creation of the Welfare Quality Network, a network for the scientific exchange and promotion of activities that help develop Welfare Quality® systems for assessing animal welfare. The network also provides knowledge and services to those players in the animal production chain that want to introduce these systems.

As a result of this work, in 2018 we completed the design of the **IRTA Animal Welfare Certification**, which is applied both to farms and slaughterhouses and establishes a common regulation to enable different certification bodies to operate under the same premises and protocols based on Welfare Quality. For its launch in 2019, the certification was completed for pigs, cattle and poultry (egg-laying chickens and meat chickens) and it will later be developed for sheep, goats, and turkeys in the slaughterhouse. The final objective of the Welfare Quality® protocols and the new certification is to achieve a high quality meat for consumers whilst ensuring the welfare of the animals we consume.

Quality and professionalism are the two aspects that are valued when it comes to awarding the **Porc d'Or** Awards, which were adjudicated for the **25th year** in 2018, in an event held in Lleida on 23 November. Through the Spanish Reference Swine Database BDporc tool managed by IRTA, the Porc d'Or Awards have witnessed changes in a very dynamic and demanding sector, which has required producers to make an effort to adapt constantly to the changing market. As Pedro López, director of BDporc and responsible for the prizes from 1994 to 2017, pointed out, productivity has risen from 19.7 weaned piglets per sow per year to 29.46, and the fertility rate, which was 79.63% in 1994, had increased to 87.38% in 2017, figures that reflect the continuous improvement in this sector, one of the most important for our economy.

The 25th Porc d'Or Awards were awarded to 45 producers out of 120 nominees, selected from 800 farms, where a total of 950,000 producers registered with DBporc were analysed. Once again, the competition was supported by the company Zoetis, which has collaborated with these awards since they started. This year's competition was also supported by Interporc and La Paeria – Lleida City Council.

The 25th Porc d'Or Awards endorsed the increase in productivity and the quality in the sector.

▶ In 2018, the preparation for the IRTA Certificate in Animal Welfare was completed. It was based on the Welfare Quality project.

▶ The rice sector met at the Rice Open Field Day, which celebrated its 25th anniversary in 2018.

Another initiative that celebrated its **25th anniversary** during the last financial year was the **Rice Open Field Day**, which was held at the IRTA Ebre Field Station in Amposta in September 2018. This event, which brings together producers, cooperatives and companies in the rice sector, seeks to promote the research and knowledge IRTA carries out to meet this sector's demands. More specifically, at the 2018 Rice Open Field Day, the results of a strategy designed to reduce the presence of the apple snail, and advances in the study of dry seeding were presented to the event's 320 participants. Elisenda Guillaumes, the Government of Catalonia's Director General of Agriculture and Livestock Farming, underlined the importance of research in "allowing progress to be made to find solutions to any problems that may arise" and in addressing the sector's needs.

Workshops and courses

In October 2018, IRTA, in collaboration with Interempresas Media, editor of the publication *Tecnocarne*, took charge of organising the ***Fòrum Carni*** (Meat Forum) for the first time. This forum is a reference meeting place for all the professionals working in the meat sector in Spain. The aim of the Forum, which was held for the third time in 2018, is to bring together owners, managers and technicians from the most important production companies, to share information on successful cases and best practices, with innovation as the main theme. The Forum was held in Girona, in recognition of the importance of its meat sector, a benchmark in innovation, which has grown significantly over the last few years.

Between 17 September and 5 October 2018, the 17th **International Course on Meat Products Technology** was held, with 60 participants from across Spain and several countries in Latin America, the highest participation recorded to date. The course, divided into three independent modules —on fresh meat products, on raw and cured dry sausages and salt-cured meat, and on cooked meat products— allows the students to gain a very broad view of the entire meat value chain, from the production of the raw material to the preparation, packaging and marketing of the meat products.

The new Oil Assessment Course was attended by 22 students of 10 different nationalities.

▶ A total of 60 students from Spain and several Latin American countries took the 17th International Course on Meat Products Technology.

▼ IRTA organised the *Fòrum Carni* ("Meat Forum") for the first time. This was the third time the event was held in Girona.

The new Olive Oil Assessment Course addresses the growing international interest in olive oil as a healthy fat and a gourmet product.

Two international courses in Plant Production were also held. More specifically, the first **Olive Oil Evaluation Course** was held between 19 and 23 March. It was attended by 22 professionals of 10 different nationalities, most originating from Europe, but also from Japan, Chile and the USA. This diversity, which reveals the international boom in the consumption of olive oil as a healthy fat and a gourmet product, facilitated a contrast of opinions and exchange of experiences in a course that teaches students how to perform a critical assessment of the quality of olive oil for commercial purposes. The objective is to increase the participants' skill in detecting counterfeit oils and identifying fraudulent labels, and to highlight the useful information required for the proper characterisation of extra virgin olive oil.

The third **International Course in Fruit Postharvest Technology and Management** was held between 5 and 10 November in IRTA's Fruitcentre building in Lleida. There were around 15 participants from Catalonia, France, Peru, Portugal and Chile. The course programme combines theoretical sessions on the latest developments in research into pathogens and rot or into conservation technologies with practical activities and visits to fruit processing centres to see in situ the practical improvements in the handling and conservation of different types of fruit.

Demonstration activities

Demonstration activities are innovative initiatives that test, under real conditions, the viability or the functioning of a technology, a production system or a new organisational proposal that may entail a substantial improvement to the competitiveness or the environmental sustainability of the arable or livestock farms or forestry plantations, of the agri-food or forestry industry or traditional food products activity.

The purpose of these activities is the transfer of technical knowledge and management adapted to the different territorial and sectoral realities, and they can involve demonstration projects, experimental plots, pilot plants and facilities, test fields and demonstration itineraries.

In 2018, **15 new demonstration activities** were implemented with IRTA's participation.

Examples from the Food Industries area include the **Creativation project**, aimed at agri-food producers to promote creativity in the development of new products. In order to do this, the project generates a database of ideas of new products collected in creativity sessions. Those with the greatest potential for success in accordance with the working group's criteria and technological capacities are selected. A case study of product development and optimisation is worked on and methodological guides are generated, which help agri-food producer associations in each phase of the process of creating and developing new products.

The same area started the **HPPAlim** demonstration projects, which aim to promote the advantages offered by the introduction of high hydrostatic pressure (HP) technology to obtain safer, healthier and more innovative food, and **Proterm**, which aims to transfer to the sector in a practical, visual manner the expertise and scientific values of the working methodology to create thermally treated products, whilst at the same time improving risk detection and informing people about the consequences of poor practices.

Meanwhile, in 2018, the Plant Production area developed various demonstration projects for the introduction of high-density models in commercial almond tree plantations (**+Ametlla**) and for the improvement of the management of the use of plant protection products in fruit trees (**Fitogest**). The **Sustainability in Agrosystems transversal area** carried out the demonstration project called **Llit-compost**, which implemented a new technology for animal welfare and the use of livestock manure.□

The +Ametlla demonstration project studies the introduction of high-density models in almond tree plantations.

▶ The aim of the demonstration activities is the transfer of technical knowledge and management to the producers.

Operational groups

The Operational groups are formed through the association of different stakeholders with common interests in order to focus on a specific, practical innovation project. Any entity or company linked to the agri-food sector can form part of a Operational Group. The members of a Operational Group undertake to work together actively to solve a specific territorial or sectoral problem or to make the most of a given opportunity.

These groups receive funding from the EU Rural Development Programmes, some through the Catalan Government's Ministry of Agriculture, Livestock, Fisheries and Food (DARP), and others through the Spanish Government's Ministry of Agriculture, Fisheries and Food.

More specifically, in 2018 funding was granted for **24 new operational groups** with the participation of IRTA, 23 of which through DARP, which join the 5 existing operational groups approved in previous financial years.

A wide variety of subjects are focused on by these groups, just like in the demonstration activities, and between the active groups or those started in 2018, we can find that the detection of the bacterial disease, fire blight, in the pear tree (Fupebro), the detection and eradication of the bitter almond (promoted by State producer and exporter associations) or water saving in rice growing (by irrigation communities and rice growers in the Ebre Delta),

to innovative strategies for optimising the use of nitrifiers in cooked meat dishes (GO, led by Sant Dalmai, SAU), the optimisation of the homogeneity of the product and the reduction in residual brine in the cured ham production industry (led by Boadas 1880), or the use of the most sustainable plastics in the meat industry (led by Embotits Salgot, SA).

Of the activities carried out in 2018, we could highlight the results transfer, through the publication of a document containing best practices (June), by the Operational Group 2015-2017 on the Extension of the commercial useful life of vacuum-packed pieces of steak, up to 84 days for export, a project led by Anafric, in which the Viñas Group, the Mercabarna General Meat Company, and Irta participated. We should also underline the progress made by the Fresnack Operational Group, led by Frit Ravich, SL whose objective is to develop new products (healthy snacks) using sweet fruit (apple, pear and peach). They are cut into slices and dried using a new technological process, which combines dehydration with hot air (conventional) and vacuum microwave technology, which gives snacks a useful life of 4-6 months. In addition to Frit Ravich, the following companies are participating in the project: the Girona Fruits SCCL, ACTEL SCCL and Giropoma Costa Brava cooperatives, and IRTA, which acts as the coordinator.

In 2018, 24 new operational groups were started up, 23 funded by DARP.

◀ The Operational Group led by Boadas 1880, worked on optimising product homogeneity in ham production.

▼ The Fresnack Operational Group developed healthy snacks using dried fruit (apple, pear and peach).

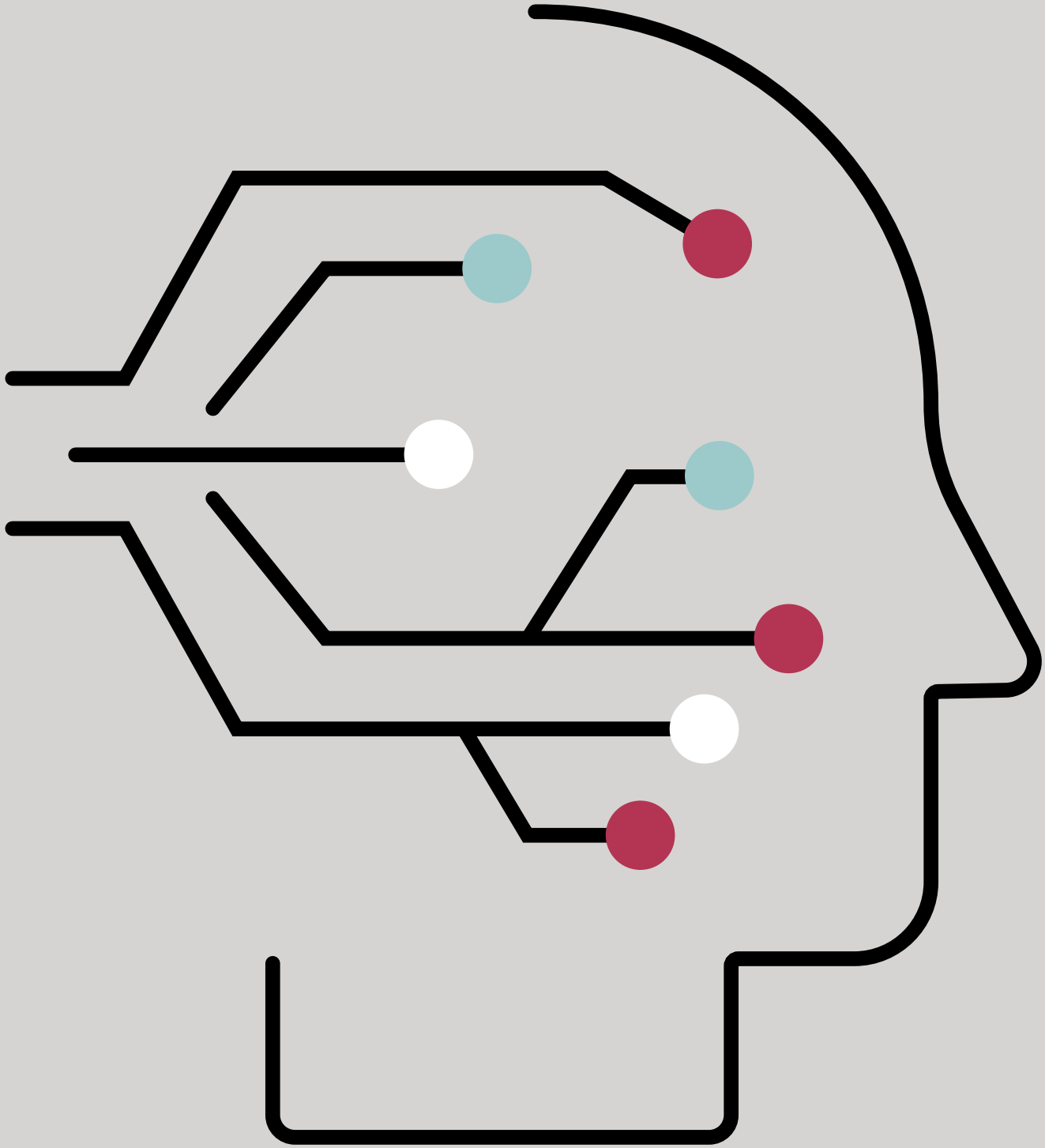
Intellectual property

IRTA has 29 registered plant varieties and 20 registered plant clones, almost all of which are found in farms.

In 2018, IRTA applied to register a new patent and register three new cereal varieties, which join an extensive catalogue with around 50 protected products.

In 2018, IRTA **applied for a patent and made three applications to register cereal varieties**, which will join the wide range of items in the centre's intellectual property catalogue. IRTA holds 16 patents, seven of which are being cultivated.
It also has 14 cereal varieties that are currently registered, 12 of which are being cultivated; 19 varieties of peach, all being cultivated; and 4 varieties of almond tree, 11 olive tree clones, 5 carob tree clones, 4 hazelnut tree clones, and a variety of geranium and different walnut tree clones that are being cultivated.

In 2018, IRTA earned over 750,000 euros from the royalties for the cultivation of all these varieties.



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Society

4

4.0

Social participation in the definition of the scientific agenda and in the impetus in innovation is essential to guarantee success when we talk about dealing with complex challenges such as assuring that everyone has access to healthy food, to establish sustainable production processes and consumption patterns, to ensure the proper management of natural resources and to combat climate change.

Only if society as a whole becomes aware of the importance of research to provide solutions for these challenges will we have sufficient resources to continue investigating in order to have more resistant and abundant harvests with limited resources, to eliminate the use of polluting composts, to have healthier, more productive animals, and to protect endangered species and ecosystems, etc. Citizens with their demands for a more sustainable world and their role as educated consumers will eventually give rise to a circular economy, which reduces, reuses and recycles waste at all points in the value chains in the agri-food sector.

For this reason, it is a priority for IRTA to promote and participate actively in initiatives to disseminate scientific research –exhibitions, festivals, talks, etc.– making the maximum use of our many locations over the country and networking with other entities, but also to commit ourselves to programmes that go beyond raising awareness and constitute social integration tools.

Bringing research closer to the public

Different activities were carried out in 2018 by the IRTA teams in order to bring the research and innovation that is carried out in our facilities closer to the general public.

The first activities were part of the LIFE Migratoebre project, which IRTA promotes along with the Institute for the Development of the Ebre Regions [Institut per al Desenvolupament de les Comarques de l'Ebre, ICEDE], the Ebre Delta Natural Park, the Centre for the Study of Mediterranean Rivers [CERM–Centre d'Estudis dels Rius Mediterranis] at the University of Vic, and the Catalunya–La Pedrera Foundation. In March 2018, the first part of the travelling **exhibition on the River Ebre and the LIFE Migratoebre project** was opened in the Ter Museum [Museu del Ter] in Manlleu. It was in Pont de Suert (Alta Ribagorça), from August to October, and on 30 de November it was opened at IRTA's centre in Sant Carles de la Ràpita.

The Migratoebre project also promoted the installation of information boards for the public on the fish ladder at the Ascó weir (March) and in Flix and Xerta (November) and it took part in the World Fish Migration Day celebrations (18, 20 and 21 April) —with activities for primary and secondary school pupils and for families at the Ter Museum (Manlleu), in Deltebre and at the Catalunya-La Pedrera Foundation's MónNatura Delta Centre— and the Children's Festival [Festa dels Menuts] (30 June and 1 July) organised by MónNatura Delta.

On 9 and 10 June, IRTA participaded in the **Festival of Science** [Festival de la Ciència] **in Barcelona**, a meeting promoted by Barcelona City Council, which was held for the 12th time in 2018. IRTA organised seven micro-talks on subjects linked to our research: *Changes for sustainable agriculture* (Robert Savé); *Using electricity produced by bacteria* (Marc Viñas); *Why do cows go mad? The enigma of prions* (Enric Vidal); *Insects in agriculture* (Georgina Alins); *Bacteria, small, invincible living beings* (Lourdes Migura); *The sex of fish will set us free* (Cristòbal Aguilera); and *The surprising viruses in plants* (Ana Montserrat Martín and Maria José Aranzana).

On 28 September, as part of **European Researchers' Night** promoted by the EU, an **Open Day** was organised at the IRTA **Fruitcentre** in Lleida. The activities included a photographic exhibition on the research and fieldwork carried out at IRTA, a guided tour for the centre's researchers to allow them to get to know the facilities and the research carried out there, and a series of workshops open to families on subjects related to fruit production, postharvest and in vitro culture.

IRTA also took part in the **23rd Science Week**, promoted by the Catalan Foundation for Research and Innovation ›

▶ As part of the European Researchers' Night, the Fruitcentre in Lleida opened its doors to schoolchildren and families.

IRTA researchers gave seven talks at the Festival of Science in Barcelona.


NOSTROMO
IRTA
IRTA

The ‘Feeding on future’ [‘Mengem futur’] report, proposes a strategy for progressing towards a productive, sustainable, healthy, responsible system that is universally accessible.

[Fundació Catalana de la Recerca i la Innovació, FCRi], represented by the researchers Assumpció Anton and Nancy Peña, who on 15 November van gave a talk to the primary 6 class at the Escola Pérez Sala, in Vilassar de Mar, entitled “Did you already want to be scientists when you were little?”. This activity served to teach the children about Life-Cycle Assessment (LCA) and, above all, it encouraged them to consider research as a job they might do in the future.

Beyond the more entertaining educational activities, we know that it is important to offer society tools for critical reflection on the challenges facing the agri-food sector.
The **‘Feeding on future’** report is in line with this approach. It was published in July 2018 by the Government of Catalonia’s Advisory Council for Sustainable Development (CADS), which several of IRTA’s researchers participate in. The ‘Feeding on future’ report proposes a national pact for a food policy, and a strategy for progressing towards a productive, sustainable, healthy, responsible system that is universally accessible by all the inhabitants of Catalonia.

The report was drawn up by Carles Ibáñez, a researcher in the IRTA Marine and Continental Waters programme, Joan Vallvé, former Minister of Agriculture, Livestock and Fisheries of the Government of Catalonia, and Montserrat Viladrich, lecturer in the Department of Business Administration

Around ten researchers from IRTA collaborated with the Government of Catalonia's Advisory Council for Sustainable Development in the preparation of the 'Feeding on future' ['Mengem futur'] report.

and Financial Management of Natural Resources at the University of Lleida. The other collaborators in the document were Jacint Arnau, researcher in the Food Technology programme; Àlex Bach, researchers in the Ruminant Production programme; Joan Bonany, researcher in the Fruit Production programme; Joaquim Brufau, researcher in the Animal Nutrition programme; Joan Girona, researcher in the Efficient Use of Water in Agriculture programme; Francesc Prenafeta, head of the Integrated Organic Waste Management programme; Robert Savé, researcher in Fruit Production; and Joan Tibau, director of the Monells centre.

Moreover, in 2018, the IRTA researchers published a total of **159 articles in technical and outreach media**.

Finally, we should mention the ongoing work that is being carried out in collaboration with the media, so as to achieve the maximum impact and dissemination of the news on research and innovation generated by our work. In 2018, around 20 press releases were sent out, which generated over 2,402 media coverage items. Of IRTA's television appearances, we should highlight the one on 5 June, in the popular science programme, **Lab24**, on **TVE 24h**, which broadcast an extensive **report on IRTA-CReSA**, as part of a series on the network of Unique Scientific and Technical Infrastructures (ICTS), which IRTA-CReSA is part of, serving as a Network of High Biosafety Laboratories (RLSAB) node.

Horticulture for social integration

IRTA's social commitment extends to projects that go beyond the educational-informative aspect and involve others such as the use of horticulture as a tool for integration. This is the objective of the **urban agriculture** project promoted by **Barcelona City Council**, which in 2018 was expanded with the introduction of two new urban gardens, on the rooftops of municipal buildings in Carrer d'Avinyó (Ciutat Vella) in Barcelona. These joined the three existing sites: one at the headquarters of the Municipal Social Services Institute (IMSS), in Carrer de València (Eixample), initiated in 2016, and two more in Carrer de la Creu Coberta, in the Sants-Montjuïc district, which were set up in 2017.

Around 50 people with varying levels of mental or physical disability work in these gardens, managed by several social entities. The project not only favours the inclusion of disabled people, it also allows the surpluses from the harvests produced in these urban gardens to be given to soup kitchens and food banks, which increases the initiative's social component. A study carried out in 2018 concluded that the project generates notable benefits in the quality of life and personal development of the participants, especially in the first few months.

Both the installation of these urban gardens, with raised growing tables and a drip irrigation system, and the

An urban garden project, started in 2016, was expanded last year with two new installations.

▼ In May 2018, 55 people participating in the urban garden project visited the IRTA centre in Cabrils.

professional advice for managing them, have involved the collaboration of technical staff from IRTA since the project started in 2016.
We also carried out two studies to measure the quality and productivity of the gardens in the Eixample and Sants-Montjuïc districts, which identified the presence of pollutants such as cadmium and lead that were far lower than the maximum levels allowed by the European Union, and lower than those in other gardens located near roads with a high volume of traffic.

The gardens produce lettuces, escaroles, spinach, chard, tomatoes, peas, courgettes, cucumbers and peppers, as well as various aromatic plants, with a productivity level similar to that of commercial crops.

The project, coordinated by the Municipal Institute for the Disabled [Institut Municipal de Persones amb Discapacitat, IMPD], also involves the collaboration of six different social bodies, thereby helping to reinforce the associative network of districts that contain urban gardens.◘

The IRTA technicians collaborate in the installation of the gardens and offer professional advice to the people that manage them.

▼ Around 50 people with varying degrees of physical or intellectual disability work in the five urban gardens set up on the rooftops of municipal buildings in Barcelona.

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