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 Occitanie-Toulouse
Centre

INRAE



Presentation of the **Occitanie-Toulouse centre**

November 2023



Pierre-Benoit Joly
President of Occitanie-Toulouse Centre
INRAE Regional Delegate

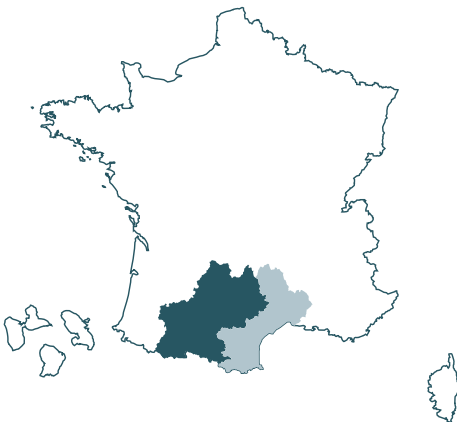
«A node within an especially rich higher-education, research and innovation system, in a region where agriculture and the agrifood sector are the largest employers, the Occitanie-Toulouse Centre is a major player in science and open innovation at the service of the agroenvironmental transitions of the food systems.»

OCCITANIE-TOULOUSE RESEARCH CENTRE

With over 1,200 INRAE (French National Research Institute for Agriculture, Food and Environment) researchers, engineers and technicians, including 688 with tenure, the Occitanie-Toulouse Centre produces over 11% of the Institute's publications.

Open to innovation with local players, the Centre focuses on single-discipline, interdisciplinary and transdisciplinary research in biology, biotechnology, the environmental sciences and agronomy, animal sciences and health management, as well as the economic and social sciences, mathematics and AI. Our finalised research is implemented via a number of strong and diverse academic partnerships within a dozen joint research units backed up by a wide range of technological platforms and experimental units.

The Occitanie-Toulouse Centre encompasses a wide range of skills and generates basic and actionable knowledge, with research units involved in various international projects, particularly in the areas of agroecology, biotechnology, high-throughput biology, economics and food toxicology.



THE DYNAMICS OF THE CENTRE

At INRAE Occitanie-Toulouse, the teams organise their research and innovation activities in response to 3 main challenges:

- the achievement of more sustainable agricultural and forestry systems which are suited to a changing climate and based on combinations of all kinds (technological, digital, organisational, systemic, etc.);
- integrated management of animal and human health, to ensure the production of healthy foodstuffs in an environmentally friendly manner;
- new processing systems for agricultural resources to create a locally based bioeconomy.

CONTEXT AND PROSPECTS

Farming and the agrifood sector are the largest economic sector in the Occitanie/Pyrenees-Mediterranean Region. Our research activities are fully consistent with the priorities of the regional research and innovation strategy policy on food production and the utilisation of biomass, as well as of the Regional Pact for sustainable foodstuffs. Our teams work with an associate international laboratory, a European infrastructure, 3 Labex (excellence) certified laboratories, 2 Equipex (excellence) certified technical facilities, 3 joint technological units, 3 university colleges focused on research, 7 biotechnology/bioresource projects and a bioinformatics project, a European Research Council-funded project, a preindustrial demonstrator, 3 Carnot (labs with public-private partnerships), an Innovation Territory and a Convergence Institute which encourages interdisciplinary approaches involving biology, ecology, the human and social sciences, agronomy and the digital sciences.

Our regional partners



Our research priorities

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The Centre's teams contribute to one of INRAE's major areas of research: human health in connection with human foodstuffs and the integrated management of animal health. They play a major part in understanding the harmful effects of xenobiotics in foodstuffs, as well as the ways in which food poisoning and antibiotic resistance emerge in connection with human and animal environmental reservoirs. We cooperate with Inserm (French National Institute of Health and Medical Research), which contributes its understanding of physiology, to work on the interactions between microbiota and the gut. The skills available at our site will enable us to contribute to interdisciplinary research based on the concept of "One Health", the purpose of which is to strengthen the connection between animal and human health.

- **Joint research units:**
- Food toxicology (TOXALIM)
 - Host-pathogen interactions (IHAP)
 - Institute for Research on Digestive Health (IRSD)
 - Stockbreeding Genetics, Physiology and Systems (GenPhySE)
 - Therapeutic Innovations and Resistances (InTheRes)

- **Partners:**
- National Veterinary College, Toulouse (ENVT)
 - Toulouse III University 'Paul Sabatier' (UT3)
 - Purpan Engineering College (INP-PURPAN)
 - Engineering Faculty of Life Sciences, Toulouse (INP-ENSAT)
 - Inserm (French National Institute of Health and Medical Research)

- **Joint research units:**
- Toulouse Biotechnology Institute (TBI)
 - Agroindustrial Chemistry Laboratory (LCA)

- **Joint service unit:**
- Toulouse White Biotechnology (TWB)

- **Partners:**
- National Institute of Science and Technology, Toulouse (INSA Toulouse)
 - Toulouse Graduate School of Chemicals, Materials and Industrial Engineering (INP-ENSIACET)
 - CNRS (French National Centre for Scientific Research)

1 INTEGRATIVE AND PREDICTIVE BIOLOGY (PLANT - ANIMAL - MICRO-ORGANISMS)

2 FOOD TOXICOLOGY AND HEALTH (ONE HEALTH / ANIMAL AND HUMAN)

3 BIOTECHNOLOGIES AND BIOECONOMICS

4 AGROECOLOGY OF FARMING AND FORESTRY, ENVIRONMENTAL ECONOMICS, ANALYSIS OF SYSTEMS

1



Our research on integrative biology contributes to better knowledge of animal, plant and microbial systems in forced and changing environments.

Our work is organised according to a number of priorities: the organisation and functioning of the genome and the effects of the environment on the expression of traits of interest, or adaptation to environmental stressors and to resistance to disease. Due to climate change, the study of symbiotic or pathogenic plant-micro-organism interactions is emphasised in the plant sciences. In the animal sciences, the synergy between competencies in various sectors (small ruminants, pigs, rabbits, ducks and

geese) builds up strength to meet the new challenges of stockbreeding. Research on microbial systems opens up new horizons to synthetic biology by discovering new enzymatic transformation pathways.

- **Joint research units:**
- Plant, Microbe and Environment Interaction Laboratory (LIPME)
 - Stockbreeding Genetics, Physiology and Systems (GenPhySE)

- **Own research units:**
- Applied Mathematics and Computer Science, Toulouse (MIAT)
 - Wild Animal Behaviour and Ecology (CEFS)

- **Experimental units:**
- Agroecology and Crop Phenotyping experimental unit (APC)
 - La Fage experimental unit (UEF)

- **Partners:**
- Engineering Faculty of Life Sciences, Toulouse (INP-ENSAT)
 - National Veterinary College, Toulouse (ENVT)
 - CNRS (French National Centre for Scientific Research)

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As fossil-fuel resources become exhausted, our work focuses on the biological and physicochemical processes used by micro-organisms and their enzymes, as well as their physicochemical fractionation and processing processes, with a view to utilising agricultural resources in the areas of energy, chemistry, health, cosmetics and materials. Our research activities cover a broad spectrum, from basic knowledge to the design and improvement of biological systems and industrial processes for the processing of agricultural resources. We aim to define the industries of tomorrow in accordance with the principles of the circular economy.

Agroecology is a source of new concepts which enable people to respond to the many issues faced by the regions.

The Centre's scientists study the sustainable management of the natural resources involved in agriculture, forestry, biodiversity and human activity in an area that stretches from the Pyrenees to the city of Toulouse. A wide range of disciplines (agronomic and environmental sciences, remote detection, mathematics and computer science, sciences for action, economic and social sciences) are used to study technological and organisational innovation as well as transition processes for production systems (field crops, stockbreeding) and their socioeconomic impact.

Joint research units:

- Agroecology, Innovation and Territories (AGIR)
- Dynamics and Ecology of Agroforestry Landscapes (DYNAFOR)
- Stockbreeding Genetics, Physiology and Systems (GenPhySE)
- Toulouse School of Economics (TSE-R)

Research units:

- Centre for the Study of Biosphere Space (CESBIO) (unit under contract)



- Wild Animal Behaviour and Ecology (CEFS)
- Applied Mathematics and Computer Science, Toulouse (MIAT)

Experimental and service units:

- Agroecology and Crop Phenotyping experimental unit (GCA)
- La Fage experimental unit (UEF)
- Observatory for Rural-Development Community Programmes (ODR)

Partners:

- Engineering Faculty of Life Sciences, Toulouse (INP-ENSAT)
- Purpan Engineering College (INP-PURPAN)
- National Veterinary College, Toulouse (ENVT)
- Toulouse University 'Capitole' (UT Capitole)
- Toulouse III University 'Paul Sabatier' (UT3)
- CNRS (French National Centre for Scientific Research)
- CNES (French National Centre for Space Studies)
- IRD (French National Research Institute for Sustainable Development)

TRANSVERSE AXIS: COMPUTER SCIENCES AND MATHEMATICS FOR THE AGROBIOSCIENCES



The massive digitisation of agrobioscience data, from molecular biology to agroecology, has generated new working conditions for research activities. INRAE is investing massively in predictive approaches in biology, from genes to agroecosystems,

in which new prospects for study are being opened by the development of modelling and algorithms. Digital approaches are having a transformative effect on research activities: animal genetics, variety selection, synthetic biology, predictive toxicology or field crop management. The "Computer Science and Mathematics for Agrobioscience Pole" has increased the potential for collaboration on modelling and data science in the life sciences, in accordance with our commitment to the planned interdisciplinary institute for AI.

Research unit:

Applied Mathematics and Computer Science, Toulouse (MIAT)

Service unit:

Observatory for Rural-Development Community Programmes (ODR)



For news and further information concerning our research
www.inrae.fr/en/centres/occitanie-toulouse

Joint scientific infrastructures support research and innovation at all units

Around 15 research infrastructures in the areas of genomics, sequencing, transcriptomics, phenotyping (from lab to field), metabolomics, imaging, screening, statistics, agrosystem modelling, monitoring and assessment of agricultural policies for rural development.

- French Plant Genomic Resources Centre (CNRGV - Genotoul)
- Bioinformatics Platform (GeT-Bioinfo - Genotoul)
- Biochip Platform (GeT-Biopuces - Genotoul)
- Genome and Transcriptome Platform (GeT-PlaGe - Genotoul)
- Transcriptomics Platform (GeT-Trix - Genotoul)
- Metabolomics and Fluxomics Platform, Toulouse (Métatoul - Genotoul)
- Integrated Screening Platform, Toulouse (PICT - Genotoul)
- Toulouse imaging-network platform (TRI - Genotoul)
- Platform for the modelling and computer simulation of agroecosystems (RECORD)

- Plant and micro-organism phenotyping platforms (Phenotoul): TPMP (Genotoul) - Héliaphen-Agrophen
- Observatory for Rural-Development Community Programmes (ODR)
- Information system for the analysis of livestock genome analysis (SIGENAE)
- Toulouse White Biotechnology (TWB)
- Pyrénées-Garonne workshop zone (ZA/PYGAR)

Four experimental units: field crops (cereals and oilseeds), sheep, rabbits and wild fauna (roe deer).

➤ PARTNERSHIPS, ADDING VALUE, INNOVATION

A continuum between research, innovation and transfer

Our scientific activities are performed within a continuum between research and innovation as well as a well-established culture of partnerships with professionals, and are utilised in the form of technological and methodological progress, patents, software or start-ups based on these innovations. The aim is to contribute to international research, innovation and transfers in the areas of bioeconomics while providing opportunities for local development. The Centre also supports environmental transitions and the local management of resources to assist farmers under the pressure of climate change. On the health front, the One Health approach involves 5 joint units in projects such as antibiotic resistance, the avian flu virus, etc. Finally, with the support of local authorities, the Centre massively supports international-standard joint research infrastructures in the areas of the life sciences and technologies at GIS Genotoul, and focuses on developing e-infrastructures and high-throughput or high-precision phenotyping facilities.

Socio-economic partnerships

The Centre cooperates directly with a wide range of socio-economic partners, from SMEs to large groups, and takes an active part in European, national and regional systems intended to improve the integration of such collaborations. INRAE supports preindustrial demonstrator Toulouse White Biotechnology (TWB). The Centre is also a member of 3 Carnot (3BCAR, France Futur Elevage, Plant2Pro) which promote cooperation between the public and private sectors, especially with SMEs. It also cooperates closely with technical institutes (Terres Inovia, Arvalis, Idele, etc.) within joint technological units (small-ruminant genetics, ruminant health, oilseeds and pulses) and with the Chambers of Agriculture network. It is a member of competitive cluster Agri Sud-Ouest Innovation. It is involved with companies (small and medium-sized enterprises) in several joint agrifood laboratories, and works with farmers within the scope of large-scale programmes (PDSR, GIEE, etc.).

Innovative projects

› A partner in around 20 certified projects

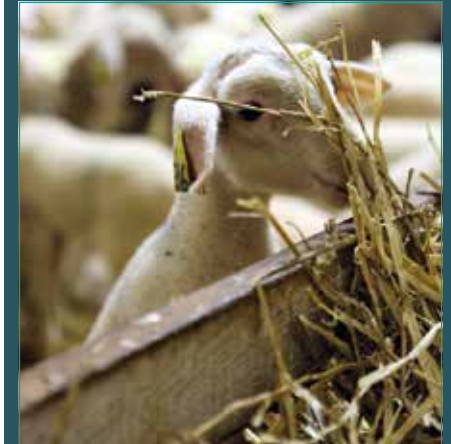


The Centre is in charge of or takes part in around 20 certified projects with a wide variety of partners (an associate international laboratory, 3 Labex certified laboratories, 2 Equipex certified technical facilities, 3 joint technological units, 3 university colleges focused on research, 7 biotechnology/bioresource projects and a bioinformatics project, an ERC-funded project, 3 national infrastructures, a preindustrial demonstrator, 3 Carnot

(labs with public-private partnerships), an Innovation Territory and a Convergence Institute) and is also a partner in a 3IA (Interdisciplinary Institute for Artificial Intelligence) project based in Toulouse. Together with INSA, the Centre is a player of the first magnitude in the IBISBA-EU European infrastructure project dedicated to the development of industrial biotechnology, which is led by France and coordinated by INRAE. All the Centre's scientific undertakings are underpinned by these projects, with major actions in the areas of integrative biology, green and white biotechnologies, the economic and social sciences and computer sciences and mathematics.

Three major successes

- The breeding of the Lacaune ewe, a 'superbreed' of dairy ewes at the European level, has been highly beneficial to the Roquefort sector – the top user of ewe's milk – and also to other dairy industries.



- The sequencing of the sunflower and wheat genomes has speeded up the breeding of productive, disease-resistant varieties which are also suited to climate change.
- Agroecology: the redesign of cultivation systems, which involved species diversification as well as the reintroduction of legumes and intermediate multipurpose crops, have made it possible to cut pesticide use by approximately 50% with no major economic impact.



Focus on... TWB: an innovation-oriented facility

The transfer from basic and applied research to industrial production requires a crucial and all-too-often missing stage: evidence that a concept is industrially viable. Toulouse White Biotechnology (TWB) is a preindustrial demonstrator that encourages the development of new, sustainable production pathways from agricultural and biological resources. Its purpose is to promote an economy based on the use of renewable carbon, i.e. the industrial production of chemicals, energy, pharmaceuticals or foodstuffs from biomass. An unusual public/private consortium, TWB comprises 52 partners. Led by INRAE, INSA Toulouse and CNRS, this demonstrator has generated almost 40 million Euros' worth of industrial contracts between 2012 and 2019.



➤ INRAE: AN OVERVIEW

The French National Research Institute for Agriculture, Food, and Environment (INRAE) is a major player globally in research and innovation. Gathering a community of **12,000 people** with **273 units** including fundamental and experimental research, spread out throughout **18 regional centres** in France.

Internationally, **INRAE is among the top research organisations in agricultural and food sciences, plant and animal sciences, as well as in ecology and environmental science.** It is the world's leading research organisation specialising in **agriculture, food and the environment.**

Faced with a growing world population, climate change, the depletion of resources and declining biodiversity, the Institute has a major role to play in providing the knowledge base supporting the necessary acceleration of **agricultural, food and environmental transitions**, to address the **major global challenges.**

➤ OCCITANIE-TOULOUSE RESEARCH CENTRE: KEY FIGURES (in 2022)

Teams

20 research facilities, of which 11 joint units and 2 experimental units

931 INRAE staff, of which **628** permanent staff
(👤 49 % and 👤 51 %)

839 partner staff in the centre's different units

Resources

88,4 million Euros in budget, of which **26,2** in own resources

15 platforms and technical platforms

10 geographical locations

Over **500 ha (1,235 acres)** of own property out of a total farmed area of approximately 600 ha (1,483 acres), and a total area of **55 549 m² (597 924 sq ft)**

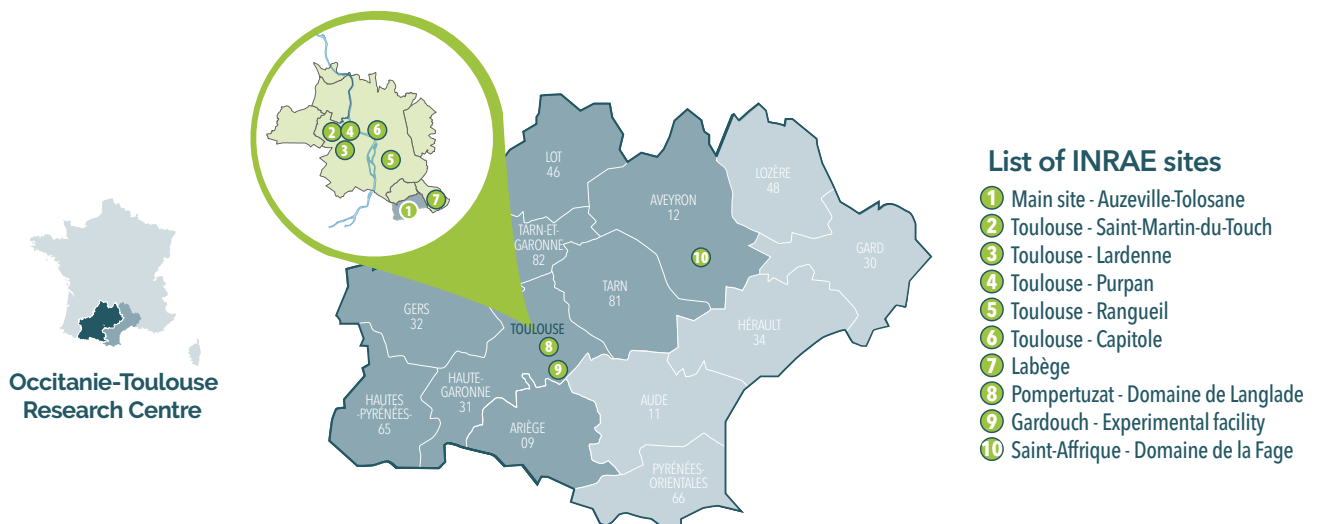
Results

331 contracts signed

71 patents (10 new patents issued) and **22** patent claims

678 publications in peer-reviewed journals

MAP OF SITES OCCITANIE-TOULOUSE RESEARCH CENTRE



➤ **Occitanie-Toulouse INRAE Research Centre**
Chemin de Borde Rouge
CS 52627 - AUZEVILLE
31326 CASTANET-TOLOSAN CEDEX (FRANCE)
Tel.: +33 (0)5 61 28 50 28
com-toulouse@inrae.fr
www.inrae.fr/en/centres/occitanie-toulouse
Join us on:

@Inrae_Tlse INRAE Occitanie-Toulouse

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French national research institute for
agriculture, food and environment