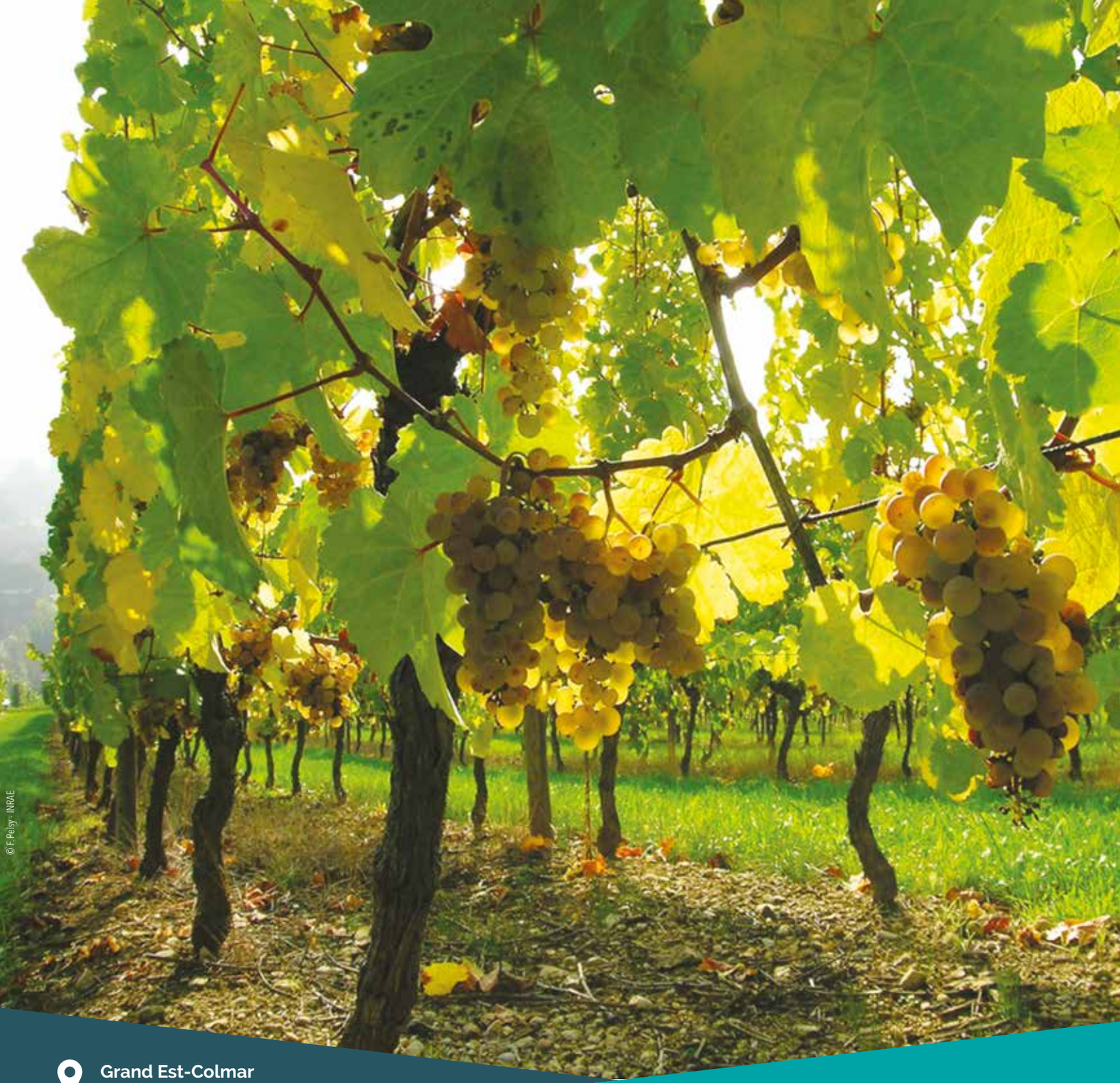

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Grand Est-Colmar
Centre

INRAE

Presentation of the **Grand Est-Colmar centre**

April 2022

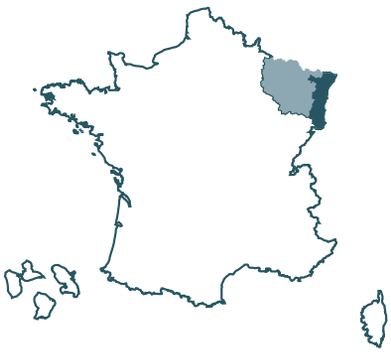
"Specialising particularly in vine disease resistance, the INRAE Grand Est-Colmar Centre is the main grapevine research institute in the northern French wine-growing area"

Serge KAUFFMANN
President of the INRAE
Grand Est - Colmar Centre

GRAND EST - COLMAR RESEARCH CENTRE

Heir to a long history, particularly in the service of viticulture, the INRAE Grand Est - Colmar Centre conducts scientific programmes around two major themes: The integrative biology of disease resistance and vine quality, including virus-vector interactions, and the sustainable management of multiperformance forest, agricultural and urban regions. It also supports professionals in designing new infection-resistance strategies for vines, and recently beetroot, and implementing new management practices, from the scale of the plot to that of the region, making it possible to greatly reduce the use of synthetic inputs. With 130 researchers, engineers and technicians, the INRAE Grand Est-Colmar Centre is the main research body of the Biopôle Adrien Zeller in Colmar, which hosts a range of professions from research to agricultural development.

The ambition of the Grand Est-Colmar Centre is to consolidate its position as a European hub for the strategic themes *Vines and Wines* with varietal creation through partnerships with our German and Swiss colleagues, Agronomy and environment, and that of *the Aphid-virus interaction*, bringing innovations.



THE DYNAMICS OF THE CENTRE

Agriculture and viticulture must confront societal and environmental challenges: Reducing the use of phytosanitary products and adapting to climate change while maintaining the quality for which French agricultural products are renowned. Our researchers are coordinating the 'Sustainable Resistance' (ResDur) experimental system to create, by crossing, new varieties of wine grapevines possessing polygenic and sustainable resistance to downy mildew and powdery mildew. Four initial varieties were listed in the official catalogue in 2018: Artaban, Floreal, Vidoc and Voltis. They reduce the use of fungicides by 90%. The knowledge accumulated on virus-aphid interactions makes our centre an essential partner in the fight against beetroot dieback. Our researchers are also leaders in the development of multi-criteria assessment methods for growing-systems. They are developing integrated modelling tools to support stakeholders in the design of local organisations for methods of production, transformation and biomass recycling, responding to the challenges of developing a sustainable bioeconomy (BESTS project) – one of the priorities of the Grand Est Region.

CONTEXT AND PROSPECTS

Viticulture is a very important sector for the economy of the Grand Est Region both in terms of the wine production and the tourist attraction of the landscapes shaped by the vine cultivation. The "Sustainable Viticulture" and "Regional Bioeconomic System" projects, carried out by the Grand Est-Colmar Centre, naturally find their place within the scope of the Regional Plan for Economic Development, Innovation and Internationalisation (SRDEII) adopted by the Regional Council to make the Grand Est one of the European leaders in the industry of the future and in the bioeconomy, by adapting its "Industry of the Future" plan to viticulture and agriculture. In addition, a topic dealt with at the centre is once again regaining importance considering the Ecophyto plan, namely virus-vector interactions, carriers of technological innovations for the protection of plants such as beetroot and cereals.

Our local and national partners

Our research priorities

1 INTEGRATIVE BIOLOGY OF VINE RESISTANCE AND QUALITY FOR SUSTAINABLE VITICULTURE

2 SUSTAINABLE MANAGEMENT OF MULTIPERFORMANCE FOREST, AGRICULTURAL AND URBAN REGIONS

Grapevine leaf affected by leafroll virus. © **Y. Bernardi, INRAE**

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The vine is subject to attack by numerous bio-attackers and pests which are controlled, in the vineyard, by the use of phytosanitary products. In order to design solutions for low-input viticulture, it is essential to better understand these diseases.

The research carried out in Colmar aims to acquire knowledge about vine diseases, fungal and viral, among the most damaging for the French vineyard. Academic work focuses on understanding the interactions between the vine and its attackers, including, in the case of viral diseases, virus vectors. In addition, the creation of varieties resistant to these diseases requires making an inventory of resistance genes naturally present in similar wild species, assessing the adaptive potential of pathogens and exploring the induction of resistance through biotechnology. The success of innovations depends on their sustainability but also on the quality of the wines produced and their potential for resilience in the face of climate change. This is why our researchers are carrying out work on berry quality, in particular the production of terpene aromas, and on vine development. Beyond the academic results, our research produces innovations that are directly transferable to the profession, such as new resistant vine varieties, virus detection tools (nanobodies) or technical practices (nematicide fallows). Experimentation in the vineyard is carried out in the centre, concentrated on 10 ha of vineyard, including 7 ha in PDO vineyards rich in four different terroirs.

Research units:

- Mixed research unit "Grapevine Health and Wine Quality" (SVQV)
- Agronomic and viticultural experimentation unit (UEAV)

Partners:

- CNRS (Institute of Molecular Plant Biology – Strasbourg)
- University of Strasbourg
- University of Upper Alsace

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For more information, please visit **www.inrae.fr/en/centres/grand-est-colmar**

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Many forms of agriculture are developing to meet the triple objective of food and non-food agricultural production, and conservation of natural resources (water, soil, air, biodiversity, ecosystem services).

Our research aims to produce knowledge about the structure, functioning and performance of different forms of agriculture, from the scale of the plot to that of the landscape or region. Thus, we determine the characteristics that can greatly reduce the use of synthetic inputs. We are particularly focused on two major types of complementary controls: The development and management of biodiversity, support for ecosystem services and the provision of bio-solutions, i.e. biomolecules or microorganisms to stimulate plant health or soil fertility. A first scientific challenge lies in understanding the relationships between agricultural and landscape management practices, biodiversity and ecosystem services. The second concerns the development of methods for evaluating environmental, economic and societal performance, useful for supporting stakeholders in agriculture to design and lead an agroecological transition. This knowledge and these methods are intended to contribute to the development of a sustainable local bioeconomy.

Research units:
- Mixed research unit "Agronomy and Environment Laboratory" (LAE)
- Agronomic and viticultural experimentation unit (UEAV)

Partners:
- The regional chamber of agriculture of Grand Est
- Pôle d'équilibre territorial et rural (PETR) Rhin-Vignoble-Grand Ballon
- University of Lorraine
- National School for Water and Environmental Engineering of Strasbourg (ENGEES)
- Swiss Federal Institute of Technology in Zürich - ETH Zurich
- University of Hohenheim

COLLECTIVE RESEARCH INFRASTRUCTURES TO SUPPORT WINE INDUSTRY INNOVATION IN THE REGION

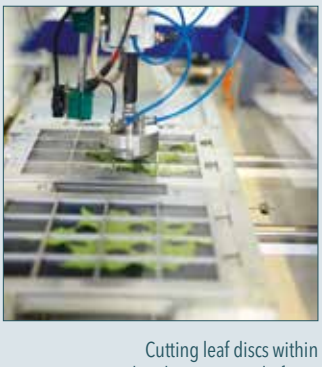
In collaboration with its partners (CIVA, IFV), the Grand Est-Colmar Centre possesses **experimental facilities specifically adapted for the study of vines in controlled conditions, such as in the vineyard, and for the evaluation of agricultural systems and land**. These devices, some named, bring together state-of-the-art equipment and unique know-how allowing regular and privileged exchanges with stakeholders in the socio-economic world.

Collective research infrastructures:

- **Platform dedicated to experimental winemaking and the oenological evaluation of products,** shared with the French Vine and Wine Institute, the Interprofessional Council for Alsace Wines and wine technicians from the Alsace Chamber of Agriculture
- **Phenotis**: Experimental greenhouses, plots and devices designed to support research programmes in the service of low-input viticulture, producing quality wines adapted to the climate of the future (see frame on next page)
- **Phenotyping platform**, dedicated to evaluating the resistance of vines to downy mildew and powdery mildew
- **Analysis platform for the secondary metabolism of the vine** (grape aroma, defence mechanisms, etc.).

xperimentation and modelling of agriculture and environment relationships:

- **PRO'spective:** Device for studying the recycling of organic waste products (PRO), one of the three main sites (2 ha) of the long-term Observation and Experimentation Systems for Environmental Research (SOERE) in France
- **PEPSVI**: Platform for the Evaluation of the Performance of Innovative Viticultural Systems, which aims to reduce the use of synthetic inputs
- **MAELIA**: Integrated modelling platform for agricultural activities to assess their impacts on natural resources (water, soil, ecosystem services, etc.) and their socio-economic performance within agricultural regions.



Cutting leaf discs within the phenotyping platform.
© F. Pelsy, INRAE

PARTNERSHIPS, ADDING VALUE, INNOVATION

The INRAE Grand Est-Colmar Centre is involved in numerous partnerships, both academic (Universities of Strasbourg and Lorraine, Institute of Molecular Plant Biology (IBMP) of the Strasbourg National Centre for Scientific Research (CNRS)) and professional, with winemaking interprofessional associations and the Chamber of Agriculture in particular. At cross-border level, as part of an Upper Rhine network, the centre has set up collaborations with various vine research institutes in Germany and Switzerland, for the exchange of knowledge and plant material.

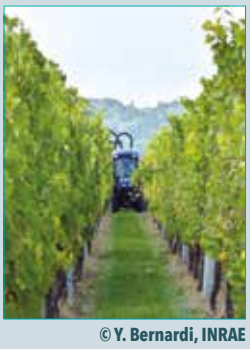
Projects to anticipate the viticulture of the future

Floreal, an INRAE variety resistant to downy mildew and powdery mildew, for making aromatic white wines, with notes of exotic fruits and boxwood.
© C. Schneider, INRAE

Towards resistant vines with regional typicity

Having been proven that through hybridisation it is possible to create varieties endowed with polygenic and lasting resistance to downy mildew and powdery mildew, while preserving the wine quality with a level equivalent to that of traditional grape varieties, a dozen interprofessional bodies requested the Grand Est-Colmar Centre to initiate programmes to create new resistant varieties similar to the typicity of the emblematic grape varieties of French wine-growing regions. These programmes are carried out as part of tripartite partnerships, associating INRAE, the French Vine and Wine Institute (IFV) and the regional interprofessional bodies concerned. They benefit from INRAE expertise and a transfer of know-how. For example, the centre supervises programmes to create Riesling and Gewurztraminer type varieties, in partnership with the Interprofessional Committee for Alsace Wines (CIVA), as well as Chardonnay and Pinot type varieties with the Champagne wines Committee (CIVC).

Climatic upheavals: What wine will we be making in the future?



© Y. Bernardi, INRAE

The effects of climate change are already visible on the vines and the wine: The grape harvest dates have advanced by two to three weeks; the berries contain more sugar, the wine alcohol content is increasing, and the wines are becoming less acidic, with new aromatic profiles. To maintain the production of high value-added wines in current vineyards, it is necessary to quantify possible developments but also to propose adaptation solutions in consultation with the profession and by integrating consumer expectations. The Laccave 2.21 programme combines interdisciplinary skills, from biology to sociology, to respond to these different challenges. The INRAE Grand Est-Colmar Centre makes its contribution by evaluating the impact of the overall rise in temperature on the composition of grape berries at the stage of primary metabolism (the levels of organic acids in particular) and of secondary metabolism (aromas and aroma precursors). To create vine varieties adapted to future climatic conditions, researchers at the centre identify, using models, what characteristics these new varieties must have and what genetic resources can be used to achieve these objectives.

Nematodes, microscopic worms present in the soil, are particularly effective vectors of the virus responsible for the fanleaf virus.
© G. Demangeat, INRAE

Fight against dieback: Alternative control strategies

The grapevine fanleaf virus (court-noué virus) induces diebacks causing severe crop losses. This is one of the main problems for French vineyards. This viral disease is transmitted by a nematode – a microscopic soil worm. The Grand Est-Colmar Centre is exploring different ways of combatting the fanleaf virus by developing biological strategies, such as the induction of a resistance to the virus by premunition and genetics, by researching natural resistance in certain Vitis accessions, and biotechnological strategies, by resistance induction. The effectiveness of nematicide fallows in reducing vector nematode populations is also being evaluated. Research is also directed towards comprehensive knowledge of viral diversity in grapevines which allows, among other things, the development of new methods for detecting grapevine viruses via antibodies called nanobodies, which could, in time, be integrated into phytosanitary certification.

Phenotis, a set of technical platforms for phenotyping the vine "from the laboratory to the vineyard"

Through vine training in the greenhouses, the pip-to-pip cycle is reduced to 1 year, compared to 3 years in natural conditions. **© S-L. Filleux, INRAE**

Inaugurated in 2019, Phenotis is a unique and original experimental device specifically designed to support grapevine research programmes: To assess the level of resistance to downy mildew and powdery mildew, to monitor the development of vines in real time and in the open field, to identify the compounds contributing to the quality of the grape berry and to explore new strategies for combatting the fanleaf virus and its vector nematode. It includes 1000 m² of greenhouses with high environmental quality allowing the cultivation of vines in pots or tubs to study the natural transmission of the fanleaf virus.
The Phenotis operation, at a total cost of nearly €2.5 million, was co-financed as part of the 2015-2020 State-Region Planning Contract with the support of Europe (FEDER).

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.

GRAND EST-COLMAR CENTRE: KEY FIGURES

Teams

4 units including 2 mixed research units and 1 experimental unit

90 tenured agents (53%, 47%), around thirty contract workers, post-doctoral and doctoral students and student trainees

25 external people located within the centre's buildings

Resources

€8.3m of consolidated budget in 2020 including **€1.2m** of its own resources

725 m² of laboratories

53 h of experimental estate, including **3** ha of vines

2010 m² of greenhouses and 672 m² of room space dedicated to wine and agronomic studies

6 collective scientific infrastructures and **3** experimentation sites

Results

30 articles per year in scientific journals

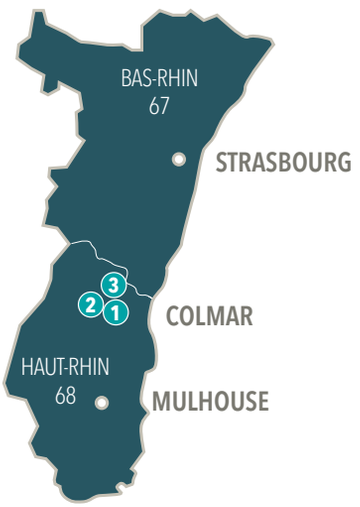
62 cactive research contracts including **5** with Europe

5 patents, including 4 European (*Nanobodies* and ephrine receptor) and 1 international with license (Super DXS)

4 varieties with polygenic resistance registered in 2018: Artaban, Floreal, Vidoc and Voltis

GRAND EST-COLMAR CENTRE: MAP OF SITES

Grand Est-Colmar Research Centre



Liste of sites

1. Colmar (headquarters)
2. Wintzenheim
3. Bergheim

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