

# ARVALIS'S WORK

IN 25 EXAMPLES

ACTIVITY  
REPORT

2020 / 2021

## AGROECOLOGY, VALUE CHAINS AND TERRITORIES



Year after year, agricultural crises have been following one another at an increasing rate, with more diverse and acute climate hazards and a growing heterogeneity on the French territory, thus

weakening numerous farms. To face these major issues of resilience, sustainability and performance, farmers and their sectors are expecting technical and practical solutions that target the current challenges, as well as means to complete the agroecological transition of the farming systems in each territory.

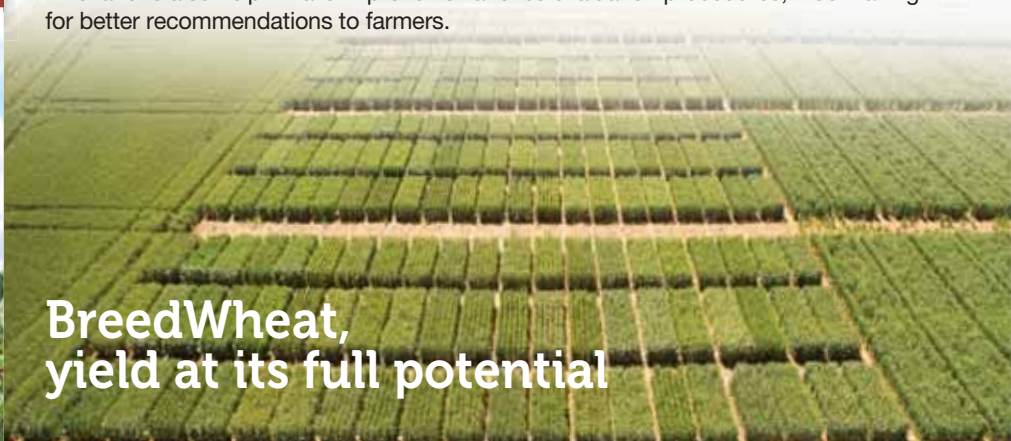
This brief activity report provides an overview of Arvalis's work. One example showing our commitment to address and mitigate climate change is the low carbon method that was successfully developed in partnership with the other arable crops institutes and approved by the French government. This method will support farmers who want to adopt practices that reduce their farms' carbon footprint. ARVALIS keeps on coming up with solutions for tomorrow, which are designed not only for producers but for their sectors as well, for example by helping start-ups develop and refine innovative solutions to measure quality and monitor grain storage, thanks to Unilis Agtech, a joint subsidiary with Unigrains. The Institute also supports all its value chains in finding solutions as part of the Varenne agricole de l'eau et de l'adaptation au changement climatique (French roundtable on water and adaptation to climate change).

**Anne-Claire VIAL** - *President of ARVALIS - Institut du végétal*

**ARVALIS**  
Institut du végétal

The complete activity report is available online at [www.arvalisinstitutduvegetal.fr](http://www.arvalisinstitutduvegetal.fr) (in French)

# Producing food in sufficient quantities



## BreedWheat, yield at its full potential

The yield of soft wheat, one of the most cultivated cereals in the world, has been stagnating since the 90's, while we need to feed more and more people using fewer artificial inputs on unstretchable agricultural areas. BreedWheat research programme was launched in 2011 with the financial support of the ANR-PIA and coordinated by the INRAe, in partnership since its beginning with ARVALIS. The programme has been exploring several leads around the fine knowledge on the wheat genome. The main idea is to find out how to use the natural genetic diversity of this complex species, and to create varieties that can adapt to climate change, among other things.

BreedWheat gathers researchers from many fields who work with public research teams, breeders, or ARVALIS, thus enabling the whole community to gain new knowledge on this crop's biology, genetics, and history. Breeders can now rely on finely characterized wheat genetic resources that represent the world's genetic diversity. They can better identify the traits related to stress tolerance and use new tools, such as genotyping chips, to better characterize their own varieties. Numerous innovations also help Arvalis improve its varieties evaluation procedures, thus making for better recommendations to farmers.

## PHENOTYPING TAKES THE HEIGHT THANKS TO PHE-B

The Montardon station (southwestern France) got equipped with a rather peculiar high-clearance tractor: it is equipped with Phe-B, a new generation high throughput phenotyping tool, small-sized and cheaper than its predecessors. Its job is simple: scanning the architecture of high crops (maize, sorghum), the number of stems per acre, the surface of their leaves, their height... these pieces of information are very useful to predict production and/or identify the best varieties in various environments.

## VARMAÏS, A guide to choose varieties



Varmais.fr, a contraction of the French words «variétés» (varieties) and «maïs» (maize), gathers online identity cards on more than 500 maize varieties, indicating their performance during annual evaluation trials.

Users can thus compare several varieties and select the ones best suited by choosing their own priority criteria to filter this prodigious mass of information.

## Will this year be a fine vintage?



Anticipating the quantity and quality of grains thanks to fine forecasts enables storage organisms, who collect grains during harvesting on large territories, to better prepare their logistics, silos, and sales.

For the first time, ARVALIS partnered in 2021 with Intercéréales and delivered on July 9th a pre-harvesting estimate of the national yield and quality of bread wheat, by integrating regional variations and the year's weather conditions. Its thus renowned and valued expertise is based on three complementary approaches: the results from agro-climatic computer models developed by the Institute; its measures and observations on bread wheat plots spread among the main production areas (more than 150 measurements in the country), and the analysis of this data by ARVALIS' network of regional engineers.

## Durostress : durum wheat stands firm

Durum wheat, like all other plant species, will have to adapt to climate change. Durostress research project thus explores its strategies to adapt to water and heat stresses. The aim is to understand the impact of these stresses on durum wheat and identify the individuals adapted to the future climate in France as well as their genetic characteristics (called "traits") that explain why certain varieties cope better than others...

This project gathers many partners from France, as well as from Portugal and Italy, as their climate already reflects what that of France could be tomorrow.



## All against ergot

Ergot is a fungus naturally found in grasses. It can settle on a cereal during its flowering when weather conditions are favourable, and it produces alkaloids very unsafe for consumers. ARVALIS is actively involved in the country-wide mobilization against ergot and launched a wide communication plan to share the latest knowledge on its biology, the regulation in this area, the means to control it... Experts have also developed tools to analyse the risks of its appearance in bread wheat, durum wheat or sorghum fields. They have also drafted a document compiling 18 «True/False about ergot» educational cards, available on arvalis-infos.

# Preserving and enhancing qualities

CHALLENGE #2

### Insects under video surveillance



IoTrap, a connected trap equipped with a camera, monitors the predator insects threatening stored grains. This new tool, resulting from a partnership between ARVALIS, the start-up Kanope (specialized in IoT), and Javelot (an enterprise involved in connected temperature sensors) alerts users in real time via an online app. Already 300 IoTrap have been put in place and help storage companies preserve the quality of their grains.

### Fibre flax represented...

«The high-quality exchange between the European Confederation of flax and hemp (CELC) and ARVALIS provides the necessary expertise for our institutional relationship. This way, whether it be on issues around global warming or the use of fewer input, R&D stakes are systematically represented. This greatly helps to raise the awareness of deputies on the stakes of the sector», declared Xavier Batut, leader of a parliamentary group advocating for fibre flax, after his visit to our experimental platform in Normandy.



### UPSIDE DOWN...

Until now, trials on grain storage were bound to ambient temperature conditions. It is indeed impossible to test insect and pest control strategies when temperatures are not favourable to their development – i.e. between September and May... Thanks to Intercéréales's financial support, ARVALIS has just set up new experimental cells, with a 250kg capacity each, in a thermoregulated (5 to 30°C) and humidity controlled (40 to 98%) room. Researchers can thus ignore outside temperatures and conduct trials all year long to find out how to protect grains against insects, preserve their quality, or yet again on ventilation strategies depending on the characteristics of incoming air... Now, the Institute can simulate spring during winter, or even winter during summer!

## ARVALIS's expertise acknowledged by the EU

For a long time, C.I.P.C., an anti-sprouting agent, has been used to preserve potatoes, but it was forbidden in 2020. Storage facilities that used it are still finding tiny - but real - traces of this molecule.

To address this issue, ARVALIS has provided its expertise to help the European Union define a temporary maximum residue limit (MRL) in potatoes. Thanks to the Institute's efforts, France is also recognized as an expert in monitoring this MRL over time. Indeed, defining the MRL wasn't an end in itself: every year, the potato sector has to assess the residual level and the implementation of cleaning practices in the facilities.

ARVALIS thus supports the French sector's monitoring plan, with almost 350 analyses results on a national level, from a representative selection of storage units that covers several types of purposes (fresh sales, processing, starch industry) and facilities (bulk storage or pallet boxes).



### IN BRIEF

#### ■ VARIETAL BIODIVERSITY

More than 150 new varieties of cereals proposed by seed companies are tested every year by ARVALIS in its 26 stations. A little-known aspect of the vibrant research and varietal diversity in France.

#### ■ STANDING UNITED AGAINST HAZARDS

*ClimA*, a Mixed Technological Network (RMT) co-facilitated by ARVALIS and the APCA (Chambers of Agriculture), aims at providing operational solutions to farmers, so that they can deal with the impacts of climate hazards.

# Healthy plants

## Searching for scents to repel boars

Wild boar damage to crops is getting worse in many French regions. Farmers are trying to repel them from their fields with different methods. The research led by ARVALIS to identify the most efficient ways with 800 maize producers shows the limits of sound-based techniques to frighten the boars. However, some scents seem to repel them: two olfactory leads, tested in 2020, are encouraging.



## PLANTS SOLIDARITY

More and more fields are hosting service plants before, during or after a crop, or even all around the cultivated area. These different species or species mixtures bring real benefits to soils structure and fertility, to control soil erosion, to limit nitrate leakage... Research are still exploring their relevance to protect arable crops, as they protected market gardening and horticulture. In January 2021, three webinars on service plants were organized by ARVALIS and attended by more than 350 participants.

## Good neighbours

**The CAPRIV Project** (Concilier Application des Produits phytosanitaires et sécurité des RIVERains, i.e. Conciliate the application of PPPs and the safety of local residents) uses dummies and active sensors to measure the exposure to plant protection products during their application. ARVALIS collaborated with the French Agency for Food, Environmental and Occupational Health & Safety (ANSES) for this study mandated by the Ministry of Agriculture and Food.



## A candidate for biological control?

**Mediterranean corn borers**, from the Noctuidae family, are maize pests. The UMR Évolution, Génomes, Comportement et Écologie (CNRS-IRD-Université Paris Sud) is carrying out trials aiming to control their attacks with another insect originating from Africa, a little parasitic wasp (*Cotesia glomerata*) that disrupts them. For this purpose, scientists have been using for several years Arvalis' secure greenhouse in Montardon (southwestern France), where this type of trials can be conducted. They must indeed check that the new insects do not have any harmful impact before they are introduced into the environment and before scaling up the trials.



## IN BRIEF

### ■ SETTING COURSE FOR PROTEINS

ARVALIS has partnered with the Institut de l'Élevage (Idele, livestock institute), the chambers of agriculture and agricultural high schools, to work on the agricultural component «Cap Protéines» of the French recovery plan launched by the government in September 2020. They are joining together to improve the protein autonomy of cattle breeding.

### ■ ARVALIS, ROARING 60S!

The 190-page book entitled «ARVALIS - Institut du végétal: passion et engagement» (ARVALIS - Institut du végétal: passion and commitment) recounts a 60 year-long adventure on a human, technical, economic, and social level. It all started when producers created the Institut Technique des Céréales et Fourrages, ITCF (Technical Institute of Cereals and Fodder crops), which became ARVALIS - Institut du végétal in 2002, after merging with AGPM Technique (technical institute in the maize sector)([www.editions-arvalis.fr](http://www.editions-arvalis.fr))

## Asalée, fine flower of crop rotations

The economic health of a farm depends on many factors: the nature of soils, the year's weather, production prices, the access to water... The choice of crop rotations – a combination of crops implanted every year – is a key element of the farmer's strategy. Climate change makes it even more complex. ARVALIS has created Asalée to help the farmers choose using data as objective as possible. Farmers and advisers have defined crop rotation scenarios that should be adapted to local conditions, with or without irrigation. This tool makes it possible to compare various crop rotation strategies as it includes up to 20 climate scenarios, and several other scenarios on factors like price, net margin, working time, irrigation water consumption, etc. Asalée thus enables the user to choose their crop rotations depending on available water resources. This interactive online app was designed in partnership with the Water Agency Adour-Garonne. It was tested in Charente-Maritime and already interests other departments.



## Low carbon: arable crops get their own label

It is impossible to implement projects that

help mitigating climate change without any approved method to measure their impact. It is indeed necessary to ensure these new practices will prevent greenhouse gas emissions or enable an increase in carbon storage. Since August 26th, 2021, arable crops do have such a method, approved by the French Ministry of Ecological Transition. This method, designed by a group of experts and scientists led by technical institutes and federated by ARVALIS, has received the French Low Carbon Label (LBC). This label was officially launched in 2019 so that France could reach its carbon neutrality goal by 2050, and it helps communities, businesses, producers and citizens who wish to have their voluntary projects acknowledged and financed, as long as these respect the method officially approved. The label enables farmers to receive a financial support for their efforts.



## CHN quenches the thirst for nitrogen

Just like a hiker would check the weather and avalanche risks before taking the path, farmers can check on their crops needs in nitrogen depending on the actual weather, before deciding to bring some inputs. This concept is called «integral piloting». Indeed, behind the many decision support tools proposed by ARVALIS lies a thorough mathematical model entitled CHN, that can assess the plants' needs, at any given time, in every plot's soil.



# Precision is the key to bring the right amount of input

^ CHALLENGE #4



## BIOLOGICAL FERTILITY: A DREAM COME TRUE

**Soils fertility includes three components:** physical fertility (an aerated soil so that plants can take roots), chemical fertility (find the minerals they need), and biological fertility (bound to the many organisms that live in the soil). This latter component is harder to measure than the first two, but it is essential. This is what makes a project like Microbioterre, launched in 2017 and piloted by ARVALIS, so interesting. It relies on the knowledge gathered by the Institute since 2009 and on all the partners aiming at measuring this component, by identifying the most relevant indicators, their precise impact and the means to analyse them. This goal – i.e. developing soil analyses and operational advice - has just been reached. Farmers can then adapt their agroecological practices to the biological fertility of their soils.

## IN BRIEF

### ■ MERCI FOR NATURAL FERTILISERS

The second version of MERCI (Method to estimate the returns from intercrops) is live ([methode-merci.fr](http://methode-merci.fr)). It assesses the biomass produced by intercrops and its fertilizing effect for the next crop, from a simple field sample. Its first version dated back to 2010.

### ■ A 2.0 CALCULATOR FOR ORGANIC FERTILISERS

Reducing dependency on artificial fertilisers is a challenge for farmers that requires efficient and performing alternatives. ARVALIS has recently created a new tool available on the Internet ([fertiorga.arvalis-infos.fr](http://fertiorga.arvalis-infos.fr)), which calculates the fertilising effect of organic or biobased products (manure, slurry, recycling-derived fertilisers) and indicates if the spreading is recommended, possible or not recommended on an agronomic point of view.

# Sustainability now



## CLIMATE CHANGE: customised scenarios

*Climassol* offers and analyses crop rotation scenarios depending on their resilience to climate change, the efficiency of irrigation water and their economic viability. It relies on *Asalée*, a tool that helps choose the crop rotation. The scenarios were developed and assessed with farmers and advisers from seven sectors in Nouvelle Aquitaine (France). The diversity of the proposed scenarios and their results confirmed that there isn't a unique adaptation pathway: each farm needs a specific diagnosis based on the constraints of its sector. The scenarios range from a decrease in irrigation volume to no irrigation, or, on the contrary, tested an increase in irrigation volume following a change in the access to water or the creation of stocks. The project also explored the diversification of species in crop rotations to improve resilience as well as the decrease in irrigated areas, focusing on the volume brought to high value crops so as to improve the net margin. The project was financed by the Nouvelle Aquitaine region.

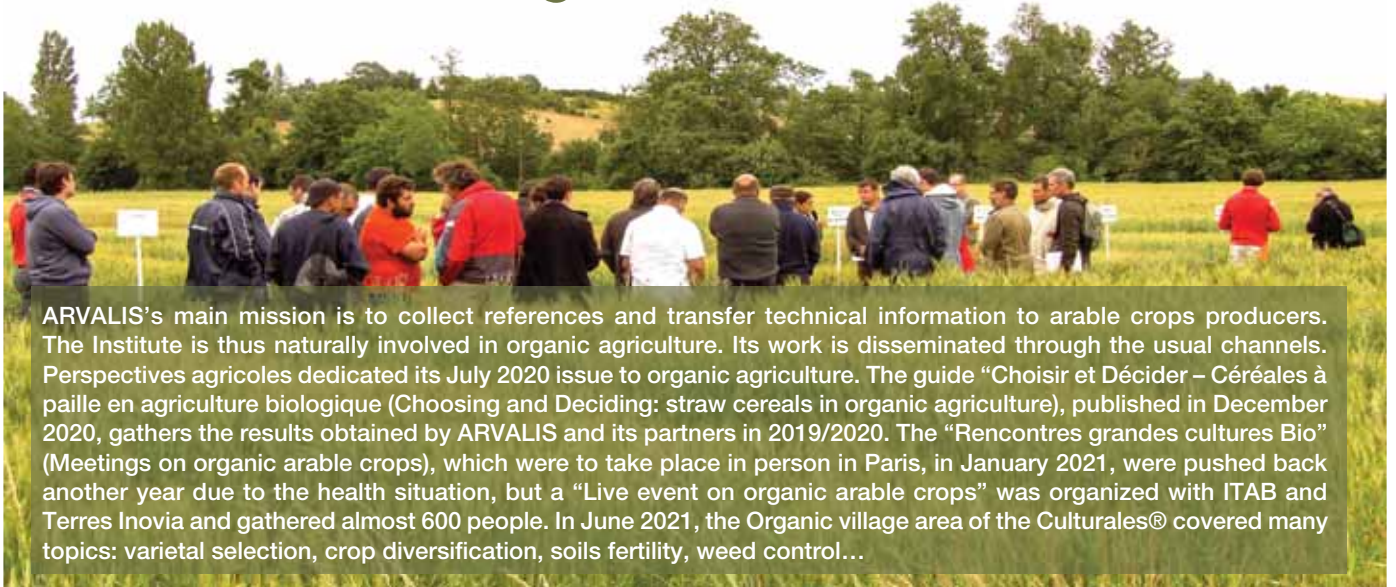
## Syppre : seen on TV



**Action Syppre - construire ensemble les systèmes de culture de demain (Syppre Action - Building tomorrow's cropping systems together)** gathers ARVALIS, ITB and Terres Inovia. It was

covered on TV in November 2020 and showed how agronomists and farmers were working together in the Occitania region to better protect soils. "Terres de Partage" is a TV program broadcasted on France 2, proposed by France Télévisions and sponsored by Intercéréales, which highlights joint initiatives in the farming sector and its chains.

## Organic ARVALIS



ARVALIS's main mission is to collect references and transfer technical information to arable crops producers. The Institute is thus naturally involved in organic agriculture. Its work is disseminated through the usual channels. Perspectives agricoles dedicated its July 2020 issue to organic agriculture. The guide "Choisir et Décider – Céréales à paille en agriculture biologique (Choosing and Deciding: straw cereals in organic agriculture), published in December 2020, gathers the results obtained by ARVALIS and its partners in 2019/2020. The "Rencontres grandes cultures Bio" (Meetings on organic arable crops), which were to take place in person in Paris, in January 2021, were pushed back another year due to the health situation, but a "Live event on organic arable crops" was organized with ITAB and Terres Inovia and gathered almost 600 people. In June 2021, the Organic village area of the Culturales® covered many topics: varietal selection, crop diversification, soils fertility, weed control...

### IN BRIEF

#### ■ SYSTERRE® ONLINE

The multicriteria cropping systems analysing tool, *Systerre®*, is online. This online release was made possible thanks to the European financial support through the project *H2020 SmartAgriHub* and will contribute to disseminating the tool.

#### ■ JOINT METHANISATION IN MONTARDON

Agriculture provides solutions to control greenhouse gas emissions by producing renewable energy. ARVALIS and APESA are pushing their long-standing partnership forward by establishing a unique R&D platform in Montardon (southwestern France) devoted to methanisation, with the help of their complementary skills.

## Democratizing digital agriculture

Naexus Technological Mixed Network (RMT) is a scientific and technical partnership tool supported by the French Ministry of Agriculture and Food and was officially launched in early 2021. It follows the digital and agricultural informal network that was created five years ago and gathers 54 partners from agricultural R&D to boost the uptake of digital technologies in agriculture.

### AI tracks down germs

Arvacelp, an automated germs counter, stems from two years of engineering and trials between ARVALIS and Eurocelp, specialised in measuring the quality of potato lots through imagery.

This tool replaces a tedious manual logging and allows for a quick, objective, and independent assessment of the various anti-sprout solutions to preserve potatoes. Each tuber is photographed from three different angles using high resolution lenses. The pictures thus obtained are then analysed using the artificial intelligence, to calculate a sprouting indicator for each tuber.



## Young shoots

Unilis Agtech was co-founded in 2020 by ARVALIS and Unigrains to speed up the digital and agroecological transition by supporting young innovative enterprises. The fund has signed its first financial and technical agreement with Inarix. This start-up intends to combine image analysis and artificial intelligence to better assess, and thus valorise, the qualities of cereals.

### Maths, weather, and modelling

Weather forecasts are one of the key information in agriculture. An increasing number of farmers are indeed getting equipped with their own weather stations and decision support tools that use weather forecast to make recommendations based on mathematical models. The accuracy of these recommendations is due on one hand to these agronomic models, and on the other hand to the precision of weather information. ARVALIS contributes to Météoprec project, alongside the French Wine and Vine Institute and Météo-France, with the "Mathématiques et informatique appliquées" (Applied mathematics and informatics) unit of the INRAe Toulouse. This led to the development of partnerships with the main providers of weather stations for farmers on the French market, and with several user networks. Météoprec has contributed to the follow up of a thesis entitled "Améliorer les prévisions à court et moyen termes des modèles agronomiques en prenant mieux en compte l'incertitude des prévisions météorologiques" ("Improving the short- and medium-term predictions of agronomic models by better addressing the uncertainty of weather forecast").



# Agriculture dares to go digital

CHALLENGE #6



## TECHNO TO REDUCE PHYTO

The Carbon Bee start-up has designed a tool called SmartStrickersTM, which, thanks to its sensors, maps the weeds present here and there on a plot, and transfers this map to the sprayer so that it only spreads herbicide exactly where these are. ARVALIS has been testing the project for two years, focusing on detecting and controlling thistle in maize crops in Boigneville (Paris region) and docks in grassland in Saint-Hilaire-en-Woëvre (north-eastern France). The tool helps save up to 80% of plant treatment products.

In every farmer there is a citizen who watches over.

The action of ARVALIS is to find the means to reconcile the requirements of the farmer and those of the citizen.

Find the evidence on [www.action-arvalis.fr](http://www.action-arvalis.fr)

ARVALIS  
Institut du végétal

# ARVALIS

## key figures

ARVALIS – Institut du végétal is an applied research organisation for farmers, specialised in arable crops and their markets. Its work focuses on cereals, maize, sorghum, potatoes, forage crops, flax, and tobacco. The Institute's mission is to find effective agronomic, economic, environmental and plant health solutions that can be disseminated to farmers, so that they can adapt and face current challenges such as climate change, agroecological transition, societal expectations, commercial requirements, and international competition.

**400**  
farmers members  
of vocational guidance  
commissions



**26**  
stations in  
France



**450**  
collaborators,  
incl. 215 engineers,  
165 technicians



Around  
**60 M€** per year  
allocated to R&D



## IMPACT

**2 000**  
professionals  
trained every year



**3 200 000**  
visits on  
the website



**130 000** subscribers  
to the weekly letter  
Arvalis-Infos and on  
social networks



**638 000** ha  
acres piloted  
via satellites with  
Farmstar



# 26 SITES

## and networked areas of excellence



- Headquarters
- Sites and regional research stations
- Agronomy Long term agricultural equipment
- Phenotyping site
- Agroecology platform
- Farmer-researcher networks
- Parcels equipped with instruments for water quality
- Air quality devices
- Mobile fogging devices
- Smart irrigation
- Smart farming R&D
- Digital technologies
- Organics R&D
- Laboratories
- Biodiversity, agroforestry
- Grain processing platform
- Potato storage and R&D
- Monogastrics facility
- Dairy or beef cattle
- Climatic chambers
- Quality analysis centers (grain and potatoes)
- Flax scutching unit
- Anaerobic digester
- High environmental value certification farm - lvl 3

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