Limagrain factfiles

# à propos

# LIMAGRAIN AND WHEAT

› **Wheat is a grass originally grown in Mesopotamia** and has been cultivated by Mankind for 10 000 years, first by indigenous nomads who became farmers, then by large families of farmer-breeders. Today, breeders, creators of living organisms, list, collect and create new wheat varieties by developing the species' best varieties.

› **Wheat is one of the world's major food challenges.** Demographic growth, the need for food security and the emergence of new consumer countries require more and better products, in both quantity and quality.

› **Limagrain, the European leader in wheat seeds and cereal products expert,** offers high performance varieties and has created supply chains to meet different needs.

## Wheat, a cereal at the heart of civilizations

**Wheat is the staple food of a third of the world's population.** Beyond its essential economic importance, it plays a cultural and symbolic role for many communities. Its ancestors were discovered by hunter-gatherers in the Mesopotamia Fertile Crescent around fifteen thousand BC. Wheat was domesticated between 9500 and 8500 BC. As populations settled following the cultivation of wheat, it became a basic necessity for the first civilizations and their first steps in plant breeding. Continuously improved since the first varieties, which produced a mere quintal per hectare, wheat has now become a species with many varieties.

**Recent varieties, benefiting from the latest advances in scientific knowledge of living organisms, combine unequalled productivity* and quality.** Since the 1960s, the consumption of wheat has in fact tripled, reaching 652 million tonnes in 2008, which is 30% of the world's cereal production.

Thanks to unprecedented international mobilization, research could soon be based on a detailed knowledge of wheat's genetic heritage. Its genome, which is forty times greater than that of rice and five times more voluminous than the human genome, is made up of three separate genomes**, offering a formidable potential for combinations. **This unique genetic diversity opens up huge perspectives for varietal creation.**

* an average of 7 T/ha in France, 8 in the UK and 9 in the Netherlands (cf. GNIS CES report)

** See article in inside pages: *Wheat has many chromosomes*

# Wheat at Limagrain, the story of a strategic choice

In 1990, Limagrain confirmed its commitment in the wheat sector by the acquisition of the seed producer Nickerson. Since then, the Group has proceeded with a succession of acquisitions to strengthen its position as the No.1 producer of wheat seeds in Europe and is restructuring to extend its leadership worldwide.

## From seed to finished product

Limagrain creates and produces plant varieties to meet the needs of farmers, market gardeners, agri-food industrialists and consumers. The Group markets wheat seeds via Limagrain Verneuil Holding. The seeds have a quality label, which guarantees their identity and purity. Production potential and its regularity over time depend a great deal on the genetics present in the variety, because of characters that provide resistance to attacks and an ability to adapt to different environments.

If seeds are the driving force behind the development of the "Limagrain Wheat Chain", **Ulice***, founded in 1992, increases their efficiency. The Ulice research center offers an unprecedented interface between plant variety creators and agri-food industries. Fundamental and applied research are closely linked creating a synergy between genetic innovations and new industrial processes. The innovations are then adapted to industrial applications and marketed by **Limagrain Céréales Ingrédients**, which merged the Group's ingredients business in 2002. The acquisition of **Jacquet** in 1995 and the manufacturing of bakery products completed the "Limagrain Wheat Chain".

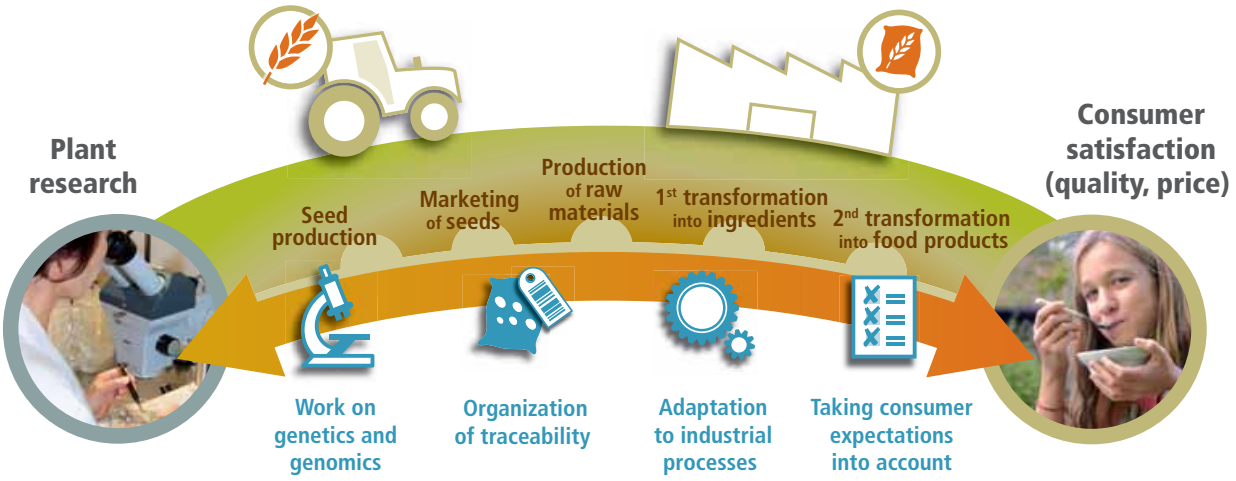
* Ulice: Laboratory Unit for Innovation in Cereals

- www.limagrainverneuilholding.com
- www.lci.limagrain.com
- www.painsjacquet.com

### Key figures for wheat at Limagrain

- **No. 1** in Spain and the UK, **No. 2** in France
- **21%** of market share in Europe
- **3 476 000 ha** sown with Limagrain varieties
- Almost **100** varieties sold in Europe under the Nickerson brand name

## The solution for downstream needs



# Wheat, a species shaped by Mankind

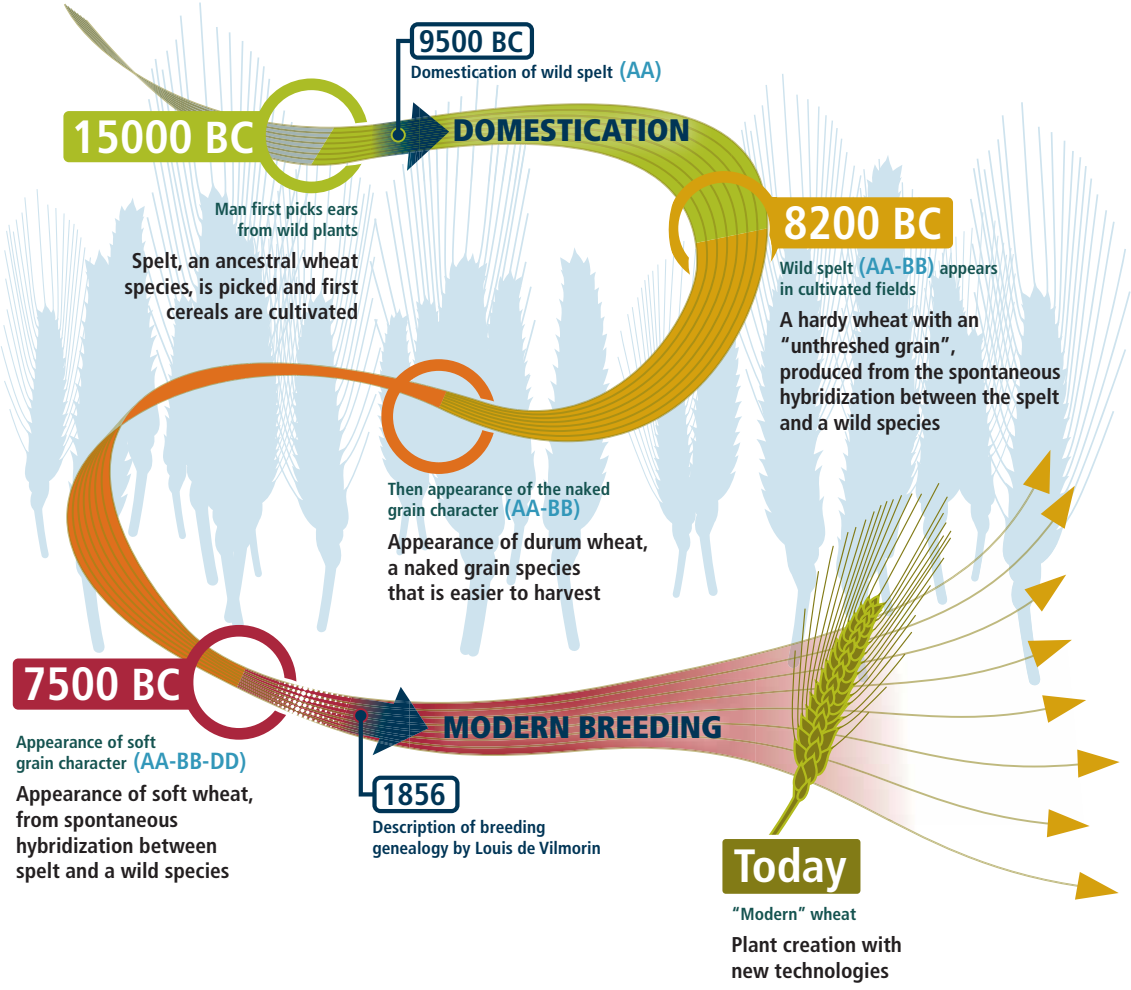
For 10 000 years, nothing has changed. Man has observed and combined the best qualities of the finest plants. The best descendants of each new crossbreed are chosen, selected and carefully preserved as a source of new progress. Farmers have created our leading wheat varieties. By exploring and developing the "outstanding" genetic material of this generous plant, breeders have been able to develop several tens of thousands of wheat varieties. They passionately preserve, maintain and enrich this biodiversity.

## Facts and figures

### The wheat genome compared to others

- **Wheat:** 16 billion bases*
- **Man:** 3 billion bases
- **Mouse:** 2.5 billion bases
- **Rice:** 450 million bases
- **Fly:** 160 million bases
- **Earthworm:** 97 million bases

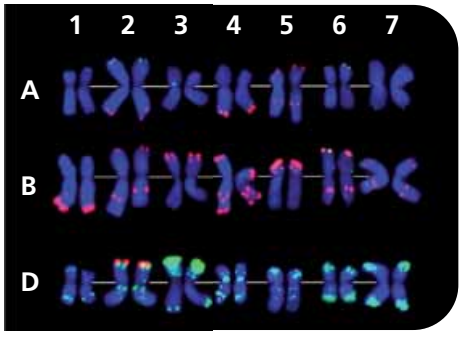
* Molecule bases (also called nucleic bases or nucleobases) belonging to the nucleotides, which are themselves DNA elements.




## Wheat has many chromosomes

**Soft wheat** has three sets of chromosomes (AA-BB-DD) while Man has only one. The whole of the soft wheat genome is even five times more voluminous than that of Man! Why such a difference? Soft wheat owes this peculiarity to the fact that hybridization has combined the genomes of two ancestors within the same plant. In turn, the combined AA and BB genomes gave birth to the spelt, then the addition of another ancestral genome DD, responsible for the "soft" character of the grain, gave birth to soft wheat (AA-BB-DD).

**Durum wheat** has two sets of chromosomes (AA and BB). One could say it came to a halt along the way. The DD genome was essential to give wheat its bread-making character. Today we are capable, thanks to the preservation of genetic resources, to combine our varieties with ancestral wheats. This enables us to repeat "original hybridizations", the sources of the leading varieties of soft wheat. History is repeated by crossbreeding recent wheats that have two sets of chromosomes (AA-BB), with wild forms (DD) that have one or several necessary characters and thus create new improved varieties of **modern wheat**.




The 21 wheat chromosomes divided into three genomes (A, B and D).

## GLOSSARY

**Wheat:** *family – grass.* Includes all species of the Triticum type.

**Durum wheat:** *species – Triticum durum.* Very rich in protein, it is used for making high-quality pasta. It is mainly used for human food and is the raw material used in semolina mills.

**Soft wheat:** *species – Triticum aestivum.* There are hundreds of varieties that meet the many demands for human food (wheat suitable for bread, wheat improvers, durum wheat, etc), animal food and industrial uses (starch products, bioethanol).

**Gluten:** a mixture of proteins, present in the starchy wheat kernel, responsible for the elasticity of the dough, producing high-quality bread.

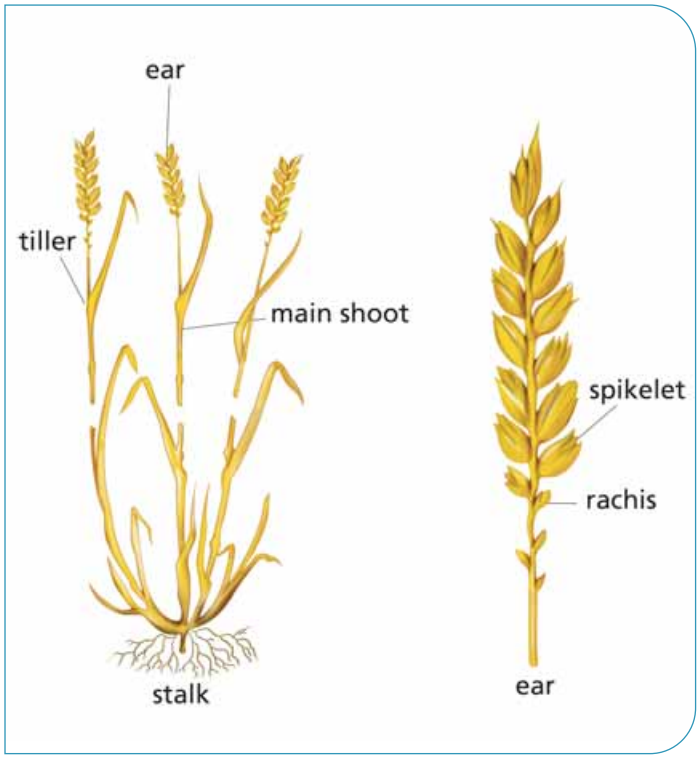



*Diagram of wheat plant and ear*

# "Wheat improvers"

These are sought-after by cereal transformers for their **protein content** and are a natural means of improving flours. To meet these demands, the Limagrain Cooperative has selected a range of varieties of "wheat improvers" that are grown by farmers under contract. The Cooperative relies on the plant breeding activities carried out by the Group and the Ulice teams to develop new specific varieties. Adapted to the terrain in the Auvergne region, they can meet the demands of farmers in terms of agronomic performance while supplying the technological qualities required by industrialists.

## Success of the Apache wheat variety

Since 2001, the Apache variety has been **one of the leading wheat flour varieties** in France. More than 10 years after its registration, its success has been seen outside France: the Czech Republic, Germany, Croatia, Romania, Serbia and Australia. It is appreciated for its regular behavior and ease of cultivation. It also offers resistance to the cold and to disease (fusarium basal rot, yellow rust and glume blotch). It has a good protein content and is particularly appreciated for its yellow crumb.

## Waxy wheat, a healthy natural solution

Some "waxy" wheats produce a starch rich in amylopectin*. Limagrain Céréales Ingrédients and Ulice have developed several cereal ingredients using this wheat variety. The ingredients have interesting functionalities for various food applications.

For example in bread making, they have high nutritional value: a small percentage naturally reduces the fat content by 50 to 70%. For prepared foods or sauces, they act as a texturizing and thickening agent that withstands freezing without using a chemical agent during manufacturing.

* Amylopectin: Carbohydrate family.
One of the main components of starch with amylose.

## DID YOU KNOW ?

**› 85% of wheat production is destined for human consumption.**

**To meet growing world needs, production has increased since the 1980s by 7 million tonnes per year.**

# Research at Limagrain

Research in wheat is oriented by the needs of farmers, agri-food industrialists and consumers.
It is imperative to produce more and better.

## Major research themes

Research is mainly oriented towards **productivity**, which means improvement of **agronomic performance**. This includes the genetic fight against **biotic stress** (resistance to insects and diseases) and **abiotic stress** (tolerance to drought, cold, etc).

The second objective in breeding research concerns **qualitative performance**. **Nutrition** and **health** are also important themes for innovation. Limagrain participates for example in the development of wheat with a high amylose content, which combats cholesterol and diabetes. Naturally more tolerant to stress and more regular in production, hybrid wheats are an alternative way to explore the possibility of producing more and better.

## Céréales Vallée, innovation in cereals

Awarded a quality label in France in 2005, the **Céréales Vallée** Competitiveness Cluster brings together 63 members in the public and private cereal sector, involved in research and industry, services and education. On an international level, the Cluster has **3 strategic research and development themes**: "cereals for the future", the true backbone of the organization, "cereals for human and animal health and nutrition" and "non-food cereals". The **BléNNat** project, for example, is seeking to develop products, thanks to variety breeding, that are **nutritionally superior**, to meet, naturally, the nutritional and health demands of consumers.

■ www.cereales-vallee.org

## Génoplante, the strength of a public-private partnership

This joint program in plant genomics combines public (INRA, CNRS, CIRAD, IRD) and private (Biogemma, Arvalis and Sofiprotéol) research. Génoplante celebrated its tenth anniversary in 2009. For Europe, analysis of the genomes of the main cultivated plants (wheat, corn, rape, peas, sunflowers, tomatoes, rubber trees, vines, trees, cacao trees, coffee trees) is a scientific and strategic challenge for farmers. The program has already enabled researchers to trace the genealogy of wheat and the hard or soft characters of the grain. Many chromosomatic zones influencing agronomic and qualitative performances have been identified.

■ www.genoplante.com

## Facts and figures

- **€111 million** for research (field seeds, vegetable seeds and cereal products)
- which is **12%** of the professional turnover and **€170 million** with partners
- More than **1 200** researchers worldwide

## It takes more than ten years to create a variety

The creation of a wheat variety is a long and costly process. **The first year**, the breeder makes several hundred crosses between the wheat varieties he wants to improve, by combining the qualities of each of them. The result of each cross is called an F1 hybrid. **The second year**, he sows and self-fertilizes this F1 hybrid to obtain F2 seeds that are sown again the following year. At this stage, the number of plants is considerable, roughly one million descendants. All these plants are studied in the field in order to identify – by observations – some tens of thousands of potential varieties. **Throughout the following years**, the plant breeder continues with the self-fertilization process in order to fix the desired genetic characteristics. In the meantime, each variety undergoes an increasing number of observations and tests (technological quality, disease resistance, productivity with multilocal tests) to eliminate the varieties that are of no interest. It is only after more than ten years of research that a commercial variety can be obtained.

# Limagrain, a world wheat expert

Limagrain's ambition today is to expand its European leadership in wheat seeds and its expertise in cereal products on an international level.

These positions are the result of a **strategic choice** and **patient construction** that began in 1990 with the acquisition of the European seed producer **Nickerson**, established in the UK, France, Germany and Spain. Since then, the Group has continuously strengthened its positions by internal growth and acquisitions: **Verneuil** in 2000 (creation of Limagrain Verneuil Holding), **Advanta Europe** in 2005, **Innoseeds** in 2006. At the same time as this European growth, the Group set up partnerships and began research work in China (Shanxi-Limagrain, created in 2002) and Australia (JV Arista, created in 2006 between the CSIRO, the GRDC and Limagrain Céréales Ingrédients). A new stage was reached with two strategic investments: first in **China**, with the acquisition of a stake in the **Longping High-Tech** seed company in 2007; then in **Australia**, with a stake in **Australian Grain Technologies** in 2008.

The Group's ambition to become a worldwide wheat expert is based on its global approach to the wheat sector, **from genetics to the finished product**. Its capacity to direct breeders' work towards the real needs of users, farmers, industrialists and consumers gives it a unique competitive advantage today.

Today Limagrain is the European leader in wheat seeds, via **Limagrain Verneuil Holding**, with a market share that is far higher than 20% in certain countries. In cereal products, Limagrain is the European leader in functional flours with **Limagrain Céréales Ingrédients** and the 2nd largest industrial bakery in France with **Jacquet**.

Today, strengthened by a network of research centers worldwide, Limagrain tests varieties in local climate and soil conditions and has industrial applications laboratories. Tomorrow, LImagrain will offer its customers wheat varieties with a better agronomic performance (more productive, more economical in the consumption of water and fertilizers, better capable of self-protection against disease and insects) and varieties that are better adapted to different uses (bakery products, cookies, human food, starch products, bioethanol, animal feed).

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