A CULTURE FOR THE FUTURE




SUNRISE

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SUNRISE,

A response to climate change and growing demand for production

In the context of climate change, agriculture must adjust to new environmental constraints and to the growing scarcity of water.

Because of its plasticity and low water requirements, the sunflower crop could be used as a model to facilitate the adaptation of the plant sector to these changes. Therefore, improving crop resistance and agronomic performance in drought conditions has become a major environmental challenge.

The global production of oilseeds - particularly sunflower seeds - must increase to meet growing demand not only from the human food industry but also from the animal feed industry (oilcake is rich in proteins) and green chemistry. Therefore, it is vital to improve yields through innovative approaches.

To address these challenges, public and private stakeholders in the sunflower sector have joined forces on the SUNRISE project. This project is part of the "Investments for the Future" program set up by the French National Research Agency.

An ambitious project

The SUNRISE project has three main objectives:

- Improve sustainable oil production in climate change conditions.
- Understand the genetic and molecular mechanisms controlling the physiology and development of the sunflower plant in order to predict the characteristics of hybrids.
- Develop sector-wide tools and methods to better manage sunflower crop.

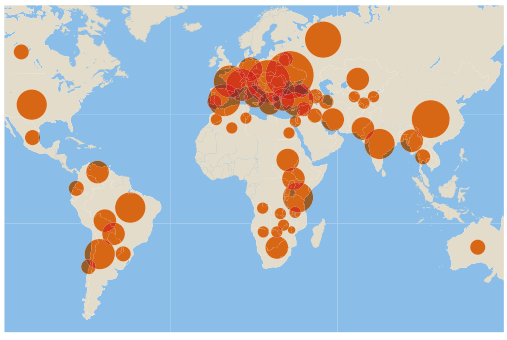
To meet these objectives, the SUNRISE project is based on three scientific focus areas:

- Characterising the sunflower genome to identify genes of interest and understand the molecular mechanisms that enable the plant to withstand drought.
- Modelling the agronomic characteristics of future varieties to predict their behaviour in different climates.
- Analysing the socio-economic impacts of the distribution of innovative SUNRISE methods for the selection of sunflower hybrids.

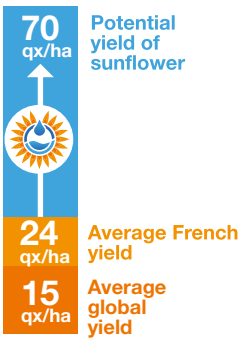
France and Europe are key players in global sunflower production

30 million hectares worldwide,
with 71% in Europe

39 million tonnes of seed produced worldwide,
with 80% of production in Europe



Volume of sunflower seeds produced per country in 2013
(Source: FAO)



The SUNRISE project aims to develop concrete solutions to improve yield level and stability.

With the help of the public and industrial partners involved in SUNRISE, we aim to propel the sunflower into the post-genomic era. By means of an innovative and multi-disciplinary approach, we are preparing this high-potential crop to meet future environmental and societal challenges.

Nicolas Langlade
INRA Laboratory of Plant-Microbe Interactions (LIPM), coordinator of the SUNRISE project.

Initial results

Identification of drought tolerance genes:

Genes that potentially confer drought tolerance have been identified by the SUNRISE team, based on the results of previous projects (Sunyfuel and Oleosol). An effect on the behaviour of plants has also been observed. Should these findings be confirmed, the associated advances would reduce yield losses due to drought.

Development of new tools:

The Heliaphen phenotyping facility, which was brought into service in 2013 in the frame of the Oleosol project, enables the simultaneous and automatic testing of 1,300 sunflower plants. The robot is a unique prototype designed specially to control water supply levels and measure the morphological and growth characteristics of the plant.

Two Axiom® arrays:
innovative, high-throughput genotyping tools with a capacity of 50,000 and 600,000 SNPs (single nucleotide polymorphisms), designed within the frame of the project. These arrays are already being used by SUNRISE's partners.

Integrating the SUNRISE project means sharing our know-how with a large network of public- and private-sector experts to optimise our test methods and tools and select new, abiotic stress-tolerant varieties that can be produced on a sustained yield basis.

Antoine Gaillard
Scientific Director - Maïsadour Semences

Accelerating the development of more competitive sunflower hybrids that are profitable to farmers is a major challenge. The SUNRISE project highlights the accomplishments and achievements of all those in the sector.

Xavier Pinochet
Head of the innovative methods and technologies department - Terres Inovia

Toulouse, a research centre with a global reach

Midi-Pyrénées is the foremost sunflower-producing region in France and is home to the world's leader sunflower breeding companies. Toulouse boasts a globally unique research collective, with over 80 scientists involved in the SUNRISE project.

• PUBLIC PARTNERS
- LIPM - Inra - Toulouse Midi-Pyrénées
- AGIR - Inra - Toulouse Midi-Pyrénées
- MIAT - Inra - Toulouse Midi-Pyrénées
- CNRGV - Inra - Toulouse Midi-Pyrénées
- EPGV - Inra - Versailles Grignon
- LBD - Pierre & Marie Curie University, Paris
- BFP - Inra - Bordeaux
- GQE - Le Moulon - Inra - Versailles Grignon
- LEREPS - Toulouse 1 Capitole University

• AGRICULTURAL TECHNICAL INSTITUTE
- Terres Inovia

• PRIVATE PARTNERS
- Biogemma
- Caussade Semences
- Maïsadour Semences
- RAGT 2n
- Soltis
- Syngenta France

Ten work packages

The SUNRISE project comprises 10 work packages, which involve all the partners and thus enable the cross-fertilisation of a broad spectrum of skills.

1. Manage the project and coordinate the various activities
2. Produce genetic resources in the form of hybrids
3. Characterise the genomes of the hybrids
4. Phenotype the molecular and agronomic characteristics of the hybrids under conditions of water deficit
5. Model the plant physiology to predict the crop response to new environmental conditions.
6. Identify the genetic and molecular mechanisms of yield stability
7. Collect and publish genomic and phenotypic data
8. Predict the socio-economic impacts of future varieties
9. Validate the genetic and molecular mechanisms and facilitate their use in industry
10. Disseminate the results to the scientific community, the entire sunflower sector and the general public

State-of-the art equipment and scientific expertise

To improve the genetic characteristics of sunflower varieties, the scientists working on the SUNRISE project have developed an integrated approach. The approach consists in designing an ideal variety for given production situations and climate scenarios based on the characterisation of genetic resources (genotyping) and of their responses to the environment (phenotyping). The project benefits from state-of-the-art equipment and scientific expertise.

Genotyping:

• The next-generation sequencers - Pac Bio RS II and Illumina - in the Genome and Transcriptome facility at the Toulouse Genopole enable the production of very long sequences and the characterisation of genetic diversity.

• The CNRGV (French Plant Genomic Resources Centre) houses and preserves plant genomic resources that are of interest to the international scientific community (wheat, corn, sunflower, etc.).

Data processing and modelling:

• The bioinformatics facilities at the Laboratory of Plant-Microbe Interactions (LIPM) and the Toulouse Genopole provide leading-edge computing and bioinformatics resources and process genome-related data: genome navigator, integration of genetic maps and sequence comparison.

• The crop model SUNFLO - developed by AGIR (Agroecology, Innovations, Territory) with the support of Terres Inovia and LEPSE (Laboratory of Plant Ecophysiology under Environmental Stress) - is used to characterise growth limiting factors of an experimental trial and to predict the behaviour of the crop under a wide range of agronomic conditions.

Phenotyping:

• A drone fitted with sensors and computational tools increases the throughput and the collection frequency of data in field crop experiments, using remote sensing and aerial imagery methods.

SUNRISE IN BRIEF 2012 - 2020

9 public research laboratories

6 seed companies

1 technical institute

80 scientists

€21M budget over 8 years, including €7M in government subsidies

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