SolACE European Project

Toward More Resilient Crop Productions

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SolACE assesses water, nitrogen and phosphorus use efficiency in crops, as well as the associated root genetic traits.

In a context of global warming and demographic growth, European agriculture needs to increase its production, but this growth is facing multiple constraints. A European consortium was thus created in 2016 to meet these challenges, with a view to provide sustainable solutions to wheat and potato producers who are now facing climate change.

Europe needs to produce more wheat and potatoes, while dealing with a reduced or more variable water availability. It is also necessary to improve the efficiency of mineral nitrogenous fertilizers and/or the availability of nitrogen (N) and phosphorus (P) in soils in order to support production while maintaining the quality of water and limiting N and P residues from farming. Europe also has to reduce its greenhouse gas emissions and rationalize the use of mineral resources.

SolACE, a collaborative project launched in 2017, aims at solving this complex equation. The project is coordinated by INRAE (the French National Institute for Agricultural Research) and financed under EU's Horizon 2020 Programme for a five-year period. Numerous themes are studied in order to improve the tolerance of wheat and potato crops to water and nutrient stress by valorizing further the available soil resources and mineral fertilization.

Several leverages are explored to this end, such as the selection of new varieties, and the rotation or use of varietal mixtures able to withstand these combined stresses without any yield loss. This requires a better understanding of the way crop roots response to water and mineral limitations and identifying the root characteristics that are being introduced as a new way of selective breeding, among other things.

SolACE is also exploring agronomic innovations that can meet these requirements: the optimization of rotations, plant covers, decision support tools, agronomic fertilizer additives, or technical solutions

based on microbial inoculants. The project includes the development of tools designed to train farmers and agricultural advisers with a view to implement these innovations.

Therefore, several actions are simultaneously carried out by the 25 partners of the project from 14 different countries (Figure 1).

To effectively advance in all these challenges, the project partners decided to involve stakeholders from the relevant sectors. Farmers, scientists, industries, value chain actors, policy makers, academics as well as the general public are at the heart of SolACE and are regularly consulted as the project moves forward, in an effort to guarantee the relevance and quality of the work done.

A group of stakeholders was created and invited to take part in the project within a Forum and through exchanges and other related events. Tools designed to disseminate and optimize the results will be used to maximize the transfer of knowledge.

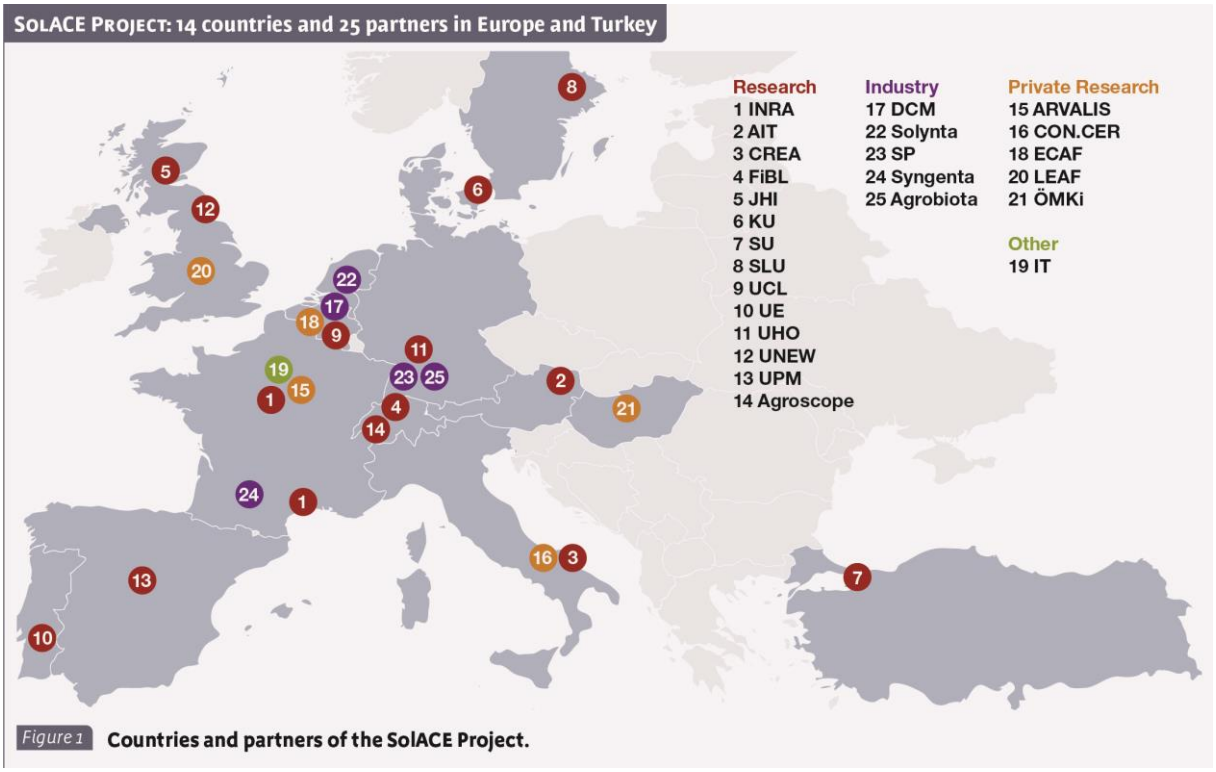

Figure 1 **Countries and partners of the SolACE Project.**

Building on the work done to get faster results

Partners decided to build on the existing work to make sure that the results of the project are innovative, operational and relevant. They thus listed all the previous and ongoing studies on a national, European and global scale that focus on the response of wheat and potato crops to stress, both on the field and under controlled conditions. The project has already reached the stage of selecting phenotypic and genetic characters that respond to the most relevant water and nutrient stresses so that they can be analyzed in these crops.

The project is setting up a data management plan designed to organize the resources and optimize their use by researchers. Data are consolidated within a shared database, which informs exploratory models describing possible future scenarios regarding climate change. This stage sets a benchmark that will be used to assess the potential impact of the solutions examined under the project.

On-farm experiments and field demonstrations are an important part of the SolACE Project.

Several studies done simultaneously

A better knowledge of plants confronted to stresses

All plants have a microbiome – that is a set of microscopic organisms that live on their leaves and in their roots and contribute to their acclimatization to a certain environment. How do they react to water and nutrient stress? To answer this question, the project is conducting an international program aiming at gathering references on the diversity and the functioning of root microbiomes and their interactions with the plant, on the field and in high-speed phenotyping platforms, focusing both on the above- and below-ground parts of the plant.

In concrete terms, the partners are searching for the genetic characters of stress tolerance in the roots, in order to identify the microbiome's specificities based on genetics and on resources limitations. Then, they assess the most promising new varieties of hybrid wheat and potato.

Managing a resilient agro-ecosystem

Several partners, including Arvalis, are also working on the evaluation and development of novel agricultural practices. They analyze the effects of different leverages, including rotations with legumes (in bread wheat and potato), tillage intensities, varietal mixtures (for durum wheat), and the use of microbial inoculants containing combinations of strains of bacteria (such as Pseudomonas or Bacillus) and fungi (for example, arbuscular mycorrhizal fungi or Trichoderma). Partners are also assessing the addition of urease inhibitors in mineral nitrogenous fertilizers and their fertilization strategies (in wheat and potato).

These experimentations are conducted in part in conventional farming and in part in organic farming, as well as in reduced tillage conditions and conservation agriculture systems.

Selected DSTs

A specific work package contributes to refining Decision Support Tools (DST) that are most promising for improving resource efficiency in crops. These DSTs are based on real-time remote sensing, including through the integration and improvement of Arvalis' Crop Simulation Model (CHN), which simulates water and nitrogen flows within the soil-plant-atmosphere continuum.

Some advances in genetics

A distinctive feature of SolACE is the improvement of knowledge on the root genetic characters of the species under study. This is why new tools – such as molecular markers targeting root genetic traits – or the designing of hybrid wheat and potato are being developed and assessed in close collaboration with stakeholders, in particular breeders.

Farmers too are involved in assessments

Novel practices and genetic innovations investigated under the project are also assessed based on agronomic, economic and environmental criteria, including through farmer networks mobilized in Europe. That way, the feasibility as well as the needs and expectations of farmers are effectively taken into account, thus allowing for operational and relevant solutions for the end-user. In France, Arvalis is charged with facilitating a network of farmers' plots cultivated with conventional durum wheat with a view to collectively identifying the practices and strategies better suited to the Mediterranean climate.

An ambitious project that pays off

With a little less than two years left before the completion of SolACE, several causes for satisfaction are already emerging, starting with the keen interest of farmers in the project. Innovative results on the combination of agronomic leverages have already been identified, with varieties adapted to them.

One of the highlights in France is the level of engagement of the farmer network facilitated by Arvalis on the theme of conservation agriculture and the commitment of the different teams from the INRAe and Arvalis in general.

Find out more

More news and information on SolACE are available on the project's official Website: www.solace-eu.net.