SolACE

Solutions for improving Agroecosystem and Crop Efficiency for water and nutrient use

H2020 project from May 2017 to April 2022

Participants: 24 members coordinated for P. Hinsinger (INRA)

Coordinator UPM group: M. Quemada

Objectives

Overall Goal

European agriculture is challenged by the need to produce more crops with fewer inputs of fertilizers, especially nitrogen (N) and phosphorus (P), under conditions of reduced or more variable water availability. Projected climate changes indicate a higher variability in rainfall in the coming decades, with an increased risk of water shortage during summers, while water resources for irrigation will be at best maintained. N and P flows exceed the so-called planetary boundaries (sensu Steffen et al. 2015), the losses of N and P from various sources including fertilizers being clearly responsible for major impacts on the environment (e.g. eutrophication of surface waters, emission of greenhouse gases such as N2O) in regions of intensive agriculture in Europe. In addition, phosphate rocks have been included in the list of 20 critical raw materials by the European Commission in 2014, which further pledges to reduce the use of P fertilizers significantly in the future. Meanwhile, socio-economic projections suggest a steady increase and volatility of fertilizers' prices (Brunelle et al. 2015). Sustainable or ecological intensification of agroecosystems needs to be implemented by combining novel crop varieties and management approaches that make better use of below-ground biodiversity and processes to sustain high levels of productivity with reduced use of water and nutrient resources. There are different pathways to move towards biodiversity-based agriculture (Duru et al. 2015), and they largely depend on the farming systems (e.g. level of intensification, following conventional, organic or conservation agriculture principles) and regional context (e.g. specialized cereal-based agriculture or integrated crop and livestock production). **SolACE goal is to help European agriculture facing major challenges, notably increased rainfall variability and reduced use of N and P fertilizers for both economic and ecological purposes, by designing solutions (strategies and tools) that combine novel crop genotypes and agroecosystem management innovations to improve water and nutrient use efficiency in a range of agricultural contexts across pedoclimatic regions of Europe and farming systems.**

Project's objectives

To reach this ambitious overall goal, the project will be based on multi-actor collaborations and stakeholder engagement to pursue and achieve the following objectives:

- **At the scientific level**, SolACE will determine (i) the crop responses to realistic combined water and nutrient (N and/or P) limitations in strategic cereal and root/tuber crops [WP1, WP2, WP3], (ii) the links between belowground traits (root growth and activity / rhizosphere microbiome / symbiosis) and resource (water, N and P) acquisition efficiency [WP2, WP3], (iii) the best-performing genotypes under combined water and nutrient stresses, and the related genes or markers [WP2, WP4], (iv) the optimum combination of traits, below- and aboveground, for improved overall system resource use efficiency [WP2, WP4], (v) the agroecosystem management innovations that make best use of plant-plant and plant-microbe interactions [WP3] in conventional, organic and conservation agriculture systems.

- **At the technological level**, SolACE will design (i) innovative agroecosystem management strategies and tools to unlock the genetic potential of large panels of genotypes, based on increased use of above- and below-ground interactions and biodiversity (crop genotype mixtures, legume-based crop rotations and cover crops, microbial inoculants), as well as improved Decision Support Systems [WP3], and (ii) novel breeding strategies (including participatory approaches) and tools to develop resource-efficient crops that benefit most from such management innovations [WP4, WP5] in conventional, organic and conservation agriculture systems.

- **At the applied level**, SolACE will (i) evaluate the performance of the designed solutions in terms of yield, food quality, and environmental impact in experimental stations [WP2, WP3, WP4], (ii) evaluate the technical feasibility, economic and environmental impact brought by the innovations developed by the project in farmers' trial networks [WP5], and assess the potential, socio-economic, institutional and regulatory barriers and enablers to their uptake [WP6], both in conventional and organic agriculture in various European pedo-climatic conditions, and (iii) transfer the project outcomes to stakeholders, from breeders to growers, from farm advisors to agribusiness suppliers [WP6].