ReCROP – Bioinocula and CROPping systems: an integrated biotechnological approach for improving crop yield, biodiversity and REsilience of Mediterranean agro-ecosystems

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Introduction

The Mediterranean economy is highly dependent on agriculture. However, agricultural sustainability and productivity in this region is under serious threat due to climate change and the depletion of water resources. This is worsened by poor management practices, such as the overuse of chemical fertilizers, pesticides, overgrazing and monoculture farming.

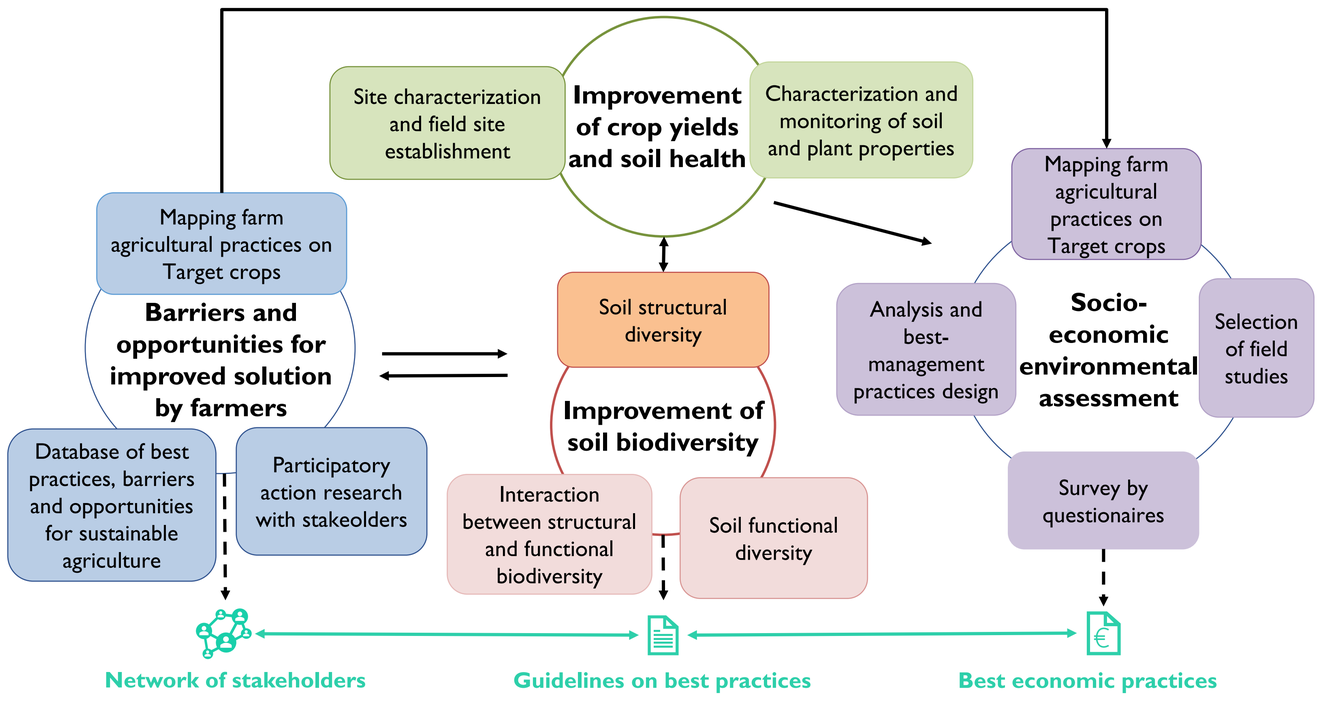
Recent climate change models indicate that European and Northern African regions will undergo extreme climatic events throughout the year, this will negatively impact crop yield and productivity. Summer droughts and heat waves periods will increase for most parts of Europe, as well as short intense rain events.

Preserving and improving productive agricultural land in this region is vital, especially through the application of sustainable soil and crop management practices that promote soil fertility and water conservation; this will improve resilience to degradation and to extreme climatic events. Soil organisms play a key role in ecosystem processes, leading to essential soil functions and are used as bioindicators of soil quality. Their monitoring is crucial to assess the impact of beneficial agricultural practices on soil functioning.

Figure 1. Vineyards in the wine-making region of Douro (NW Portugal)

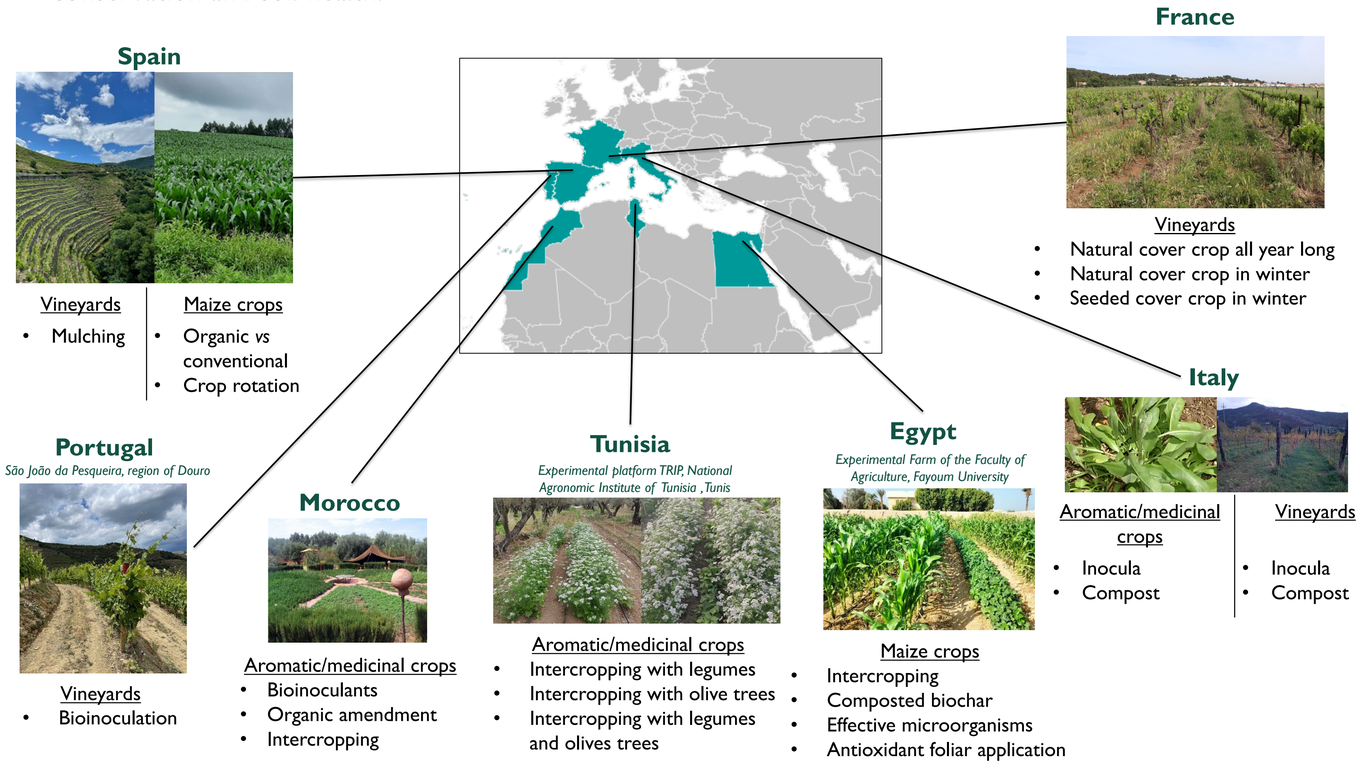
ReCROP objectives

Identify sustainable and resilient agricultural production systems in the Mediterranean region through the combined use of biotechnological tools and environmentally friendly agronomic practices.



Improvement of soil biodiversity

- One of the goals of ReCROP is to evaluate **the beneficial impact of different agricultural practices on the structural and functional soil diversity at different levels of the soil food web**.
- **Different agroecosystems with key local crops** (i.e vineyards, maize and aromatic/medicinal plants) of the Mediterranean region are studied under field conditions to help improve crop resilience, yield, water conservation and soil health.



- This work will contribute to **identify which practices are beneficial for the biodiversity of Mediterranean agricultural soils**, thus providing **resistance and resilience**, in terms of **soil functioning** and against soil disturbances under the current scenario of climate change.

Methods

A multi-taxa approach is used to assess the influence of these practices on the abundance and diversity of soil fauna. The macrofauna and mesofauna (*i.e.* springtails and mites) as well as microbial biomass, activity and biodiversity of soil microbial communities (bacteria, archaea, fungi) will be monitored.

Epigeal mesofauna and macrofauna

Arthropods are sampled using pitfall traps of containing a non attractive preservative (mono-propylene glycol). The traps are collected after 8 days. Different taxa will be analysed (*i.e.* springtails, ants, spiders, carabids).

Figure 2. Pitfall traps

Soil mesofauna

Soil mesofauna is sampled using cylindrical soil cores (diameter 5.5 cm; depth 10 cm) and extracted with a a high thermal gradient extractor (Macfadyen-type). Collembola will be then isolated and identified to species level.

Figure 3. Mesofauna extraction using a high thermal gradient extractor (MacFadyen)

Environmental DNA

Prokaryotes, fungi and invertebrates are also being analysed by multi-targeted amplicon sequencing (16S rRNA, 18S rRNA, ITS, COI, Oligo) and metagenomic sequencing.

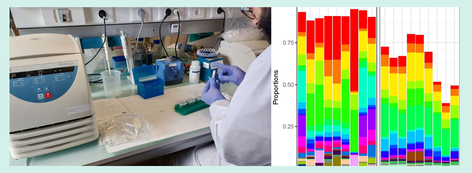


Figure 4. extracting DNA and example of the barcharts obtained

➔ By studying abundance, biomass, species richness and diversity, as well as functional traits, it will be possible to produce **a multi-taxa index of soil biological quality**.

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