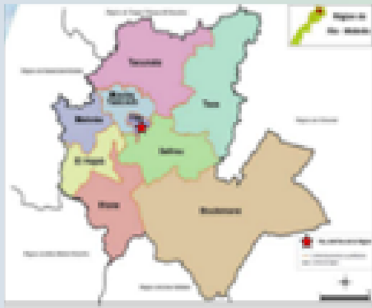


Case Study 3: Fès-Meknes, Morocco

RESILIENT AND CLIMATE-SMART OLIVE GROWING

Context and background



The Fès-Meknes region in Morocco, comprising two prefectures (Fès and Meknes) and seven provinces, covers an area of 40,075 km² and houses over 4.2 million people, with 60.52% living in urban areas. The region is a significant contributor to the national economy, accounting for 9.3% of Morocco's GDP in 2017. It is renowned for its arboriculture, particularly oliviculture, which has been intensified under the Green Moroccan Plan. Oliviculture is the primary perennial crop in Morocco, representing 60% of the arboriculture area and contributing around 5% to the agricultural GDP.

Despite its economic importance, olive production faces challenges, particularly diseases such as *Phytophthora* root and crown rots and *Verticillium* wilt. These diseases threaten olive trees and necessitate sustainable disease control strategies, particularly in the context of climate change.

Objectives

The primary objective of this case study is to develop and implement sustainable disease control strategies to enhance the resilience and robustness of olive production in the Fès-Meknes region. The study focuses on:

- 1) Microbial characterization of olive soils and screening of potential antagonists to restore soil fertility and mitigate olive diseases.
- 2) Evaluating the efficacy of existing bacterial antagonists from the consortium against olive diseases.
- 3) Assessing the resistance of various olive varieties to *Phytophthora* root and crown rot and understanding the underlying resistance mechanisms.

Experimental design

The study is divided into three specific challenges:

1) Characterization and Screening of Potential Antagonists:

- Screen PGPR (plant growth-promoting rhizobacteria) from different olive fields in the Fès-Meknes region.
- Conduct in vitro screening using dual culture bioassay on agar medium.
- Test selected microorganisms on 1-year olive seedlings in greenhouse pot experiments.
- Investigate the mechanisms of action of effective PGPR bacteria for their potential as biological control agents (BCAs).



2) Efficacy of Existing Bacterial Antagonists:

- Evaluate the disease suppression abilities of already characterized beneficial microorganisms from consortium partners.
- Expand the activity spectrum of these antagonists to new pathogens.
- Select the most effective antagonists for further studies on mechanisms of action and formulation as BCAs.

3) Use of Resistant Olive Varieties:



- Evaluate the resistance of various olive varieties at Agro-Pôle Olivier Meknès to *Phytophthora* root and crown rot.
- Investigate the resistance mechanisms by screening gene expression and comparing resistant/tolerant and susceptible varieties using molecular tools.

Key innovations

- **Integration of Novel Preventive Strategies:** Implementation of newly screened PGPR bacteria to suppress olive diseases in the Fès-Meknes region.
- **Mechanistic Insights:** Detailed investigation of the mechanisms of action of effective PGPR bacteria and existing bacterial antagonists.

- **Resistance Evaluation:** Comprehensive assessment of resistance in diverse olive varieties, including Moroccan, Spanish, and other Mediterranean types.
- **Molecular Screening:** Use of molecular tools to understand the genetic basis of resistance and identify up/downregulated genes in resistant/tolerant varieties.

Preliminary results

- The preliminary results of the pot experiment showed that the selected bacteria from the existing collection of the laboratory demonstrated a higher potential to decrease the severity of root rot disease in olive trees. Notably, the two strains *Alcaligenes faecalis* ACBC1 and *Bacillus amyloliquefaciens* SF14 both showed an 8.33% reduction in disease severity and were selected for further assays.
- In the greenhouse assay, out of the eight olive varieties tested, only three (Picual, Koroniki, and Haouziya) were found to be resistant to the pathogen causing root rot disease.
- Eight *Trichoderma* isolates were found to be effective in reducing *Pythium shmithenneri* growth both *in vitro* and *in vivo*. The genomes of the two most effective isolates were identified and submitted to NCBI.

