

Case Study 5: Berkane, Morocco

EXPERIMENTAL FARM FOR CITRUS ROOT ROT AND CANKERS DISEASES AND PHYTOPHTHORA ROOT ROT

Context and background

Berkane, a province in the Eastern Moroccan region, is renowned for its substantial citrus orchards, covering 22,000 ha with a production of 400,000 tons, predominantly clementines and oranges. Despite its economic significance, the region faces challenges from phytosanitary issues, including dry root rot, Phytophthora rot, and citrus cankers. These diseases have emerged with intensified cultivation practices, necessitating a comprehensive study to address these constraints effectively.

Objectives

The study aims to:

- 1) **Characterize Fungal Pathogens:** Identify the specific fungal pathogens responsible for dry root rot, citrus cankers, and associated Phytophthora species in Berkane.
- 2) **Assess Beneficial Bacteria:** Test and develop strategies using beneficial bacteria to enhance soil fertility and control the major pathogens affecting citrus crops.

Experimental design

1) Pathogen Characterization:

Sample Collection: Collect soil and diseased citrus tree samples across Berkane.

Isolation Techniques: Use dilution methods for fungal pathogen isolation and bait traps for Phytophthora species.

Molecular Identification: Apply ITS gene primers for molecular identification of fungal taxa.

Pathogenicity Testing: Conduct greenhouse tests on citrus seedlings using a completely randomized design to assess the aggressiveness of fungal isolates.

2) Beneficial Bacteria Evaluation:

Bacterial Screening: Test newly screened and existing bacterial antagonists from the citrus rhizosphere under laboratory and greenhouse conditions.

Inhibitory and Stimulatory Analysis: Evaluate the ability of bacterial antagonists to inhibit pathogen growth and stimulate plant defenses.

Greenhouse Trials: Test the most effective bacterial isolates on citrus seedlings, with and without pathogens, using various pathogen concentrations, bacterial strains, and citrus rootstocks.

Key Innovations

1) Integrated Pathogen Management: Develop comprehensive protection strategies combining biological control and plant growth stimulation, tailored to the specific pathogens and citrus rootstocks in Berkane.

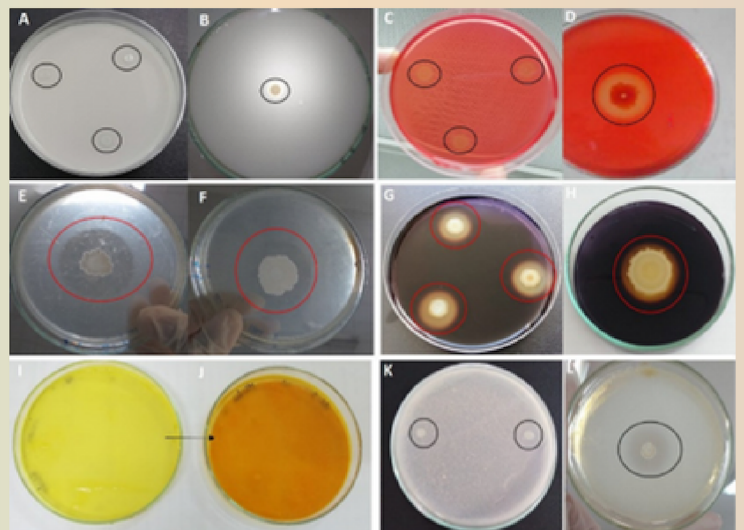
2) Molecular and Biocontrol Synergy: Utilize molecular techniques for precise pathogen identification and integrate biocontrol agents to enhance disease resistance and soil health.

3) Customized Protection Programs: Create region-specific recommendations for disease control and plant growth enhancement, considering the diverse resistance levels of different citrus rootstocks and varying climatic conditions.

Preliminary results

Early findings from the study indicate:

- Out of 20 bacterial isolates, 18 produced pectinase, 16 produced cellulase, and 8 produced chitinase.
- All isolates produced amylase and protease, while only 4 produced hydrogen cyanide.
- Fourteen isolates solubilized tricalcium phosphate, and ten produced indole-3-acetic acid (IAA).



- Production of antimicrobial substances varied greatly, with surfactin being the most common (14 isolates).
- PGPR capabilities were observed, with increased growth in canola plants treated with bacteria.
- *Bacillus subtilis* K4-4 and GH3-8 showed the most promise for disease control and bio-fertilizer applications.