

Case Study 7:

Sidi Bouzid, Tunisia.

SUSTAINABLE OLIVE TREES AND INTENSIVE CROP PRODUCTION USING REGENERATIVE APPROACHES TO FACE ABIOTIC AND BIOTIC STRESS

Context and background

Olive cultivation plays a vital role in the social and economic life of Tunisia. The olive sector (olive growing plus the olive oil industry) provides a directly and indirectly livelihood. Olives and olive oil constitute a significant portion of the agricultural production and exports of Tunisia. In addition, tomato is among the most cultivated vegetable crop worldwide and in Tunisia. They are strategic crops with national economic importance.

Most of the agricultural regions are located in the Centre of Tunisia where Sidi Bouzid occupied the important production areas. The region is classified as arid with cold and humid winters and hot and dry summers. The average annual evaporation is 1.470 mm. Therefore, agriculture is primarily based on irrigation using groundwater. Soils are deep with an organic matter content ranging from 0.5 to 1.5%, being suited for the majority of the crops.

The deficit of hydric resources, the increase in their salinity, as well as the infections by several fungal diseases (vascular wilt, Downey mildew and gray mold) are currently threatening the production of olive and vegetable crops. In addition, climate change is worsening the impact of these biotic and abiotic stresses.

Objectives

The strategic objectives in Tunisia are to improve agricultural practices, restore soil fertility, and improve access to water and rational management of water resources, and a sustainable improvement in agricultural productivity. Therefore, a new agricultural development model adapted to climate change must be promoted.

The experiments carried out within the SIRAM project contribute to innovate sustainable agricultural approaches adapted with Tunisian agriculture context.

The Tunisian case study is based on the four SIRAM pillars in the context of innovative regenerative agriculture:

- Beneficial microorganisms for plant growth and disease control. The use of PGPR and BCAs to improve tomato and olive performance and resilience to fungal diseases.
- Agronomical practices to safeguard soil quality and fertility. The reduced or no-tillage associated with the compost on olive field can improve soil quality, soil productivity and surface water quality.
- Crop varieties with resistance towards abiotic and biotic stresses. The performance of local and introduced cultivars of tomato and olive was tested in pot experiments towards abiotic stresses (hydric deficit) and the tested innovative agricultural approaches.
- Bioeconomy approaches to recycle and valorize waste biomasses that restore soil organic matter and have bio stimulant properties. The compost composition is based on crop waste residues (as olive pruning product, crop residue for vegetables) in order to valorize the waste biomasses. The effect of each compost composition was tested on plant growth promotion potential and restoring soil properties.

Experimental design

1- Efficacy of Compost and microbial consortia to enhance olive resilience to Olive Verticillium Wilt Disease

Verticillium wilt of olive (VWO) caused by *Verticillium dahliae* and affecting several Mediterranean countries as Tunisia cause high economic losses. The use of integrated strategy is more efficient to reduce the verticillium wilt disease. This study aimed to determine the suitable management in control of VWO in combining among factors as microbial consortium, compost, four cultivars (Arbequina, Arbosana, Chetoui, Chemlali) with different resistance level.

The management of VWO on potted and field experiment in greenhouse lasted three months. Then, several parameters were estimated as:

- Physiological parameters (photosynthesis, chlorophyll)
- Agronomic parameters (length, leaf area)
- Biochemical parameters: stress response (ROS enzymes), MDA, proline, proteins, antioxidant activity, phenols, etc.
- Soil physico-chemical proprieties: pH, EC, N-P-K contents, humidity, soil texture,...
- Leaf Mineral composition (macro- and micro-elements)



Main Results

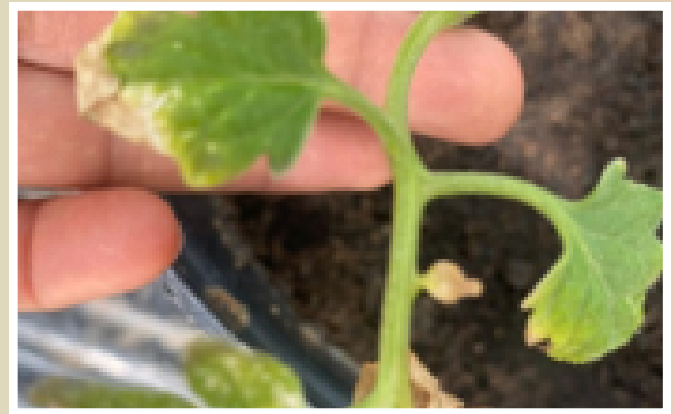
The results showed high susceptible (Arbequina), and resistant (Chemlali) cultivar against *V. dahliae*. The combined treatment of microbial consortium and compost with each four cultivars (T3) showed the best ability in reduction disease severity in comparison from other treatments in four olive varieties (Arbequina, Chetoui, Arbosana, and Chemlali) with severity indices of 0.67, 0.67, 1.17, and 1. Microbial consortium and compost are more compatible with Arbequina cultivar by enhancing significantly plant vigor, antioxidant defenses, proteins, and phenols. In T3 in all cultivars, content of APX is higher conversely MDA was lower and the difference between them is more clear in Arbequina cultivar. Combined among three factors is improved the plant vigor, antioxidant defenses, phenols, proteins, and soil quality parameters both of physicochemical and microbiological significantly for Arbequina, Arbosana, and Chetoui. In addition, the combination of microbial consortium and compost can be potentially used in integrated management for Verticillium wilt.

2- Resistant cultivars combined with compost and microbial consortia efficient against biotic stress on tomato

Among the biotic constraints, a particularly dreaded vascular disease is Fusarium wilt caused by *Fusarium oxysporum f.sp. lycopersici* (FOL) (soilborne pathogen), which is the primary pathogen responsible for tomato vascular wilt.

Two varieties (Dorra and Firenze) responses to biotic stress (Fungal disease: *Fusarium oxysporum f.sp. lycopersici*) were tested in pot experiment.





The main preliminary results are:

- The combination of compost with the microbial consortium reduced the severity of Fusarium wilt disease (0.30% and 0.40% for Dorra and Firenze varieties, respectively) and stimulated tomato growth, particularly stem diameter (3.23% and 4.15% for Dorra and Firenze varieties, respectively), plant length (28.33% and 25% for Dorra and Firenze varieties, respectively), leaf number (9.67 and 7.67 leaves/plant for Dorra and Firenze varieties, respectively), leaf chlorophyll content, plant weight, and leaf surface area.
- The determination of defense mechanism stimulating potential showed variation in the activity of oxidation enzymes (improvement of peroxidase, catalase, and ascorbate peroxidase activity), improvement of total phenol and protein contents, and reduction in MDA levels following treatment with microbial agents, especially when associated with compost.

This integrated disease management approach holds promising potential for sustainable tomato crop protection.

