

# Olive based Agroforestry with cereals and leguminous: a reliable alternative for sustainability in arid climates.

## Problem

Olive growing in arid climates is based mainly on monoculture with intensive tillage since decades. This practice, with lack of organic fertilization and pruning material turnover, induces soil degradation, soil fertility loose and enhanced erosion. Thus, olive productivity and resilience to climate change dropped with less income to farmers. Sustainability of olive producing system is under serious threats especially due to resources depletion and climate change.

## Potential solution

Intercropping legumes and cereals in olive groves could be a sustainable practice that can improve soil fertility, crop yield and enhance diversification. The diversity of plant species improves productivity as well as increasing organic carbon (C) and total nitrogen (N) stocks in soil, microbial biomass, and crop residues (Callaway, 2007; Karbout et al.2020). Agroforestry system based on olive, tends maximize synergies between trees and associated crops, especially in areas subjected to water scarcity and harsh climatic conditions (Scordia et al., 2023).



**Figure 1:** Intercropping of olive with bean in irrigated orchard in northern Tunisia in semi-arid climate (left), faba bean with olive in rain-fed orchard (center) and Barley with olive in rainfed orchard in central Tunisia in arid climate (Sfax, Tunisia)

## Applicability box

### Geographical coverage

Mediterranean climate, semi-arid and arid regions (Tunisia)

### Application period

Autumn to spring period

### Required time

Sowing time can be shorter with adapted machinery. No additional time during crop development. Crops are harvested together. Ploughing time is needed to landfill crop residues.

### Period of impact

All-over the year

### Equipment

Standard machinery for sowing and ploughing.

## Outcome

The intercropping of olive with barley resulted in an increase of water storage in the soil even though the very low rainfall during the growing season. This permits a minimal water availability during summer period. Faba bean permitted and increase of soil organic matter content. Cereals were effective in improving soil assimilable potassium and reducing pH and assimilable sodium. The association of faba beans in the olive grove reduced soil pH and assimilable sodium and improved assimilable potassium contents. Over the two trial periods, the use of intercrops in the olive grove was effective in improving soil fertility. Agroforestry improved bacterial communities while fungi population was improved by barley intercropping.

Intercropping of olive tree with fava bean induced a better vegetative growth of olive tree and the most important production of the whole biomass. During the first year the native vegetation was the most efficient when compared to faba bean and barley. In the second-year barley and faba bean has better results. Olive with cover crops system needs an adaptation period due to the competition with native vegetation

## Practical recommendations

- Use of adapted mixture winter varieties of Barley and Faba bean to local conditions with short growing seasons and available seeds on the market at affordable price;
- Weed control: herbicide was removed after sowing using tractor
- Narrow rows spacing should be used at sowing when intercropped, to control cereals/grain legumes competition; Fertilization: no fertilization was applied; however, fertilization can be used before sowing (N fertilization)

*The success of the intercropping is affected by different factors such as soil and climate conditions, choice of species and cultivars, organic vs. conventional management system, weeds/pests/diseases control, technical equipment and type of intercropping.*

## Practical testing/ Farmers' experiences

- Choice of the appropriate varieties and the suitable sowing density for mixture crops,
- Preparation of the soil (tillage, remove of weed),
- Testing of adaptation of the covers crops species and varieties,
- Follow-up of water balance and crop production, soil analyses (SOC and nutrients) may be usefull.



*Preparation of soil (Tillage and remove of weed) Sowing of winter Fafa bean and Barley under rowing*

## Further Information

- Besbes, M., Chahed, J., et Hamdane, A., 2014. Sécurité hydrique de la Tunisie. Gérer l'eau en conditions de pénurie. Le Harmattan, Paris.
- Ben Mbarek ,H., Gargouri,K ., Mbadra,CH., Chaker,R ., Souidi,Y., Abbas,O. , Baeten,V, and Rigane.H.,2020. Change and spatial variability of soil organic matter humification after long-term tillage and olive mill wastewater application in arid regions.
- Gargouri, K., Rigane, H., Arous, I., Touil F., 2013. Evolution of soil organic carbon in an olive orchard under arid climate. Sci Horti 152:102–108. <https://doi.org/10.1016/j.scienta.2012.11.025>
- Kouki, K., Bouhaouach H., 2009. Etude de l'oasis traditionnelle Chenini Gabès dans le Sud Est de la Tunisie. Tropicultura 27:93–97

## About this practice abstract and Biodiversify

**Authors:** Hadda Ben Mbarek, Mohamed Ghrab, Ibtihel Sbai, Ajmi Larbi, Saida Elfkhi, Fathi Ben Amar, Olfa Elloumi, Ahlem Jalleli, Sameh Maktouf, Kamel Gargouri

**Publisher:** Aristotle University of Thessaloniki, Faculty of Agriculture, Forestry and Natural Environment, School of Agriculture, University Campus, 54124, Thessaloniki, Greece, <http://www.agro.auth.gr/>

**Publisher:** Institut de l'Olivier, Sfax, Tunisie

**Date:** March 2024

Biodiversify is a PRIMA 2019 project (<https://www1.montpellier.inra.fr/wp-inra/biodiversify/>) investigating how agricultural biodiversification (i.e. mixed cropping, cover cropping and agroforestry) can increase ecosystem services, sustainability and resilience of Mediterranean agriculture



The PRIMA programme is supported under Horizon 2020 the European Union's Framework Programme for Research and Innovation.

