



# Organic crops in olive orchards

Getting more income from your orchard, and enhancing biodiversity and soil fertility

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## Why an associated crop?

Olives and olive oil are central in the healthy Mediterranean diet, and there is an increase demand for olive products coming from sustainable and organic farming.

Olive orchards, both traditional and modern, have often large spaces between tree rows (5 m to 9 m) that must be managed, notably for weed removing. To face current challenges, including the increased need for (i) arable land, (ii) radiation use efficiency and (iii) fully covered-soil to avoid erosion, sowing an understorey crop appears a good solution.

Organic durum wheat, another significant component of the Mediterranean diet, is an interesting option to consider as an understorey crop.



Diversity of durum wheat varieties growing within an organic olive orchard (INRA Mauguio, France). Ref: D.Desclaux



Evaluation of durum wheat varieties in an organic olive orchard (INRA Mauguio, France) to find the best adapted to agroforestry. Ref: D.Desclaux

## How to manage durum wheat in organic olive orchards

Low nitrogen availability during reproductive stages is a significant problem for durum wheat in organic farming. Nitrogen deficiency results in a low protein content level and in a loss of vitreous aspect. This can lead to an income reduction for the farmer. Developing varieties adapted to organic conditions, to agroforestry, and to rotations or intercropping with legumes such as chickpea, lentil and fababean, are essential to improve nitrogen use efficiency and soil nutrient content. The design of traditional olive orchards in the South of France is based on 6 m x 6 m inter and intra rows, to ensure maximum sun light. The inter-row spaces are large enough to allow the passage of sowing and harvesting machines (up to 4 m wide) and, therefore, to hosting an understorey crop. The tillage should be minimal to limit olive tree root damage. Sowing of the cereal should take place immediately after olive harvesting in autumn. Some organic treatments can be applied on olive trees after the durum wheat harvest in June or July. Drip irrigation can also be used within the orchards.

The presence of trees leads to shade effects on crops and to modifications in microclimate, water availability and pest and disease patterns. Finding the best durum wheat varieties adapted to such conditions was the aim of a study evaluating a range of durum wheat genotypes (pure lines and populations) for their ability to respond and to interact positively with trees.



Durum wheat varieties grown between rows of unpruned olive trees (INRA Mauguio, France) to evaluate their shade tolerance. Ref: D.Desclaux

## Advantages

- Producing a second crop, such as durum wheat, under olive trees increases the productivity per unit of land, maximizes the radiation use efficiency, and helps to prevent erosion.
- Tillage between tree rows improves the soil structure and benefits the olive trees.
- Crop diversification can provide farmers with a more stable income, reduce financial risks due to the increased volatility of the olive oil market, and the susceptibility of olive species to alternate bearing.



Continuous microclimate measurements (air and soil temperatures, relative air and soil humidity, wind speed, and incident photosynthetic active radiation) are carried out in the agroforestry trial (INRA Mauguio, France.) Ref: D.Desclaux

## Olive and wheat yield

Olive production was not reduced due to the presence of wheat and even showed an increase. However, further research will be required to confirm this trend. Wheat production under agroforestry was reduced compared to the control (open field without trees), but the level of reduction varied largely among the evaluated varieties (from 5 to 80%). The reduction was due mainly to a lower number of tillers per plant. However, the number of spikes, the specific weight (+ 4 points) and the 1000-kernel weight increased (+25%) under agroforestry farming. The Land Equivalent Ratio was between 1.3 and 1.7 depending on the year, indicating that intercropping produces 30% to 70% more than mono-cropping.

## Further information

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## Favourable environment for wheat and trees

Olive trees create favourable soil and air temperature conditions for wheat growth. The higher temperatures during seedling emergence are conducive to early vigour and a higher plant density both after winter and at maturity. In addition, during filling stages, the wheat suffers less from high temperatures as a result of the shade. Moreover, litter from olive trees provides a source of nitrate in the top soil. (In the agroforestry trials the value was 50% higher than in the open field.. At the same time, the tillage carried out before wheat sowing improves the soil structure and benefits the trees.

## Innovative breeding criteria for agroforestry adapted crop cultivars

When selecting cultivars adapted to agroforestry, it is important to consider response traits (i.e. how plants respond to environmental stimuli) and effect traits (i.e. how plants influence ecosystem functions). Often, crop breeding for agroforestry is focused on breeding for shade tolerance. However, this narrow way of thinking ignores the numerous potential benefits of interactions between crops and trees. It is important to consider the crop variety traits, not only in terms of adaptation and competition, but also in terms of contribution to the microclimate, the need for water and nutrients, and issues such as pests, weed and tree/crop management. Consequently, the most relevant core-traits concern radiation use efficiency, leaf structure, phenology, root morphology and rooting profile.