

Agroforestry of annual cereals and legumes in olive orchard provides ecosystem services

Problem

The increase of the world population requires analogous increases in food production per area and maintaining the sustainability of agriculture (Justes et al., 2021).

Solution

Agroforestry systems with annual crops and especially winter legumes and cereals intercropped can increase yield per area (Tziolas et al., 2022), enhance resource use efficiency (especially water and nutrients), increase resilience to abiotic stresses such as drought, and control of weeds, pests, and diseases without the systematic use of pesticides (Guesmi et al., 2022). Agroforestry systems can support food security at territorial and regional levels, as well as contribute to alleviation of rural poverty.



Figure 1. Agroforestry systems with intercropping of barley and triticale with pea to increase biodiversity.

Applicability box

Geographical coverage

Mediterranean climate.

Application period

Autumn.

Required time

No additional time during cultivation. The harvested crop needs to be separated at a collection point.

Period of impact

Duration of crop.

Equipment

Standard machinery used for wheat cultivation.

Outcome

Agroforestry systems with annual crops can achieve higher yield per area and can provide an additional income for the farmers with no need to include N fertilizers.

Practical recommendations

- The seed bed should not be too fine-grained after cultivation.
- Test soil samples and amend P and K levels if it is necessary.
- Select cultivars (cereal and grain legume) with the same maturity time according to local seed costs and availability on the market.
- Mix the seeds 75% grain legume and 25% cereal (comparing to the standard sowing quantities of the two crops) in the seed tank (check that the mixture is homogenous) and sow with a conventional seeder.
- Use same row spacing as for cereal.
- Apply weed control as needed (organic or conventional).
- Adjust height of harvester to pick up grain legumes close to ground.
- 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.
- Proportion of yield from each species can vary largely from sowing proportion. In most case total yield is higher than the average of sole crops. Also, there is increase in protein content as legumes are responsible for a high protein content and cereals have a high plasticity for tillering /compensation and supporting the legume from logging.

Practical testing/ Farmers' experiences

- If this crop system seems suitable for you, we recommend to test it under your conditions.
- Separate a part of your field before sowing and apply the mixture.
- Cultivate the rest of the field as usual and compare the intercrop to the sole cereals and /or legumes.

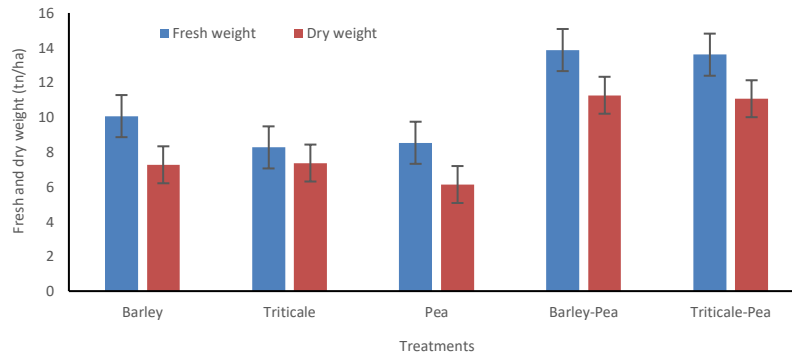


Figure 2. Agroforestry systems of barley, triticale, pea and intercropping systems of barley-pea and triticale-pea in olive and fresh and dry yield.

Further Information

- **Webpage:** <https://www1.montpellier.inra.fr/wp-inra/biodiversify/>
- **Scientific Journal:**
 - Guesmi, H., Aichi, H., Menasseri, S., Fouad, Y., Ben Youssef, S., Ben Ghanem, H., & Chaar, H. (2022). Effect of Olive Tree–Barley/Common Vetch Agroforestry System on Soil Organic Matter Under Low-Input Conditions in a Tunisian Semi-Arid Climate. *Communications in Soil Science and Plant Analysis*, 1-23.
 - Justes, E., Bedoussac, L., Dordas, C., Frak, E., Louarn, G., Boudsocq, S., Journet, E.P., Lithourgidis, A., Pankou, C., Zhang, C.C., Carlsson, G., Jensen, E.S., Watson, C., Li, L. 2021. The 4C approach as way to understand species interactions determining intercropping productivity. *Frontiers of Agricultural Science and Engineering*, 8, 3.
 - Tziolas, E., Ispikoudis, S., Mantzanas, K., Koutsoulis, D., & Pantera, A. (2022). Economic and Environmental Assessment of Olive Agroforestry Practices in Northern Greece. *Agriculture*, 12(6), 851.

About this practice abstract and Biodiversify

Authors: Andreas Michalitsis (AUTH), Paschalis Papakaloudis (AUTH), Christos Dordas (AUTH).

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/>

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.