Cereal-legume intercropping with olive trees for better agroforestery performances under semi-arid Mediterranean conditions

Problem

The population of the Mediterranean countries increased continuously over the last decades (**Samiraglia et al. 2023**), especially in southern countries. Moreover, the loss of agricultural areas in these countries due to the desertification, climate change and anthropic activities has led to a reduction in arable land use (**People et al. 2019**).

Applicability box

- Geographical coverage: Semi-arid Mediterranean conditions (2 contrasting locations).
- Application period: Autumn
- Required time: Autumn for sowing
- Period of impact: All the season
- Equipment: Standard machinery used for cereal cultivation.

Solution

The adoption of sustainable management practices that increase soil health and land productivity is considered as the main tool to ensure food supplies in southern Mediterranean countries. The bio-diversification of agroforestry system has been identified as one of the main agroecological practice, which is considered as an effective strategy for providing multiple benefits at both the farm and landscape level. It promotes agronomic, socioeconomic and environmental advantages (**Burgess et al. 2022**).

Figure 1: Barley-Olive trees intercropping (Right of the two pictures in light green) and Pea- olive trees intercropping (Left of the two pictures

Outcome

The results of our study showed that olive tress canopy significantly stimulated shoot and root growth of intercropped barley by increasing LAI, Shoot dry biomass and root depth and width compared to the monoculture. The intercropping enhanced barley yield and protein yield. We noted an increasing of soil nitrogen availability which will improve the vegetative growth of intercropped olive trees.

Practical recommendations

- It is advisable choose the right seeding rate to minimize competition between plants and to optimize space and maximize the benefits of intercropping and also to ensure optimum soil cover and weed control.
- Before sowing, do an initial soil analysis to determine what is in stock in the soil. And if necessary, amend the soil.
- Carefully determine the managment system according to the climate and the soil type, between conventional and organic system. And according to the orchard design
- Use same row spacing as for cereals in monocultures.

Season	Cropping system	LA (cm2) AR	AF	CHL (Spad) AR	AF	VBL (cm) AR	AF	LN/VB AR	AF	N uptake (%) AR	AF
	Olive-Barley-N	2.92^c	5,56^c	77.78^a	81,14^a	13,16^a	15.58^a	9,33^b	12.67^a	1.37^c	1,56^b
	Olive-Barley-S	2.99^c	5,51^c	76.61^a	79,26^a	7,66^c	8.58^{cd}	8.67^c	10,83^b	1.61^b	1,93^{ab}
	Olive-Pea-N	4.25^a	4,62^{cd}	79.14^a	74,52^a	5,33^c	8.01^{cd}	8,66^{bc}	10.05^b	0.87^d	2,15^{ab}
Season: 2021	Olive-Pea-S	4.17^a	5,38^c	79.63^a	69,16^a	6,16^c	6.17^d	6,02^c	8.67^c	1.59^b	2,26^a
	Olive mono-N	3.65^b	4,57^{cd}	79.93^a	76,43^a	4,66^c	5.83^d	7,13^c	8.83^c	1.09^c	0,96^c
	Olive mono-S	4.02^{ab}	3,712^d	81.81^a	73,78^a	4,02^c	8.33^{cd}	6,10^c	8.02^c	1.39^c	1,34^b
	Olive-Barley-N	3.24^b	5,91^b	72,42^b	62,91^b	10.1^c	12,66^{ab}	9.33^c	13,16^{ab}	1.95^b	1,01^c
	Olive-Barley-S	3.52^b	6,85^{ab}	73,72^b	64,18^b	10.52^c	14,25^a	10.67^b	13,83^{ab}	2.31^a	1,28^b
Season: 2022	Olive-Pea-N	3.91^{ab}	5,67^c	71,99^b	58,98^b	10.33^c	13,50^a	8.67^c	13,66^{ab}	1.75^b	1,44^b
	Olive-Pea-S	3.89^{ab}	7,20^a	74,59^b	59,18^b	10.67^c	15,47^a	10.50^b	16,05^a	1.52^b	1,79^{ab}
	Olive mono-N	3.50^b	5,63^c	75,81^b	67,72^b	11.17^b	12,50^{ab}	9.50^c	12,84^{ab}	2.56^a	0,65^d
	Olive mono-S	3.10^{bc}	5,33^c	75,43^b	68,60^b	11.51^b	12,16^{ab}	10.83^b	13,50^{ab}	2.99^a	0,96^c
p value	Season	0.35	≤0.001	≤0.001	≤0.001	0.003	≤0.001	0.91	≤0.001	≤0.001	≤0.001
	Cropping system	0.24	≤0.001	0.47	0,17	0.002	≤0.01	0.13	0,08	≤0.001	≤0.001
	Season×Crp Syst	0.045	0,04	0.94	0,38	≤0.001	≤0.01	0.049	≤0.01	≤0.001	0,51

LA: Leaf area of five leaf,. CHL Chlorophyll content, VBL: Vegetative buds length, LN/VB: Number of leaf per one vegetative bud and N uptake: Nitrogen uptake by olive leaf

Table 1: the effect of growing season and cropping system on different physiological parameters of olive trees, specifically focusing on Leaf Area (LA), CHL, vegetative bund Length (VBL), Leaf number per vegetative bund (LN/VB) and Nitrogen Uptake (N uptake), considering both the arable crop (AR) and AF
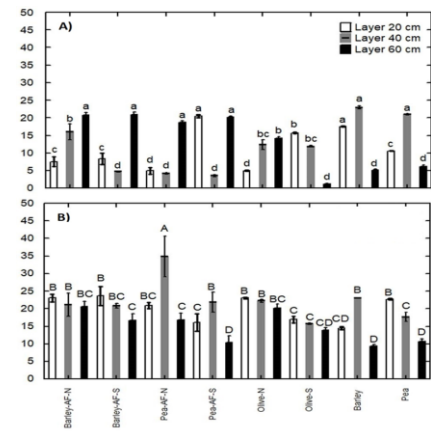

Figure 2: Stocks of nitrate (NO3$^-$) in three different soil layers: the 0-20 cm layer, the 20-40 cm layer, and the 40-60 cm layer

About this practice abstract and Biodiversify

Authors: Zemmouri Bahia, Haddad Benalia, Kherif Omar and Latati Mourad

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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.