Agroforestry as an effective practice for sustainable soil management in olive orchards in Morocco

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Introduction

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AGROFORESTRY

COMBINING ONE OR MORE WOODY SPECIES WITH ANNUAL CROPS TO OBTAIN A MIXED FARMING SYSTEM

SUSTAINABLE AGRICULTURE

Aim

Investigate the effects of intercropping systems on soil fertility, on mineral nutrition, on productivity and quality of olive tree in the Saiss region of Morocco.

Monitoring changes in:

- Soil fertility level,
- Olive leaf macronutrients content,
- Olive yield,
- Olive oil content,
- Quality of the olive oil

Material & Methods

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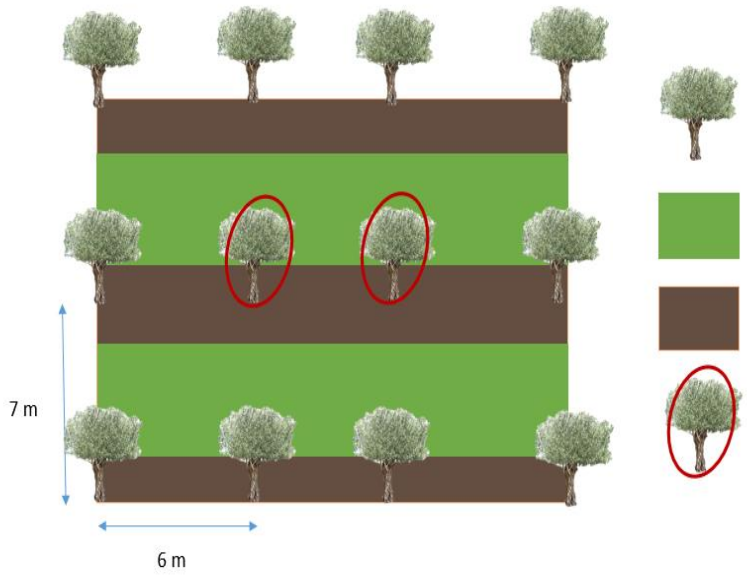
Field Site Description & Experimental Design

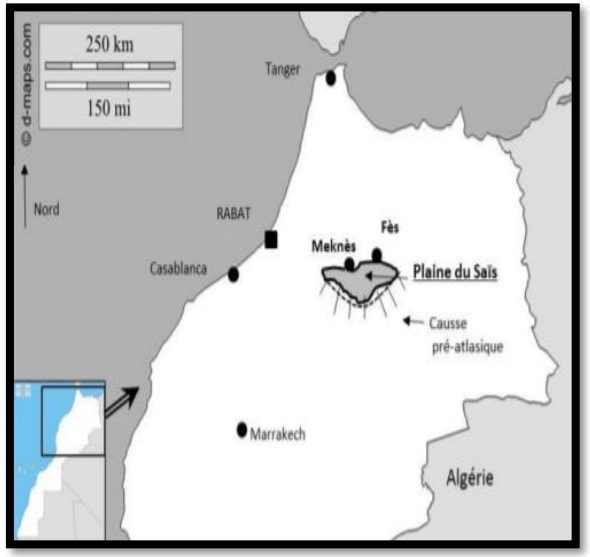


- **PLANT MATERIAL:** Haouzia cultivar
- **PLANTING DENSITY:** 7 m × 6 m
- **AGE OF OLIVE TREES:** 10 years

- **TREATMENTS:**

- Olive-Chickpea intercropping system.
- Olive-Faba bean intercropping system.
- Olive-Lentil intercropping system.
- Olive-Soft wheat intercropping system.
- Olive trees in a monoculture system.

CLIMATE: Mediterranean climate



SAISS REGION, MOROCCO
(Dugué et al., 2015)

- **THE EXPERIMENT DESIGN:** Randomized complete block with three replicated blocks.
  - **THE FACTOR:** Intercropping crop type.

Sampling and Analysis

SAMPLING

FIELD EXPERIMENTS

LABORATORY EXPERIMENTS

- SOIL ANALYSIS
- OLIVE LEAVES ANALYSIS
- OLIVE FRUIT QUALITY
- OLIVE OIL CONTENT AND QUALITY

- OLIVE YIELD ESTIMATION

Results & Discussion

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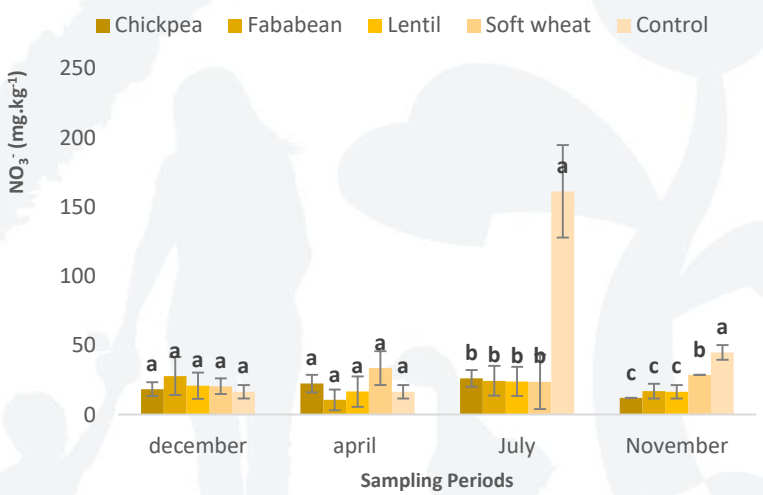
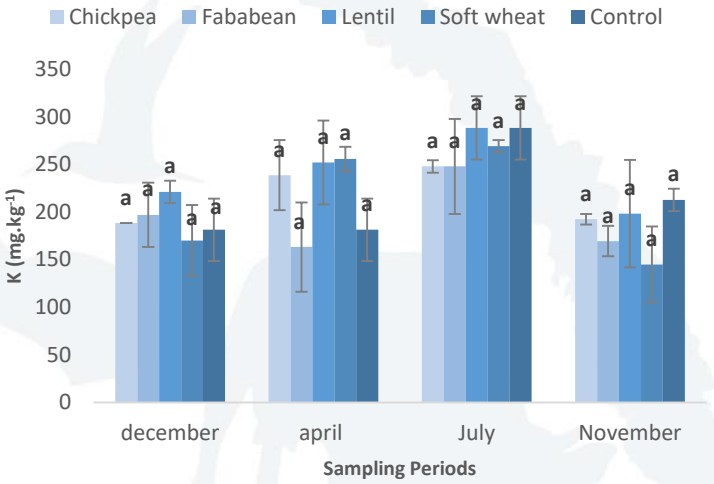
Soil Fertility Levels in Different Intercropping Systems

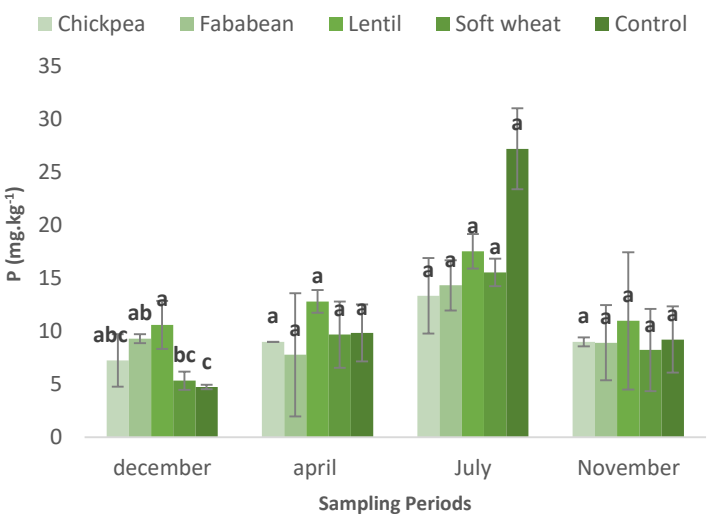
Soil nitrates



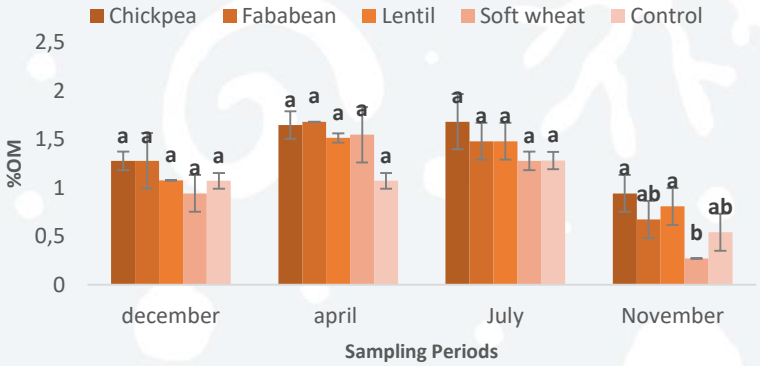
Soil exchangeable potassium



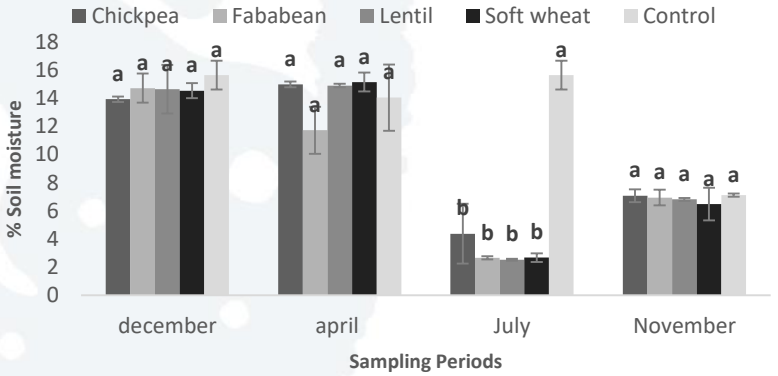
Soil available phosphorus



Soil organic matter



Soil moisture



Olive Leaf Macronutrients Content in Different Interropping Systems

Olive leaf macronutrients content in July

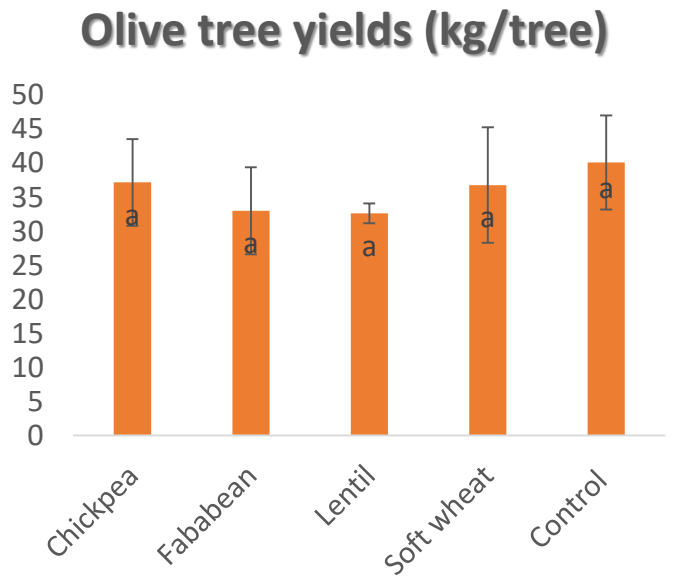
Sampling Period	Treatment	N (% of dry matter)	P (% of dry matter)	K (% of dry matter)
July	Chickpea	1.27 ± 0.08 a	0.15 ± 0.02 a	0.21 ± 0.06 bc
	Fababean	1.12 ± 0.05 a	0.14 ± 0.02 a	0.15 ± 0.01 c
	Lentil	1.24 ± 0.12 a	0.14 ± 0.02 a	0.23 ± 0.02 b
	Soft wheat	1.11 ± 0.09 a	0.14 ± 0.02 a	0.20 ± 0.01 bc
	Control	1.13 ± 0.35 a	0.16 ± 0.01 a	0.31 ± 0.05 a
	F_{ANOVA}	0.559 ns	0.588 ns	**6.921 ****

(*): for each column, the numbers followed by the same letter are not significantly different at p=5% considering Duncan test; ns, not significant, * $p < 0.05$, ** $0.001 \leq p < 0.01$, *** $p < 0.001$.

Olive Fruits Yield and Quality in Different Intercropping Systems

Olive fruits quality parameters

Treatment	Fruit fresh weight (g)	Mesocarp fresh weight (g)	Endocarp fresh weight (g)	Mesocarp: endocarp fresh weight ratio
Chickpea	2.93 ± 0.50a (*)	2.06 ± 0.37 a	0.68 ± 0.12 a	3.01 ± 0.07 a
Fababean	2.60 ± 0.51 a	1.89 ± 0.42 a	0.62 ± 0.09 a	3.02 ± 0.35 a
Lentil	2.58 ± 0.11 a	1.84± 0.12a	0.61 ± 0.05 a	3.02 ± 0.41 a
Soft wheat	2.90 ± 0.67 a	2.11± 0.51 a	0.66 ± 0.12 a	3.18 ± 0.24 a
Control	3.16 ± 0.55 a	2.34 ± 0.47 a	0.69 ± 0.02 a	3.36 ± 0.66 a



- The fruit fresh weight is above 2.43 g
- The mesocarp: endocarp fresh weight ratio is of the order of 3 (< 5) (IOOC, 2004)

Olive fruits destined for olive oil production

(*): for each column, the numbers followed by the same letter are not significantly different at p=5% considering Duncan test.

- Olive Oil Content and Quality in Different Intercropping Systems

Olive fruit oil content and olive oil quality parameters

Treatment	Olive oil content (% of dry matter)	Free acidity (%)	Peroxide value (meq O_2. Kg^{-1})
Chickpea	33.35 ± 2.30 a (*)	2.07 ± 0.16 a	10.58 ± 2.10 a
Fababean	34.59 ± 4.89 a	1.88 ± 0.32 a	11.75 ± 4.11 a
Lentil	33.95 ± 3.04 a	1.69 ± 0.28 a	9.92 ± 1.23 a
Soft wheat	34.32 ± 2.02 a	1.97 ± 0.28 a	11.75 ± 2.75 a
Control	35.95 ± 3.35 a	1.69 ± 0.28 a	11.25 ± 2.46 a

Free acidity and Peroxide values were within the range for characterizing oil as **Virgin olive oil** (IOC, 2019).

(*): for each column, the numbers followed by the same letter are not significantly different at p=5% considering Duncan test.

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Conclusion

The findings suggested that using **agroforestry** intercropping systems can be an effective practice for the **sustainable** production of **olive orchards**. It could **optimize** olive tree **productivity**, **preserve soil fertility**, and **ensure more returns to farmers**.

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