IECAG 2024 Conference

The 4th International Electronic Conference on Agronomy

02–05 December 2024 | Online

MDPI

Assessing the Influence of No-Till and Cover Crop Practices on Soil Organic Carbon in a Tunisian Sandy Olive Orchard

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INTRODUCTION & AIM

Tunisia, a leading producer of organic olive oil, faces challenges such as decreased yields and climate change impacts. Adopting sustainable farming systems can reduce greenhouse gas emissions and improve soil quality. Cover crops in olive groves can enhance soil properties, reduce erosion, and increase nutrient availability. They also contribute to carbon sequestration, mitigating climate change effects. Combining cover crops with conservation tillage improves soil quality and crop production while reducing the harmful effects of global warming.
The objective of this study is to explore the impact of integrating legume-based cover crops into rain-dependent sandy olive groves in Tunisia. The research seeks to evaluate the capacity of these cover crops to alleviate the effects of climate change by enhancing soil carbon sequestration and reducing greenhouse gas emissions in a semi-arid environment. Additionally, the study aims to conduct a thorough analysis of how cover crops influence soil carbon and nutrient dynamics, as well as biological characteristics, highlighting their importance in sustaining soil health and productivity.

METHOD

1. Description of the study area and experimental design

The investigation was conducted at a traditional olive farm in Monastir, Tunisia. The site comprised sandy soil and 60-year-old Chemlali olive trees, distributed across 70 hectares. The study implemented a randomised block design with three replications, comparing four treatments (No-till, Faba bean, Vetch, and Fenugreek) to a control with conventional tillage. Sowing was performed in autumn, and cover crops were incorporated into the soil in March.

CC-Faba bean	CC-Fenugreek	CC-Vetch	Spontaneous vegetation	Control
Control	CC-Vetch	Spontaneous vegetation	CC-Faba bean	CC-Fenugreek
CC-Fenugreek	CC-Faba bean	Control	Spontaneous vegetation	CC-Vetch

Figure 1. Experimental design

2. Biomass and soil sampling

The research included sampling biomass from cover crops within a 50*50 square area. The collected samples were divided into aerial portions and root systems, subsequently dried and weighed to determine the net biomass per hectare. The aerial biomass was powdered and subjected to nutrient and carbon sequestration analyses. Soil specimens were obtained prior to and following the incorporation of cover crops, then examined for nutrient content and assessed for functional quality.

Figure 2. Sampling of seeded Cover Crop and aboveground estimation

3. Laboratory analysis

The samples were analysed for chemical properties (total nitrogen, P Olsen, total potassium, and organic carbon) and enzymatic activity. Soil organic carbon was determined by oxidation with potassium dichromate. β-glucosidase and dehydrogenase activities were measured using colorimetric methods. The data were analysed using ANOVA (SPSS 20 for Windows), tested for normality, and differences of $p < 0.05$ were considered statistically significant.

Figure 3: Soil functional quality analysis

RESULTS & DISCUSSION

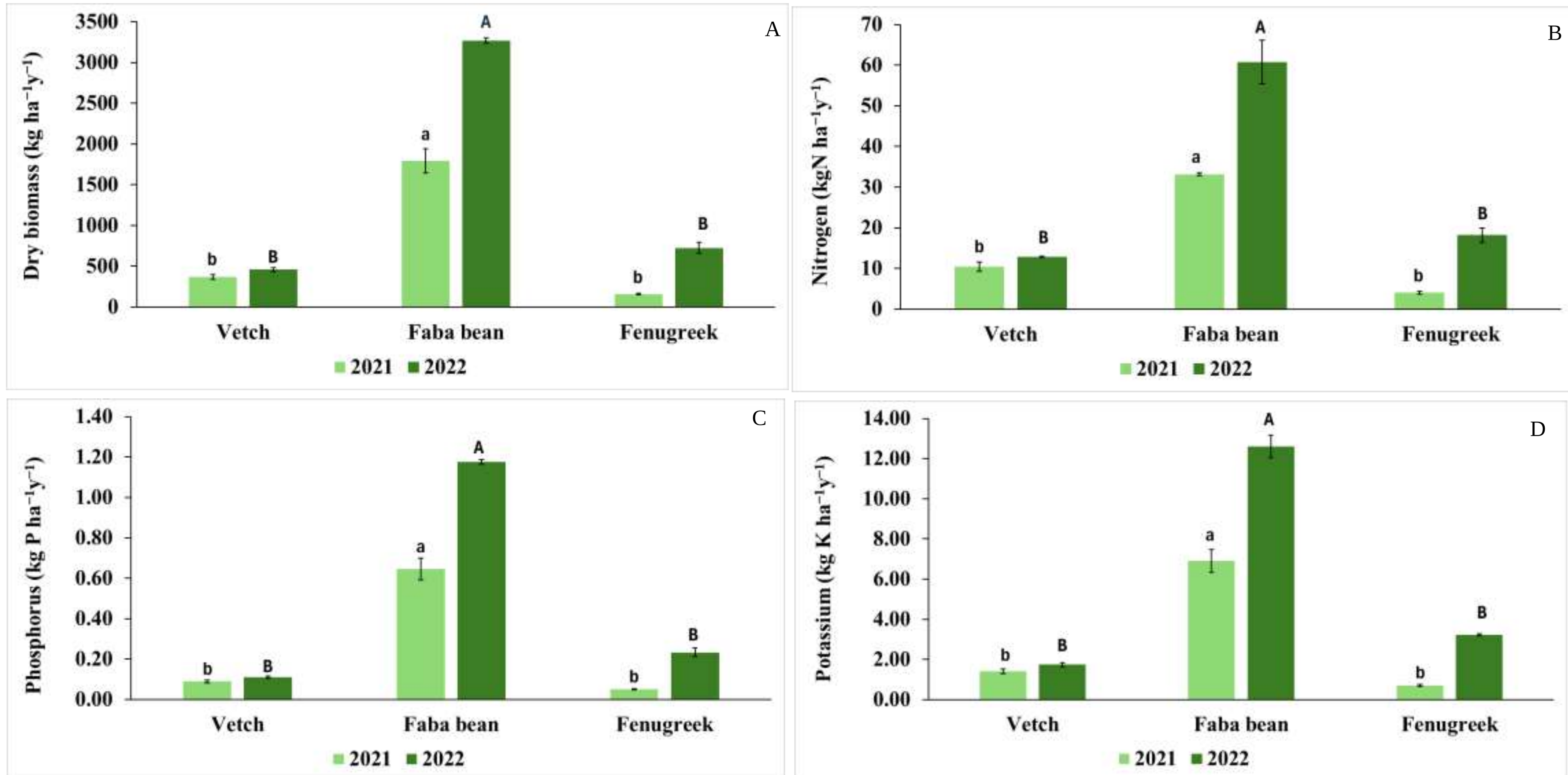

Figure 4: Dry biomass (A), and Nutrients retention by cover crops aerial biomass in Jammel N (B), P (C) and K (D)

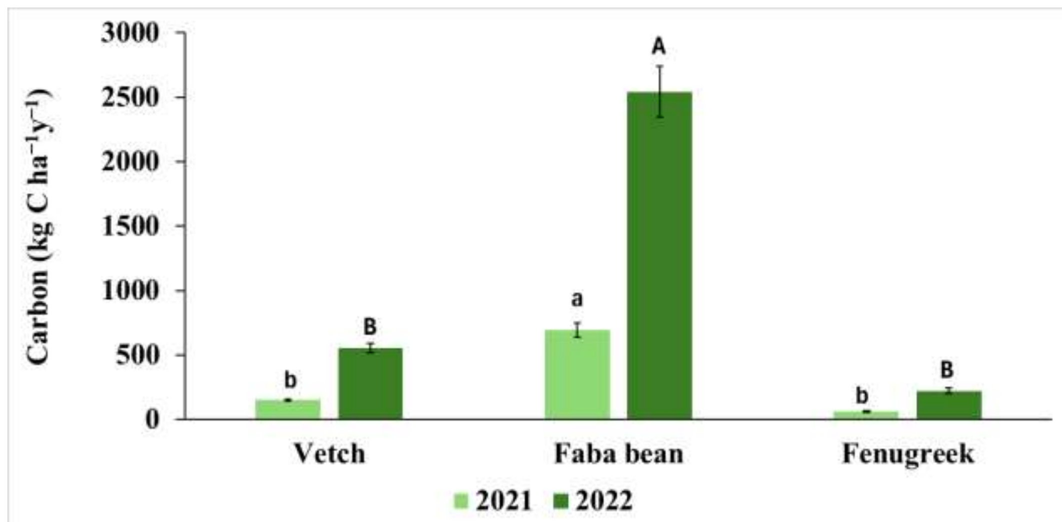

Figure 5: Dry biomass carbon retention

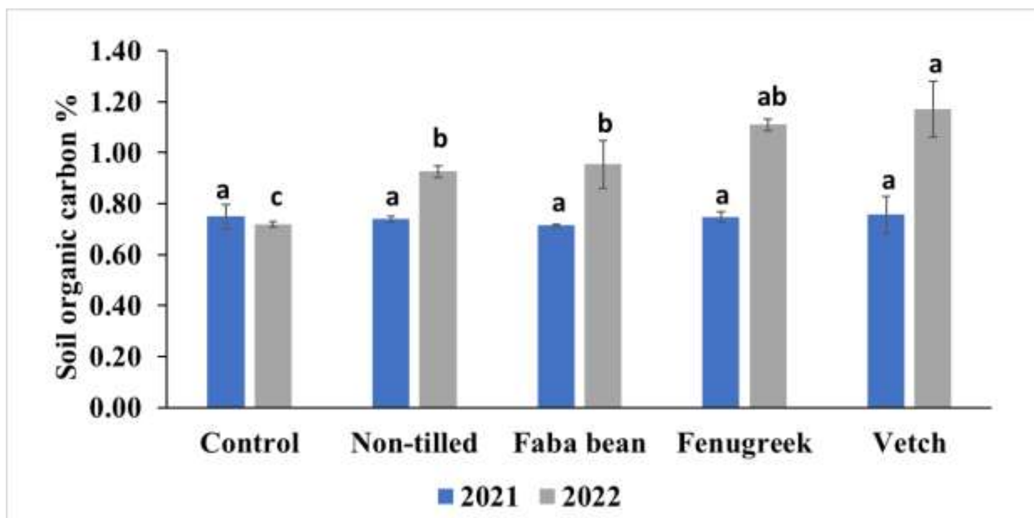

Figure 6: Soil organic carbon

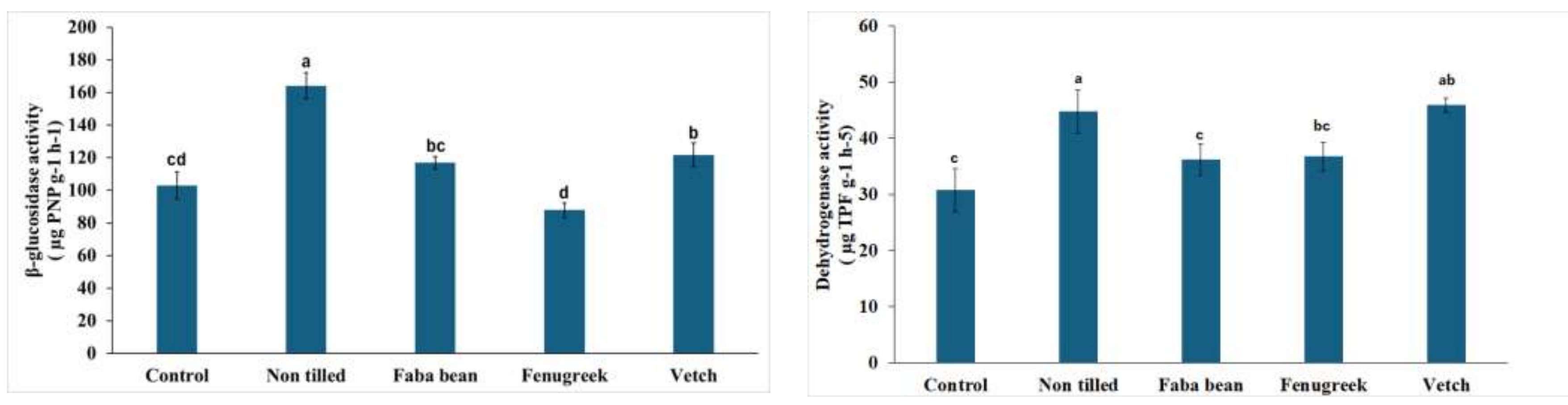

Figure 7: Soil enzymatic activity

CONCLUSION

The integration of cover crops and no tillage in sandy soils can effectively enhance SOC levels, promote sustainable agricultural practices, and mitigate climate change. Future research should focus on the long-term impacts and optimization of cover crop species and management practices for different soil types and climatic conditions

FUTURE WORK / REFERENCES

Elhaddad, F.; González, J.A.C.; Abdelhamid, S.; Garcia-Ruiz, R.; Chehab, H. Alternative Cover Crops and Soil Management Practices Modified the Macronutrients, Enzymes Activities, and Soil Microbial Diversity of Rainfed Olive Orchards (cv. Chetoui) under Mediterranean Conditions in Tunisia. Sustainability 2024, 16, 5329. https:// doi.org/10.3390/su16135329