

Impact of soil management on biodiversity, soil properties and climate change mitigation-related agroecological indicators



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Introduction, context and objectives

Intensive agricultural management practices (i.e., the burning of pruning residues, the absence of organic amendments) lead to a reduction in organic matter and nutrients in the soil resulting in agroecosystem vulnerability. Implementing a cover crop would provide soil organic matter while increasing nutrition levels in the soil.

Cover crops can help to achieve good soil, which is important for production and plant health. However, cover crops are not commonly used by farmers. Additionally, no state-of-the-art approach that clarifies the impact of service crops has been established so far. In this context, the objective of this field study was to compare the dry biomass production, C content, and nutrient content of seeded cover crops to those of natural plants grown in an olive orchard.



Fig. 1 Map of the field experiment and comparison between seeded cover crops and spontaneous vegetation.

Mat & Methods

A mixture of cover crop trial in sandy loam soils under Mediterranean climatic conditions was conducted in a rainfed olive grove in Western Crete. In this study, the dry biomass, macro- and micronutrition, and carbon status of the seeded cover crops (legume and grass) were compared to natural plants in an olive grove. Seeded cover crops were conducted in two sustainable management systems (cover crops solely, and a combination of compost, pruning residues, and cover crops); natural plants were in a conventional system involving soil tillage.

Results

In combination with conservation tillage practices, the addition of carbon inputs may improve soil fertility. Results indicate that the dry biomass production and C content of cover crops under sustainable management systems was significantly higher than that of the control. The higher dry biomass production and C content found in cover crops compared to the natural vegetation indicates not only that this type of management provides enhanced carbon storage, but can also potentially lead to a future increase in soil organic matter through decomposition. Higher dry biomass is important in the context of carbon sequestration, and cover crops facilitated carbon storage in this study. In addition, this study suggests that sustainable agricultural management practices would provide significant benefits in terms of nutrient retention and CO₂ fixation, thus improving ecosystems in Mediterranean countries.

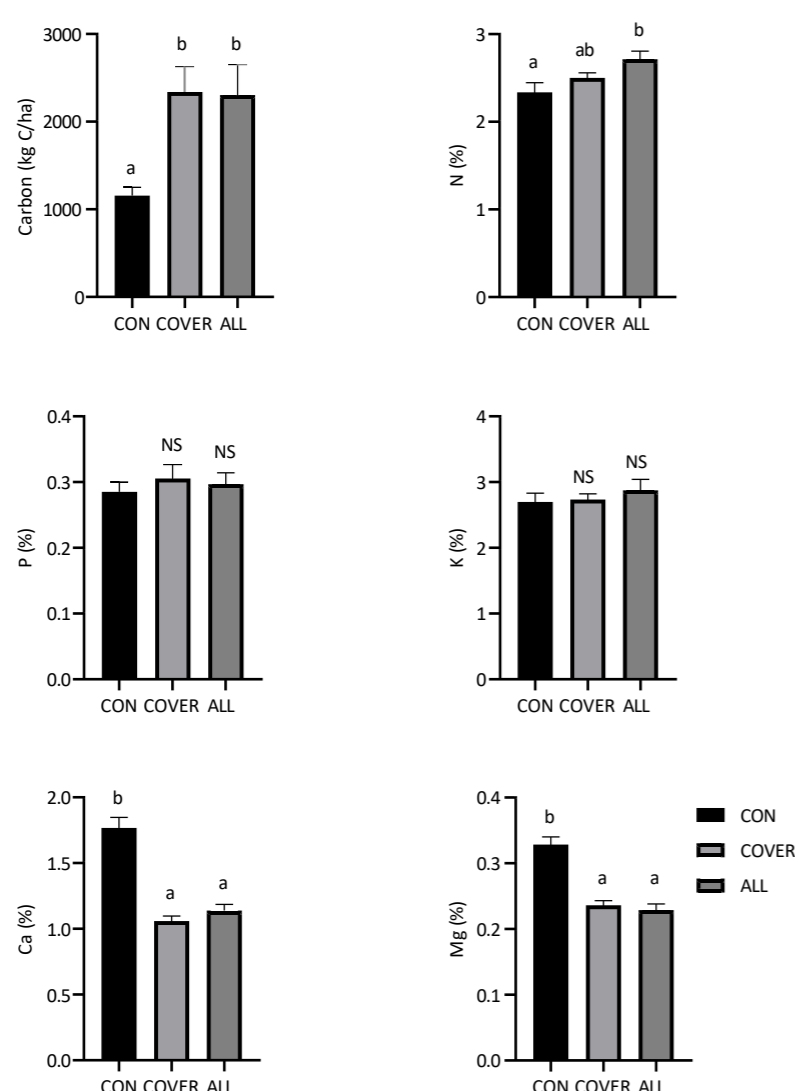


Figure 3. Carbon content (kg C/ha) and nutrient concentrations (% dry weight) of seeded cover crops in the COVER and ALL treatments and spontaneous plants in the CON treatment. Mean values \pm SE per each treatment is presented. Different letters indicate significance at $p < 0.05$ (LSD test).

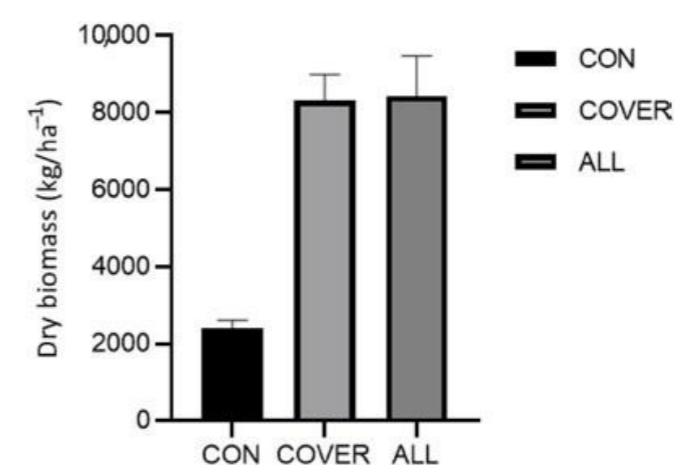


Fig. 2. Dry biomass of seeded cover crops in COVER and ALL treatments and spontaneous plants in CON treatment using one-way ANOVA separately for fresh and dry biomass. Mean values \pm SE per each treatment is presented. Different letters indicate significance at $p < 0.05$ (LSD test).

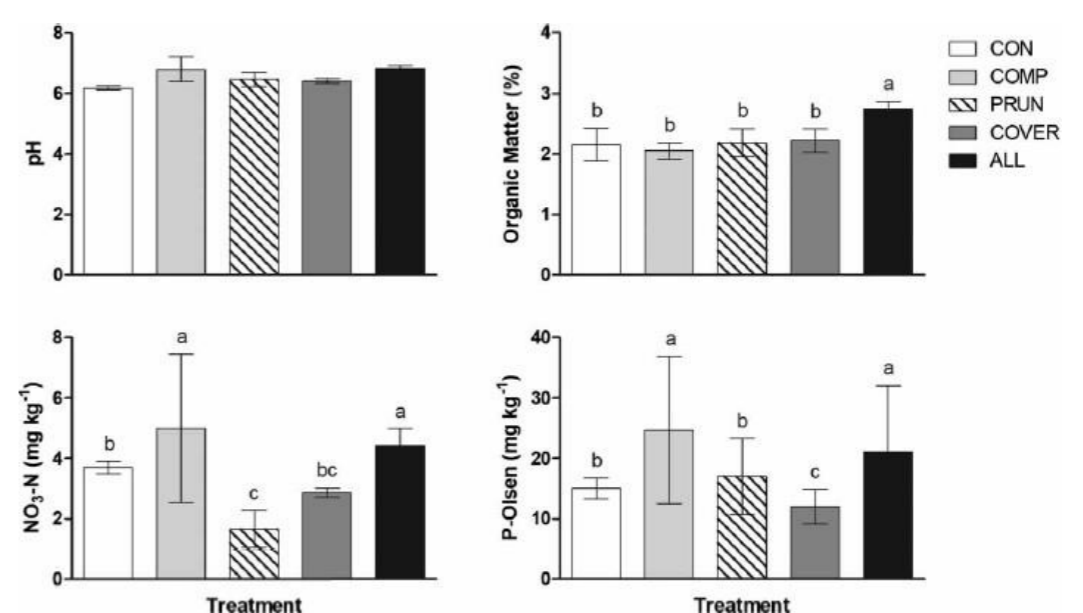


Figure 4. Selected chemical properties of the 0-30 cm soil depth under the five different treatments (recycling of composted residue (COMP), (recycling of raw pruning residue (PRUN), seeding of cover crops (COVER), all combined (ALL), and control with no addition of organic materials (CON). Average values \pm SE are shown ($n=3$). Different letters denote significance at $P < 0.05$

Conclusions and perspectives

A large part of cultivated soils in Southern Europe as well as in other continents is considered poor in nutrient and biological terms. The adoption of the sustainable management practices applied in this study is in complete agreement with the European policy on the transition from a linear to a circular economy and would provide significant benefits for rural stakeholders and ecosystems in the long term.