Soil microalgae and cyanobacteria characterization in a differentially managed olive orchard

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Soil microalgae and cyanobacteria offer potential benefits for the sustainable and resilient agriculture. Fixing the CO_2 by photosynthesis, they contribute to enrich the soil in biomass and organic carbon, as well as to enhance its aggregation and porosity. Being in synergic interaction with other soil microorganisms, they exchange nutrients and contribute to make more hospitable the plants development microenvironment, through bioactive compounds production promoting their growth, as well as the pathogens prevention. Moreover, (N)-fixing cyanobacteria provide nitrogen, essential nutrient for plants growth. In order to explore the potential biofertiliser, biostimulatant and biopesticide action of microalgal communities in agricultural soils, the aim of this research was to characterize soil microalgae and cyanobacteria in a Mediterranean olive orchard located in a semi-arid climate (Ferrandina, Basilicata, Italy), differentially managed sustainable (S_{mng}) or conventional (C_{mng}) land use for 22 years. The S_{mng} soils had significantly higher algae ($2.210 \cdot 104$ g^{-1} soil in S_{mng} and $0.872 \cdot 104$ g^{-1} soil in C_{mng}) and the same trend was observed for cyanobacteria ($0.408 \cdot 102$ g^{-1} soil in S_{mng} and $0.240 \cdot 102$ g^{-1} soil in C^{mng}). By light microscopy, using two selective liquid media (with and without N), microalgae and cyanobacteria dominant species were observed and identified by morphological features: *Trebouxia*, *Euglena*, *Chaetophora* green algae genus and *Cymbella* diatom genus were detected in the conventionally managed soil samples, whereas *Anabaena* cyanobacterial genus, *Oedogonium* and *Scenedesmus* green algae genus and *Navicula* and *Pinnularia* diatom genus were identified in the sustainably managed soil samples. Their metabolic activities and the profiling of metabolites were also evaluated: the type of soil management approach produced a distinctive metabolic profile, suggesting a specific influence of the agriculture management type used on the metabolic activity of the soil algae and cyanobacteria.

Keywords: soil microalgae; soil cyanobacteria; autotrophic microorganisms; soil fertility; sustainable management