

Testing the impact of agricultural practices on protist and metazoan communities in rice paddy soils through environmental DNA

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Soil is a fundamental environment hosting a high biodiversity and enclosing numerous microhabitats. Multiple studies have proved that the adoption of more sustainable practices in crop cultivation results in improved soil biodiversity conservation, whereas conventional agronomic practices can have detrimental impacts on soil attributes. Besides, rice is a major staple food and at the same time, the landscape heterogeneity within its agroecosystem is of fundamental need for several different organisms linked permanently or temporarily to water.

In this study, we used an environmental DNA metabarcoding approach targeting two different genes, the 18S rRNA and the cytochrome C oxidase subunit I (COI), aiming to assess the changes in the protist and metazoan soil communities and their functional diversity under three different rice cultivation managements (i.e. agroforestry, organic and conventional), and along four stages of the rice growth cycle (i.e. basal, vegetative, flowering and maturation phases).

Results showed that the most abundant phyla in the rice paddy soil were Cercozoa and Ciliophora for protists, and Annelida, Nematoda and Arthropoda for metazoan. In particular, Cercozoa were abundant in the agroforestry cropping system, while Ciliophora showed higher abundance in control cover crop field. Annelida were more abundant in the conventional cultivation regime, while both Nematoda and Arthropoda were less abundant, with a significant increase in the organic and agroforestry regimes. Considering the taxonomical and functional diversities, slight differences among treatments were identified both in protists and in metazoans because of the combined effect of agricultural management and the succession of drying-flooding phases during the growing season.

The community's beta diversity described a positive effect of the organic and agroforestry cropping systems, highly dissimilar from the community found in the conventional rice field. Soil physical-chemical properties did not differ significantly from one treatment to another. This study broadens our understanding of the effects of agricultural practices on the biodiversity inhabiting the soil in rice agroecosystems, highlighting the positive impact of organic and agroforestry management as suitable environments for the rice soil biocenosis. It also contributes to emphasizing the importance of soil biodiversity conservation and the benefits of redesigning agricultural practices.