Theme 2
Sustainable soil management for food security and better nutrition

Sustainable soil management and biodiversity friendly practices in protected areas: The Sentina Natural Regional Reserve case study

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INTRODUCTION

Soil has been defined as a vital living system and the organisms inhabiting it are considered as a potential and still unknown nature-based solution able to deliver and maintain fundamental soil-based ecosystem services for plant, animal, and human health. Soil mesofauna is involved in organic matter decomposition and translocation, nutrient cycling, microflora activity regulation, and soil structure formation. The application of the Soil Biological Quality index based on arthropods (**QBS-ar**) is a way to assess soil health condition and sustainability of agricultural practices through the analyses of the structure of soil microarthropods communities, which are highly sensitive to soil disturbances (Parisi *et al.*, 2005). Practices such as tillage and overfertilization, typically applied in intensive agriculture, give rise to different soil threats such as loss of biodiversity, nutrient imbalance, and soil compaction. While the adoption of sustainable management practices proved to preserve soil-related ecosystem services, and consequently the processes which contribute to preserve soil fertility. In fact, achieving sustainable soil management is crucial within the context of the European Green Deal (Montanarella and Panagos, 2021).

Fig.1. Pictures of the Sentina Natural Regional Reserve. Google Earth images (https://www.riservasentina.it/).

The objective of the present study is to assess the health of the agricultural soils located within the Sentina Natural Reserve, Marche region (Italy). Two farms (referred as FE and RL sites) involved in pasta and flour production and applying conventional management systems with different degree of intensity, were selected.

FE applies deep tillage, monoculture, and pesticide applications, while RL applies minimum tillage, crop rotation with legumes, false sowing and, set-aside with radish. The final aim is to compare the two farms' systems in order to identify the most sustainable management model for the preservation of soil health that could be adopted by other smallholders, in protected areas to protect and possibly enhance the natural fertility of soil.

METHODS

In each site, soil samples for physico-chemical analysis and QBS-ar were collected in summer and autumn 2021. In addition to the classical "qualitative" (i.e., no abundance-based) approach of QBS-ar, the novel approach QBS-ab (Mantoni *et al.*, 2021) that includes in the calculation of the index also the microarthropods' abundance was applied. The statistical analyses were performed using R 4.2.0 software.

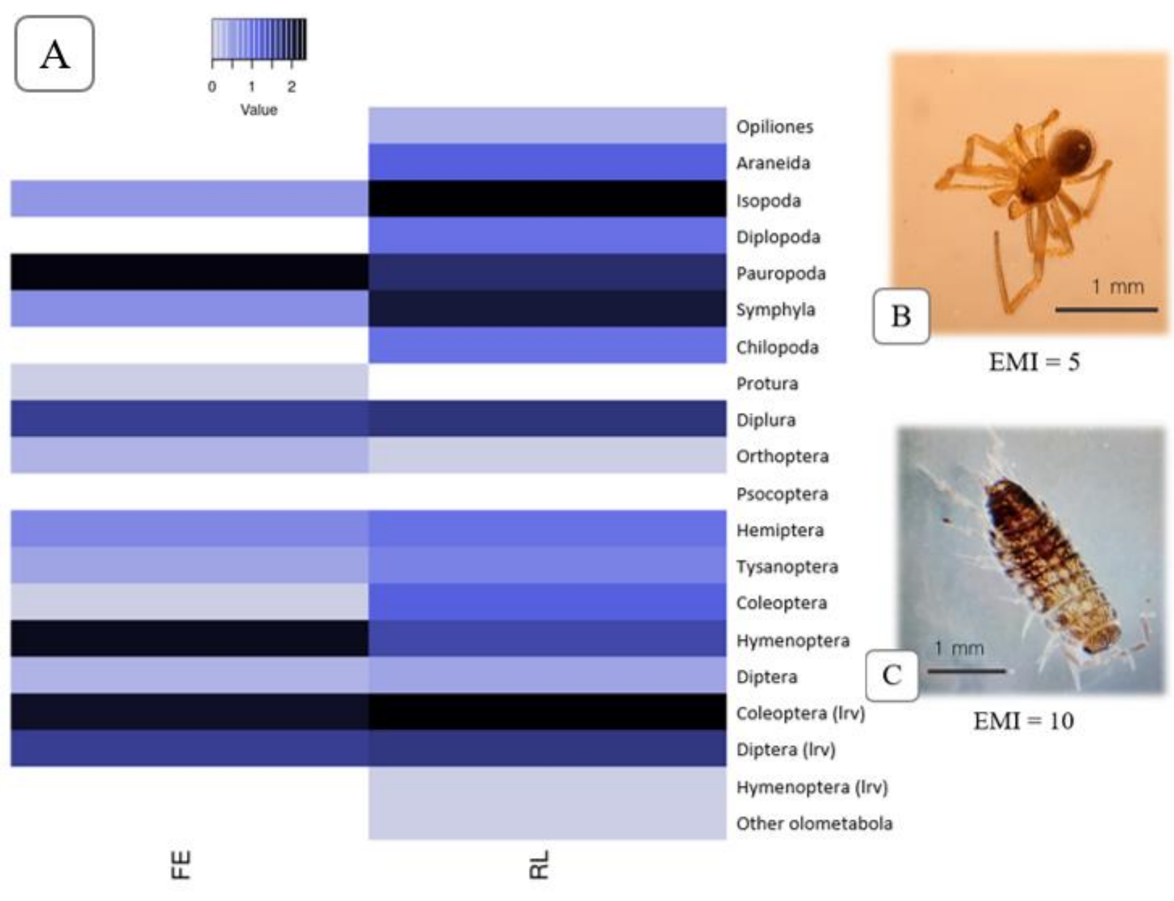

Fig.2. A. Heatmap of the total abundance of the microarthropods collected during the spring sampling, Acarina and Collembola are not included. On the right some of the soil arthropods found in the samples: B. Araneae. C. Isopoda. The heatmap was created using Heatmapper (www.heatmapper.ca).

RESULTS

Both farms, even if in conventional management, present an excellent biological quality of the soil with values comparable to those of natural environments (Menta *et al.*, 2011). Comparison between the two farms in the summer season show that RL, with respect to FE, had a higher density of microarthropods (609917 vs 152083 ind/m^2), averaged values of QBS-ar (151.5 vs 123.3) and QBS-ab (242.8 vs 187.3) (Fig.3).

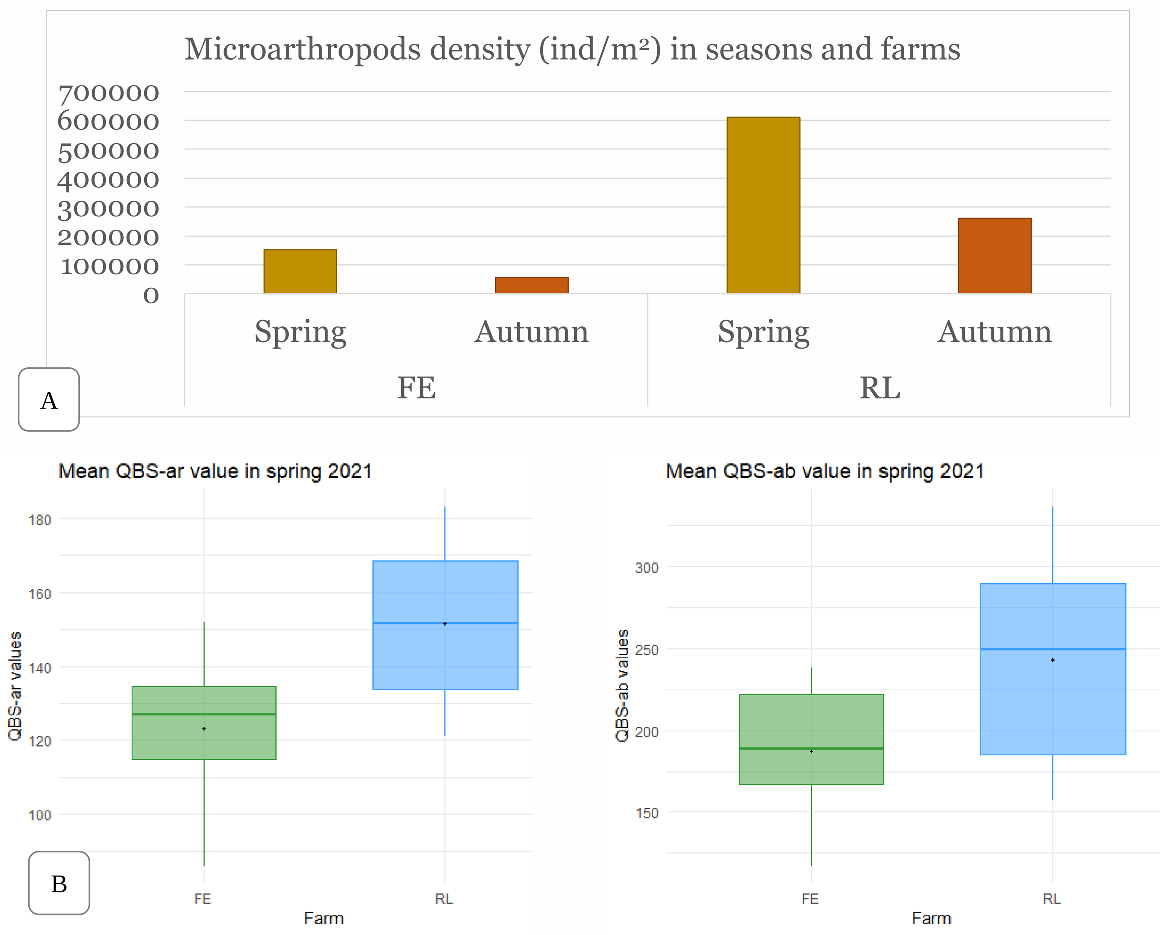

Fig. 3. A. Histogram of microarthropods density (ind/m^2) in both farms and seasons B. Box-plots of mean QBS-ar and QBS-ab values for the spring. For the statistical part, data were checked for normality (Shapiro-Wilk test) and homoscedasticity (Bartlett test), then were compared for sites and for season (Paired Student's T-test, $p < 0.05$) (Autumn data not shown). Density and QBS-ab showed significant differences between farms and season while QBS-ar showed significant differences only between farms.

CONCLUSIONS

This study shows the potential of protected areas for the production of food. Further, it underlines the need to apply sustainable agricultural practices to preserve biological soil fertility. The adoption of biodiversity friendly practices reaches out to the needs of the consumer who is interested in finding a food that is not only safe, healthy, and nutritious but also produced in a sustainable way. There is a new awareness on food which gave birth to the willingness to pay for the preservation of biodiversity, and thereby providing higher market values to the food and consequently strengthening the rural economy of these areas.

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