Soil Biological Quality index based on earthworms (QBS-e) in strip cropping versus pure stands: preliminary results of the OrtoBioStrip project

Marco Monticelli, Martina Coletta, Aurora Torresi, Leonardo Salvatori, Mario Marconi, Antonietta La Terza
School of Biosciences and Veterinary Medicine, University of Camerino, Camerino (MC), Italy
Email: marco.monticelli@unicam.it & antonietta.laterza@unicam.it

Introduction

Lately agroecosystems have been facing climatic and biotic challenges that need to be addressed, and the **OrtoBioStrip** (**OBS**) project aims to test a novel cultivation approach that promotes sustainable agricultural practices [1]. In detail, **strip cropping**, is the simultaneous cultivation of different crops in the same field in a rotational system, rather than in "classical" pure stands (Fig. 1-2). In this project, the **QBS-*e*** (Soil Biological Quality through ***earthworms***) index was used to test the **soil health status** of 4 fields under classical and strip cropping cultivation regimes.

OBS agronomic practices

- **Implementation of strip cropping**
- Allocation of pluriannual nectar source flower strips
- Diversification of plant genetic material
- Reduced tillage 15-20cm

Why **earthworms** as bioindicators?

- Increase of soil organic matter (SOM)
- Sensitive to mechanical and chemical disturbances
- Cheap, quick, easy to obtain
- Studies show good correlation with soil quality [2].

Study sites and experimental design

- Fields dimensions were approximately 0.4 ha, 10-15% slope with calcareous clayey loam soil texture.
- Each combination of crop (faba, wheat and clover) and management (strip cropping and pure stand fields) was assayed with 9 replicates for the following samples and measurements:

- Soil monolith for earthworms extraction

- Soil moisture and temperature
- Soil chemical-physical parameters. These were estimated from composite samples representative of each field.

- All the fields were under organic management and information on agronomic practices were included in the interpretation of the results. Statistical analyses and graphs were computed with R software.
- Earthworms were classified **ecologically** (for QBS-e) and, when possible, **taxonomically** at the species level.

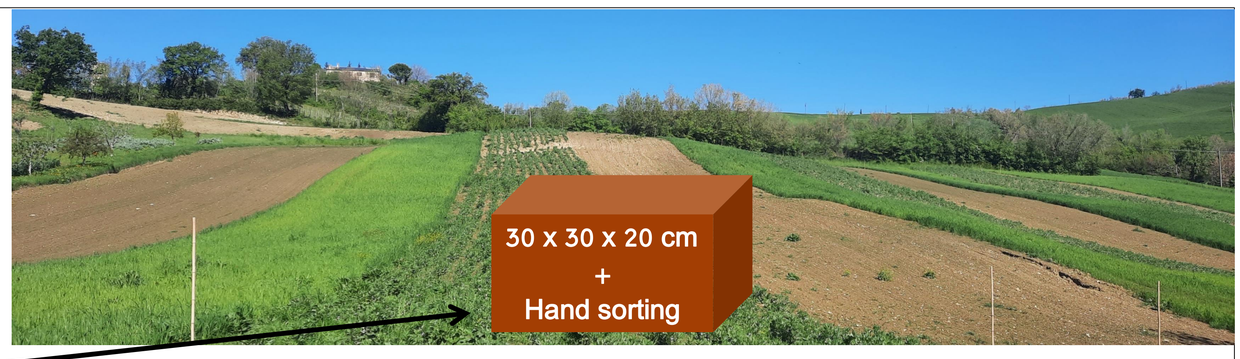

Fig.1 Strip cropping field in Fratterosa (PU), Marche region, Italy, 240m a.s.l. Sampling date: April 26-27th 2023

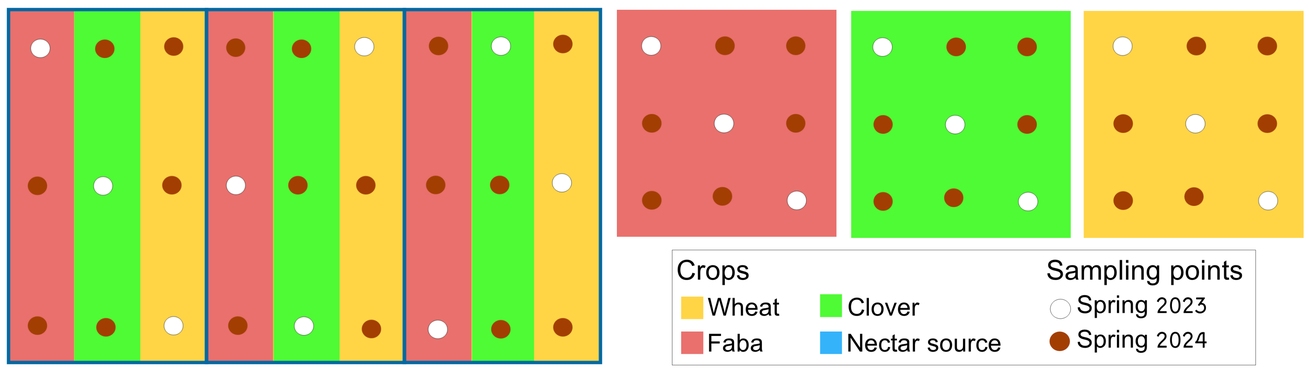

Fig.2 Representation of the **4** fields, divided into **1** strip cropping field (left), consisting of 3 blocks of strips, and **3** pure stand fields (right). In 2023 only white dots (i.e. replicates) were sampled, while in 2024 the brown dots will be added.

Results and ongoing activities

- Reported species were the **endogeic** *Murchieona minuscola, Aporrectodea rosea, Proctodrilus antipai, Allolobophora chlorotica*, the **hydrophylic** *Eiseniella tetraedra* and the **coprophagous** *Eisenia fetida. A. chlorotica* was the most abundant species accounting for the 40% of adult individuals. The total number of individuals was 117 with an adult to juvenile ratio of 0.19 suggesting an early sampling season and/or unsuitable environmental conditions for sexual maturation.
- In the first year, there was a significant difference in QBS-e values, mainly due to the pure wheat (Fig.3 two-ways ANOVA p=0,023). As this crop was fertilized unevenly compared to the other crops, it was not considered to be indicative of the effect of strip cropping. Indeed, in the remaining fields there is no significant difference according to management type (p=0,87), but only to crop (p=0,061).The results indicate that **soil biological quality was not affected by the strip cropping** practice, the effects of which are expected to be observed in at least 2-3 years.
- **Soil nutrients** greatly influence earthworms and QBS-e values, with a correlation of 0.811, 0.808, 0.794 and 0.730 for nitrogen, carbon, phosphorous and potassium respectively. Together they can explain about 2/3 of the observed variance (multiple R^2= 0,6755). No significant correlation was found with soil temperature and moisture.
- In spring 2024, several improvements are foreseen: chemical extraction of earthworms with allyl isothiocyanate (AITC) to sample anecic species as well; increase in the replicates to provide more representativeness; and addition of another farming site where also the effect of the pluriannual flower strips will be assessed.

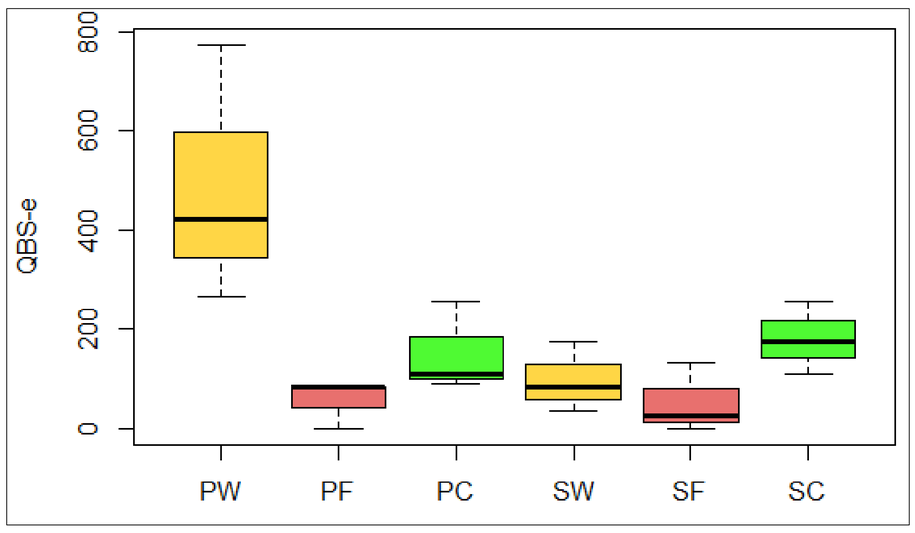

Fig.3 Boxplot showing QBS-e values divided by management type (P=pure, S=strip) and crop (W=wheat, F=faba, C=clover).

Acknowledgements

1. Campanelli G, Iocola I, Leteo F, Montemurro F, Platani C, Testani E, Canali S (2023). Strip cropping in organically managed vegetable systems: agronomic and environmental effects. Renewable Agriculture and Food Systems
2. Fusaro S, Gavinelli F, Lazzarini F, Paoletti M (2018). Soil Biological Quality Index based on earthworms (QBS-e). A new way to use earthworms as bioindicators in agroecosystems. Ecological Indicators

È TEMPO DI AGRICOLTURA
PSR MARCHE 2014-2022
Unione Europea / Regione Marche
PROGRAMMA DI SVILUPPO RURALE 2014-2022
FONDO EUROPEO AGRICOLO PER LO SVILUPPO RURALE: L'EUROPA INVESTE NELLE ZONE RURALI
Unione Europea
REGIONE MARCHE

Project ID: 59666

19-21/05/24 IUSS Centennial, Florence