Carbon speciation and carbon isotopic characterization of agricultural soils in Emilia-Romagna Region (Northeastern Italy)

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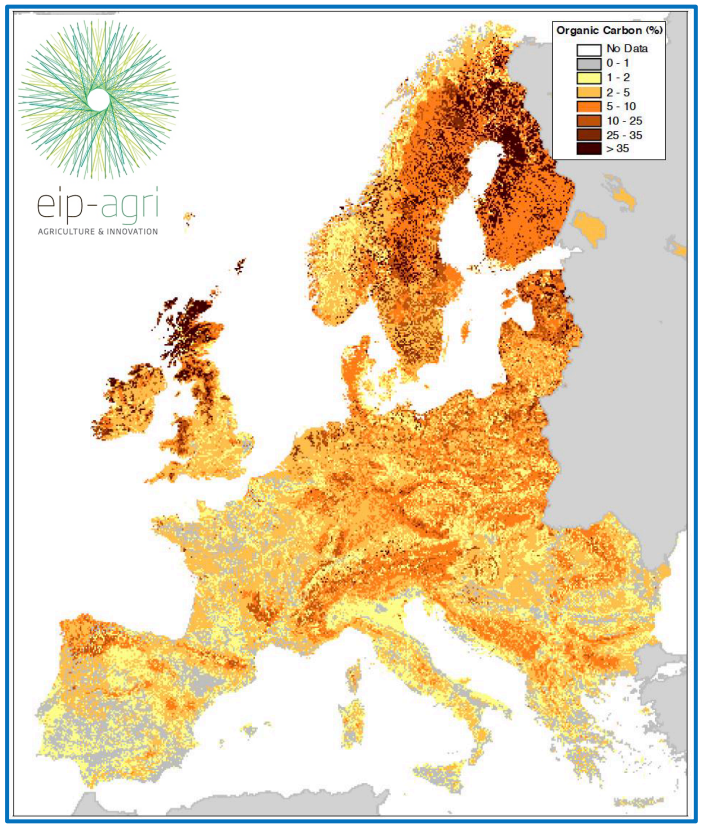
Aim of the SAVESOC2 Project



Most Southern Europe soils are **poor organic carbon** (OC) content, showing low (≤2%) or even very low (≤1%) OC values.

Programma di Sviluppo Rurale dell'Emilia-Romagna 2014-2020

UNIONE EUROPEA
Fondo Europeo Agricolo per lo Sviluppo Rurale

RegioneEmilia-Romagna

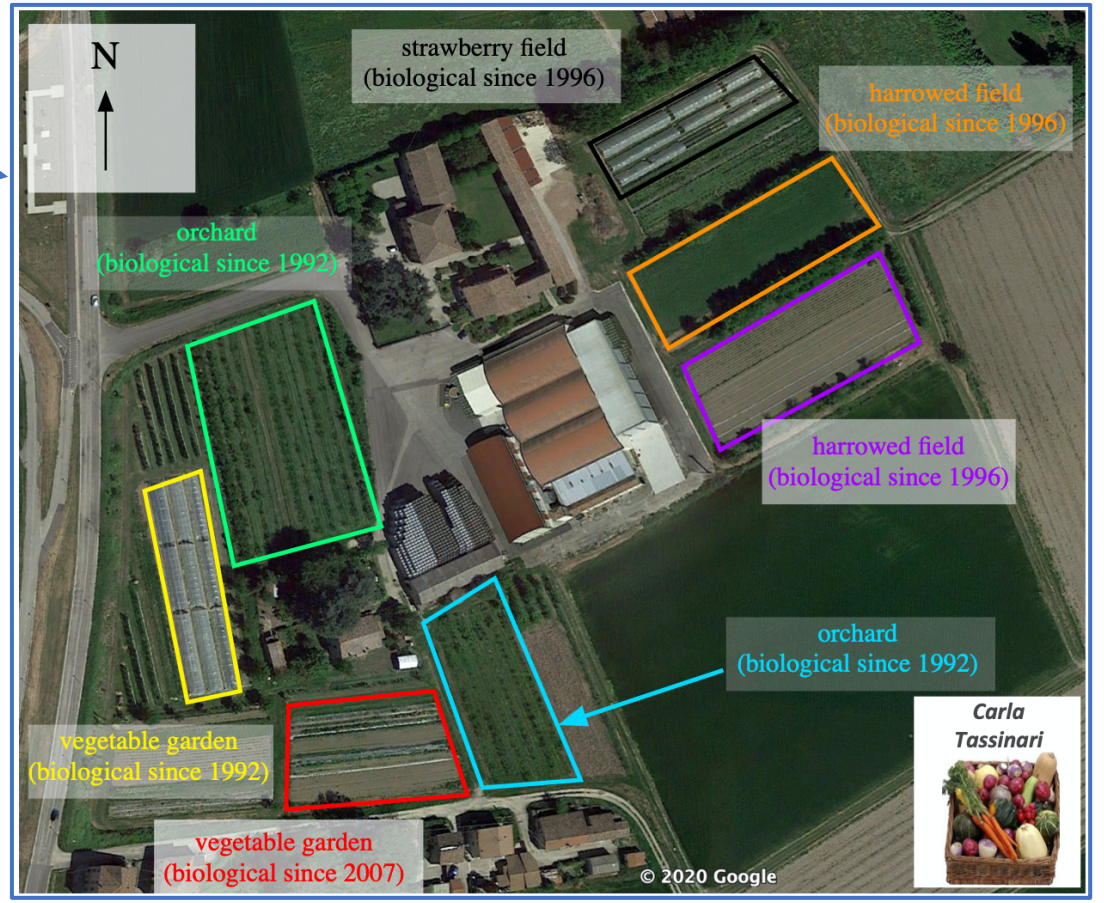
Emilia-Romagna Region (Italy) invested in the **Rural Development Programme** (Programma di Sviluppo Rurale), which financed projects addressed to the needs of specific rural areas.

SAVE SOC
+ FERTILITY
- GHG

SaveSOC2 (*Save Soil Organic Carbon*) project aims to **evaluate the quantity and quality of Soil Organic Matter (SOM)** in Emilia-Romagna Region farms, in order to identify the **best agricultural practices** for:

- soil carbon conservation and sequestration;
- mitigation of SOM mineralization to contrast the greenhouses emissions.

Study area



SAVESOC2 project investigated soils of the **biological Carla Tassinari farm** (near Ferrara).

Samples were collected in seven sites at different depth:

- 0-15 cm;
- 15-30 cm;
- 80-100 cm.

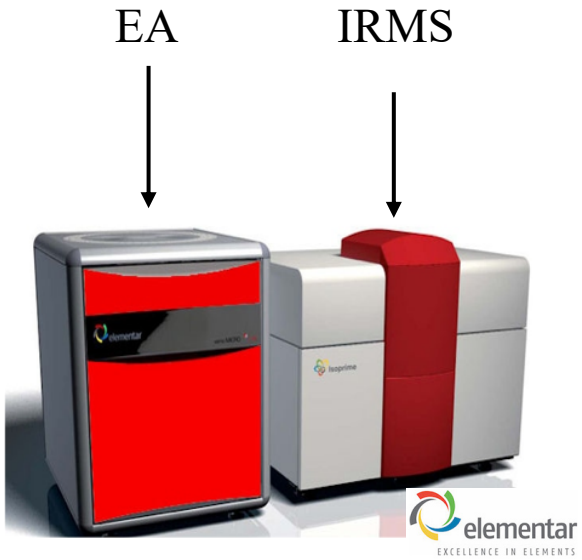
pH: subalkaline

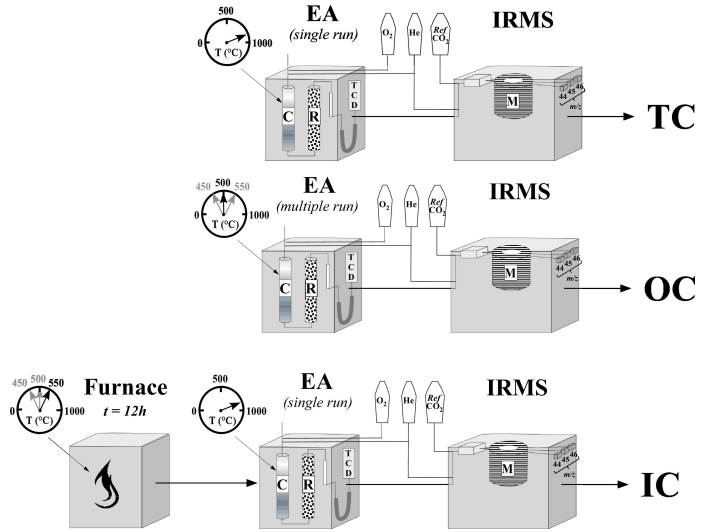
EC: non-saline

Soil texture: loam and silt loam

Methodology

Elemental Analyzer -Isotopic Ratio Mass Spectrometer

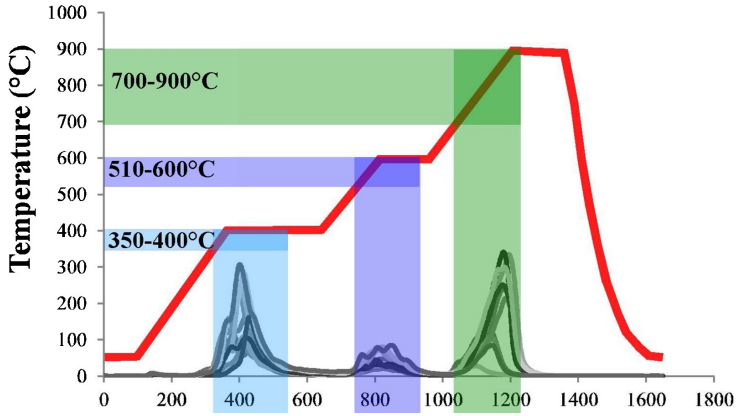




From: Natali *et al.*, (2018)- Catena

Following the Thermally Based Separation protocol (Natali et al., 2018), elemental and isotopic analyses were performed to characterize soil inorganic and organic fractions of each sample.

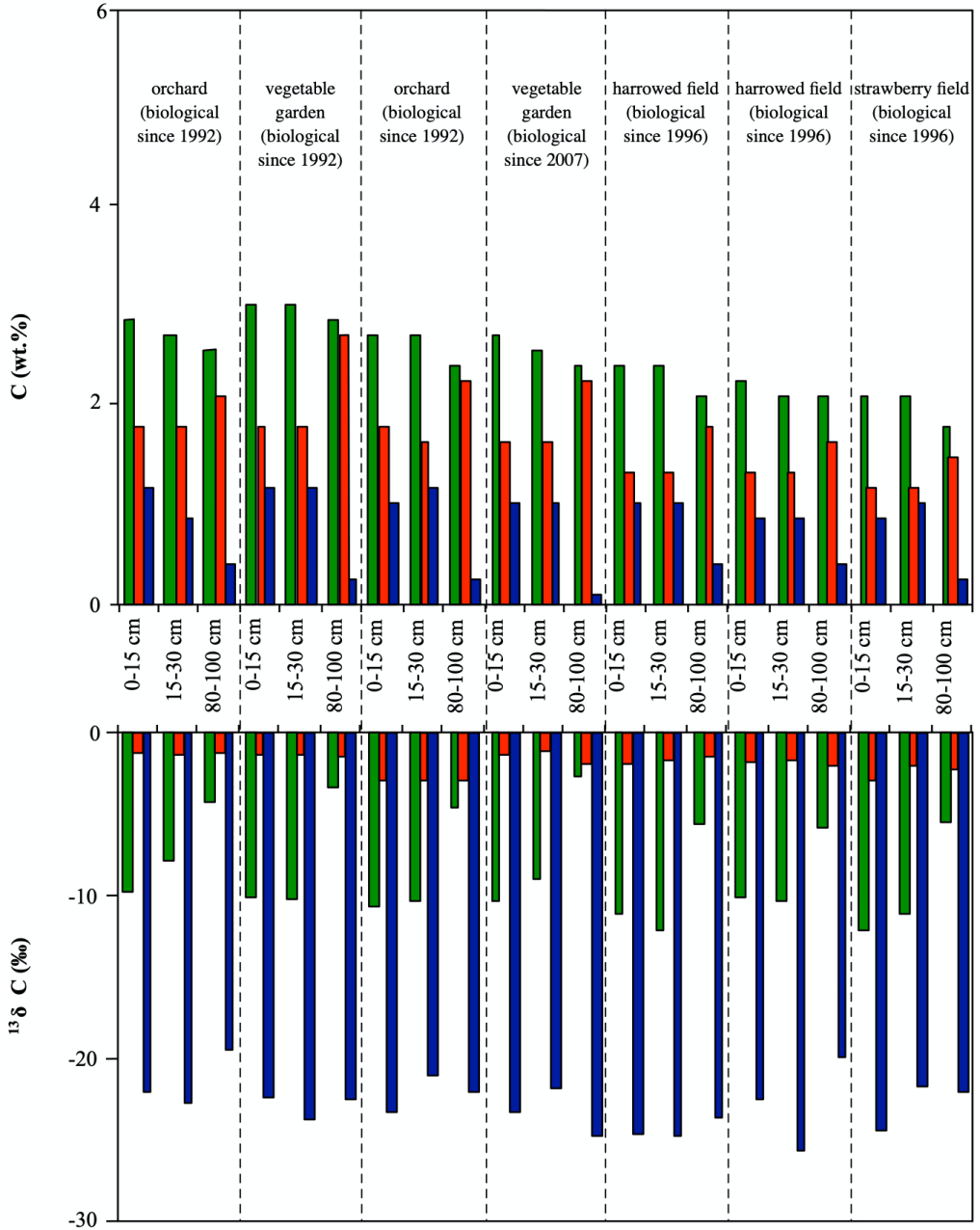
Soli TOC



From: Natali *et al.*, (2020)- Thermochimica Acta

Soli TOC Cube was also used to discriminate the labile organic carbon (TOC_{400}) and the residual oxidizable carbon (ROC) fractions, which are oxidized at temperature below and above 400°C, respectively.

Results: elemental and isotopic speciation of IC and OC



Total carbon (TC)

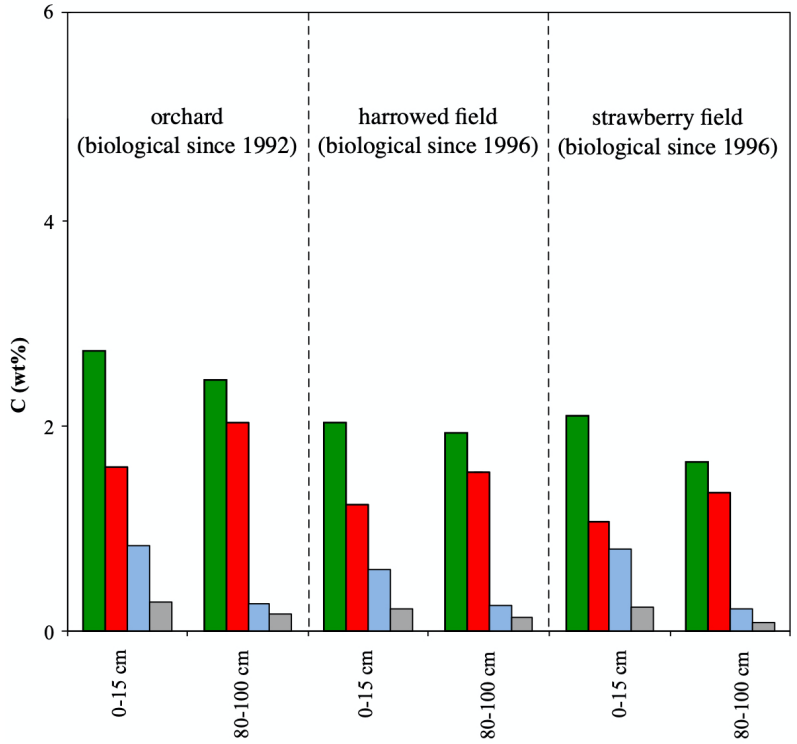
Total inorganic carbon (IC)

Total organic carbon (OC)

- In each site, IC slightly increases over depth while OC shows a clear decline.
- Irrespectively of the sampling depth, OC is always lower than IC.

The relatively low negative $\delta^{13}C$ values of the TC reflect the **predominance of IC the soils**.

Results: speciation of OC fraction and organic carbon stock



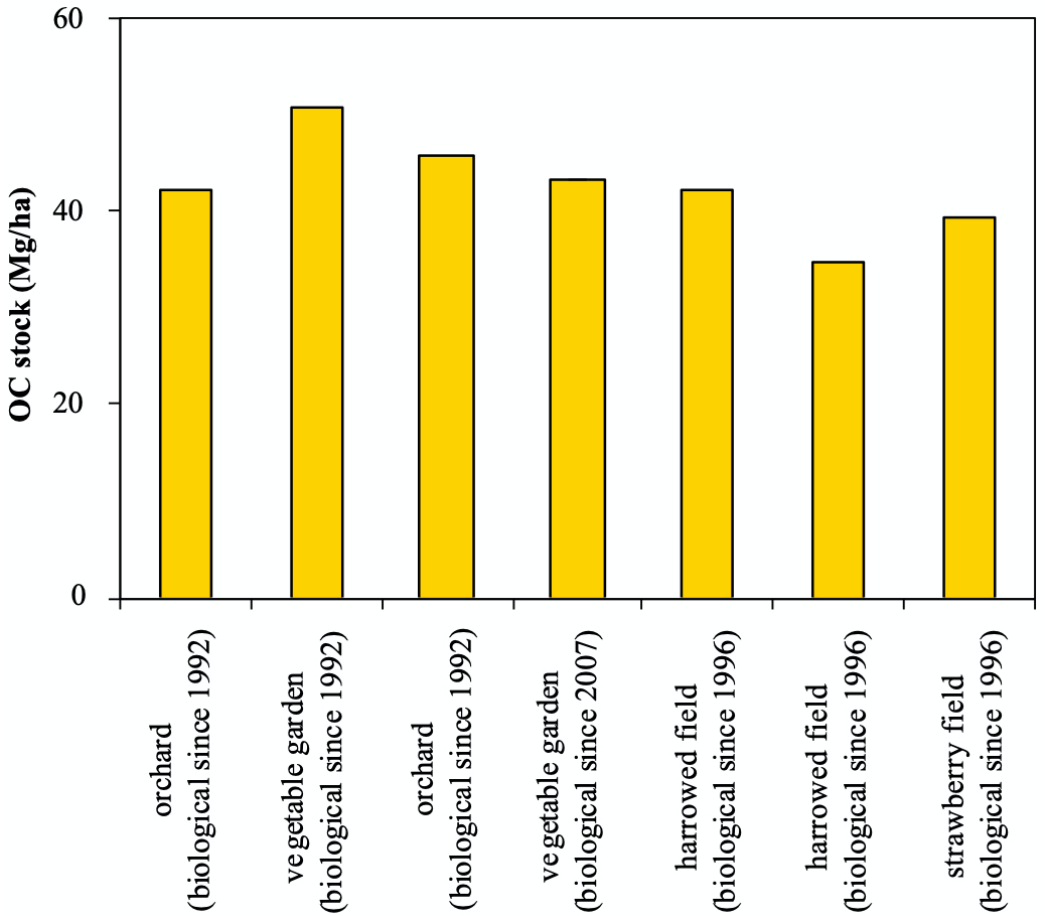
Total carbon (TC)

Total inorganic carbon (TIC)

Labile organic carbon (TOC_{400})

Residual oxidizable carbon (ROC)

Irrespectively of the sampling depth, the **TOC_{400} is higher than ROC**, indicating a large availability of "fresh" organic matter, probably due to the application of manure.



The low OC stock values indicate a **low storage of organic carbon**.

Bulk density: 1.47 g/cm^3
(https://geo.regione.emilia-romagna.it)

Conclusions

The elemental and isotopic analyses performed at different depth in a biological farm of Emilia-Romagna Region showed:

- the predominance of inorganic carbon respect to organic carbon;
- the low storage of organic matter in the topsoils (0-30 cm);
- the available organic matter is “fresh”, probably due to the application of manure, and there is a low amount of residual organic carbon.

The low OC content and the high presence of labile OC pool can be critical for SOM sequestration, preventing the accumulation of stabilised organic compounds and leading to the decrease of fertility of soil. Therefore, **burying stable organic matter is strongly recommended for this area**.

References

Natali, C.; Bianchini, G.; Vittori Antisari, L. (2018). *Thermal separation coupled with elemental and isotopic analysis: A method for soil carbon characterisation*. Catena **164**, 150-157.

Natali, C.; Bianchini, G.; Pasquale, C. (2020). *Thermal stability of soil carbon pools-ineferences on soil nature and evolution*. Thermochimica Acta **683**, 178478.