



UNIVERSITÀ DEGLI STUDI DI MILANO
DIPARTIMENTO DI SCIENZE AGRARIE
E AMBIENTALI - PRODUZIONE,
TERRITORIO, AGROENERGIA



DiSAA
DIPARTIMENTO
di SCIENZE
AGRARIE e
AMBIENTALI

“Alternatives to Glyphosate in conservation agriculture: effects on carbon sequestration in a field experiment in northern Italy”



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SSS10.5 - Sustaining soil functions in organic and inorganic farming – soil quality assessment, processes and models



Thu, 07 May, 14:00–15:45 | D2231

Conservative Agriculture (CA) practices are recognized to enhance **soil organic carbon (SOC)** stock and in turn to mitigate the effect of climate change.

CA has 3 principles:

- Reduced tillage
- Crops diversification
- Constant soil cover with retaining crop residues + **cover crops (CC)**



In CA, CC are usually terminated with **Glyphosate**, which determines environmental impacts (Hagner et al., 2019). An alternative is mechanical termination with **roller crimper** or **disk harrow**.



OBJECTIVE of the STUDY:
Evaluation of the effect of mechanical termination and Glyphosate on carbon sequestration in CA?

- **2-year field experiment on an organic farm (Lodi, Northern Italy)** **CC = Barley, Cash crop = soybean**
Crop rotation: CC (Nov. 2017 → May 2018), Soybean (June → Oct. 2018), CC (Dec. 2018 → May 2019), Soybean (May → Oct. 2019)

- **4 treatments of CC termination + soybean sowing + weeds control in soybean:**

 **CONV: Glyphosate + Disk Harrowing (15 cm) + sowing + hoeing**

 **ORG-MT: Disk Harrowing (15 cm) + sowing + hoeing**

 **ORG-NT: Roller Crimper + Sod seeding**

 **CONTR: Disk Harrowing (15 cm) + sowing**

- **Measured variables:**

Biomass of CC, soybean, weeds in soybean

SOC (30 cm top soil) at CC termination and soybean harvest



**Randomized
block design**

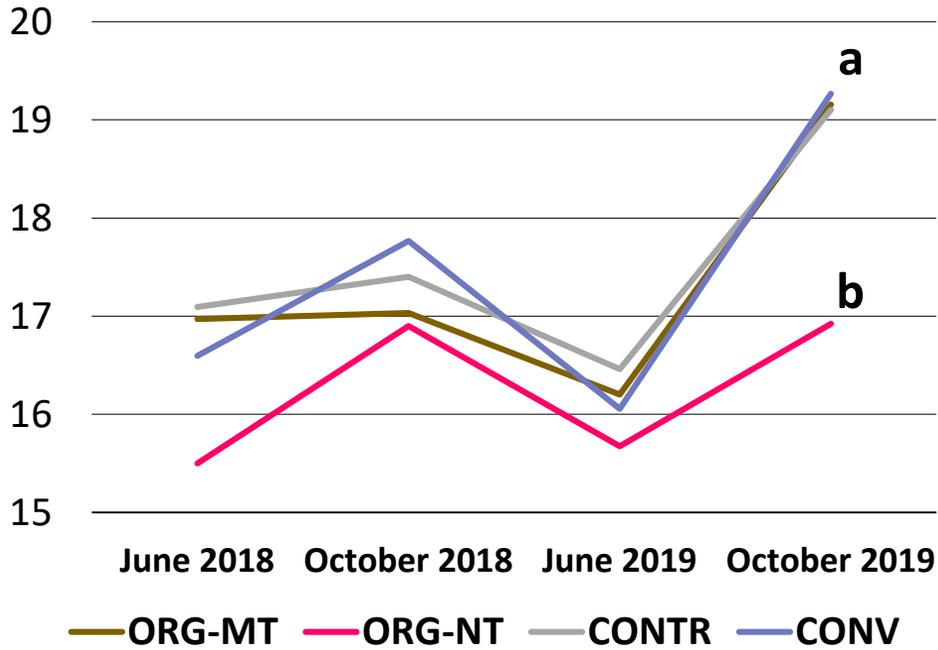
**4 treatments in
3 blocks**

**Sampling area:
30 m X 12 m
in each plot
(dashed line)**

RESULTS



SOC g kg⁻¹ (top layer of 30 cm)

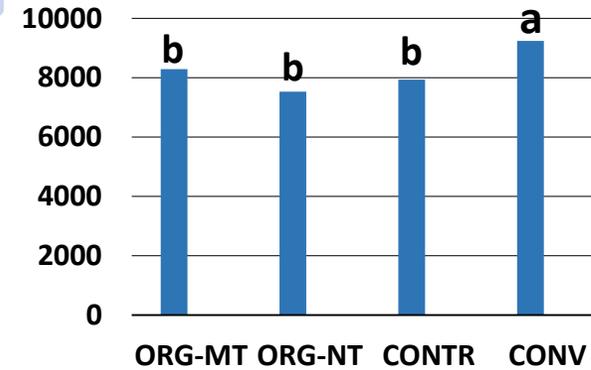


Data are treatment mean across blocks.
Data were treated with a mixed model (IBM SPSS 25.0).

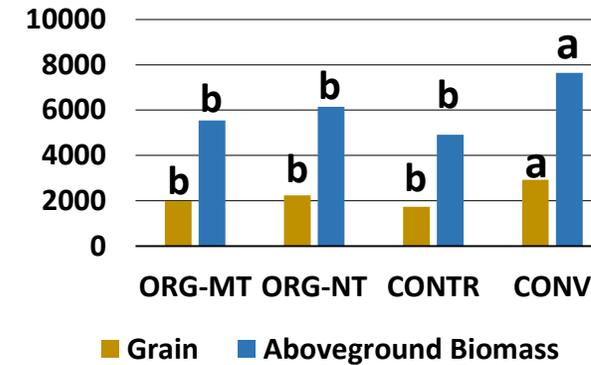


CC=Barley

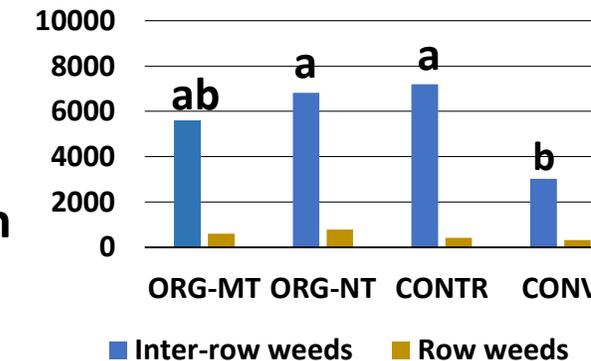
2-year average Biomass kg DM ha⁻¹



Soybean



Weeds in soybean



- SOC change is positively correlated to the CC (barley) biomass.
- CONV (Glyphosate use) resulted in significantly higher CC and soybean biomass at the end of the second year (+32%, $p < 0.01$) because of the higher weeds control.
- CONV allows to stock more carbon via photosynthesis that in turn results in higher SOC content.
- As a short term result, SOC under ORG-NT (ruller crimper + sod seeding) resulted in low SOC accumulation due to the scarce contact between CC litter and soil particles (limited microbial decomposition).
- If we consider the tractor fuel consumption in the treatments along with the biomass production, the carbon sequestration did not vary between CONV and the mechanical treatments.
- Further studies are needed for the definition of optimized field management practices to reduce the passage of machinery while increasing crop production and SOC.