SoilCare

Italy study site experiment #1:
CONSERVATION TILLAGE AND DEEP-ROOTING TILLAGE RADISH TO ALLEVIATE COMPACTION AND ADD SOIL ORGANIC MATTER

The problem

The loss of Soil Organic Matter (SOM) from soils and compaction from trafficking on top of them creates poor structure, ability to retain air and moisture and depletes vital soil organisms. This experiment in Veneto, Italy explored the potential of conservation tillage and deep-rooting radish for alleviating compaction and increasing soil organic matter.

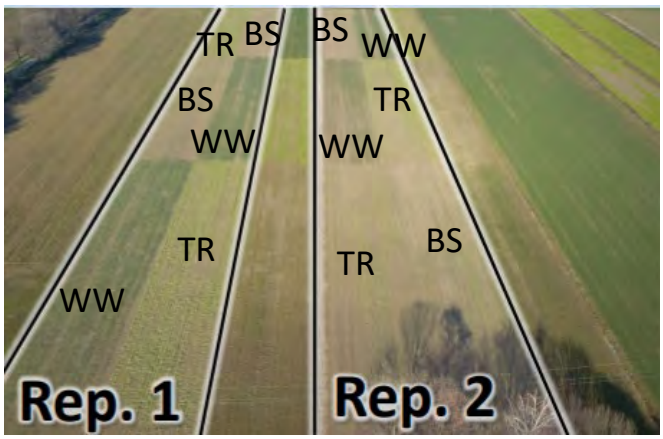
The proposed solution

'Tillage radish' has been developed for its deep rooting characteristics, which means that it has the ability to create a structure deeper into the soil through root channels potentially helping to alleviate compaction, allowing air and moisture in, whilst adding organic matter into the soil. It could also help to sequester carbon below the plough layer (approx. 30 cm).

Conservation tillage involves the opposite of tillage – not tilling! By avoiding tillage, the soil has less pressure on the surface from traffic such as tractors, preventing further compression. Over time, the soil should then be able to de-compress, especially with the addition of deep-rooting radish providing structure and space for air, water and beneficial microbes.

Experimental design

A plot trial experiment was carried out from 2018-2020. Effects on soil between different soil covers, including tillage radish TR), winter wheat (WW) and bare soil (BS), were compared, as well as the yield of maize grown after these treatments. Two replicates of these treatments were used. Each soil cover type was given both conventional tillage (CT) and no tillage (NT) treatments.



NT CT NT CT

Measurement	Time of year	Approach used
Physical soil analyses	Spring	Aggregate Emerson test, bulk density
Chemical analyses	Spring	SOC, mineral N, P Olsen, pH
Hydraulic conductivity	Spring	Double ring infiltrometer
Soil cover	Winter	Image analyses
Earthworm count	Spring, Autumn	Mustard extraction

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Results

Figure 1 shows that in 2019, there was a significant yield difference between conventional tillage (CT) and no tillage (NT). All treatments registered from moderate to insufficient production, mostly due to adverse climate conditions at sowing. However, no significant difference in maize yield was found in 2020, when the system was more stabilized and with standard environmental conditions.

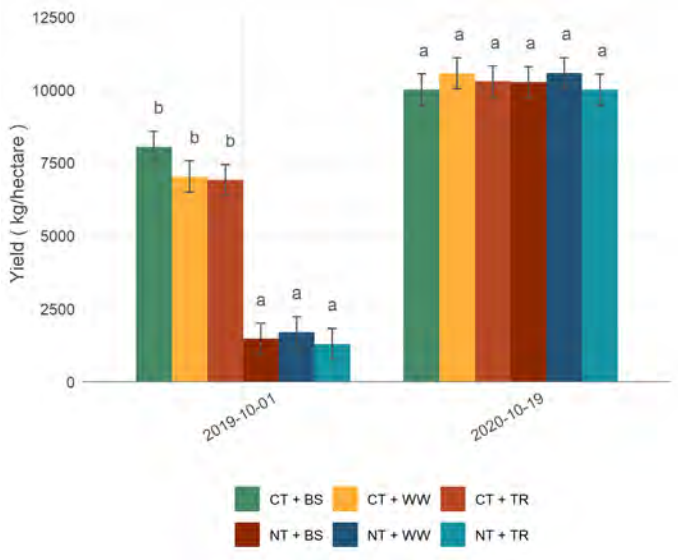

Figure 1. Yield of maize in 2019 and 2020.

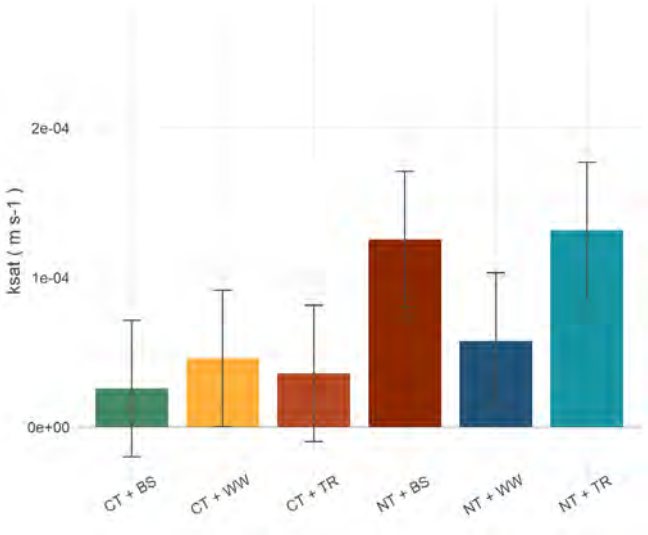

Figure 2. saturated hydraulic conductivity difference across the treatment combinations of cover and tillage.

Figure 2 shows that soil hydraulic conductivity had high variability among the treatments, with no clear effects of tillage radish. It may require a longer timespan when converting from conventional to conservation agriculture in order to see any effects.

- Winter wheat led to the higher soil cover potential, according to proximal image analyses, while tillage radish obtained an intermediated result.
- Earthworm counts were positively correlated with the no tillage treatments. No significant differences were reported between the different cover crops.

Winter wheat cover

Tillage radish cover

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Economic impact

- The economic sustainability of the SICS tested here (conservation tillage and tillage radish) is positive (see table below, in price per ha).
- However, the 2019 results indicate that there is a risk of crop failure, mainly related to possible adverse meteorological conditions in spring. Therefore, it is important to note that the economic outcomes of this SICS is likely to vary depending on weather conditions.
- Further evaluation is needed to explore the frequency of extreme events which are likely to affect the economic outcomes of adopting this SICS.

Agricultural management technique	Ploughed, no cover crop (control)	No-till, raddish cover crop (SICS)
Investments costs	0	0
Maintenance costs	0	0
Production costs	1670	1527
Benefits	1982	2104
Summary=benefits-costs	312	577
Percentage change	85.2	

Summary of the benefits of SICS (SICS vs. control), this case shows a positive impact of SICS in comparison to the control, the numbers are in euro/ha

Stakeholder feedback

- The results of this experiment aligned with the expectations of the stakeholders, with many farmers finding them interesting and encouraging due to the positive effect of the adopted SICS on soil quality.
- Farmers were, however, surprised that tillage radish did not perform better.
- Some of the farmer participants stated they are now considering incorporating winter cover crops in their rotations and recognised the need to use appropriate species.
- Farm technicians underlined the need to undertake precise economic evaluations to ensure that the SICS is economically viable as well as environmentally beneficial.
- It was identified that there is a need for better linkages between Universities, farmers, and businesses for knowledge exchange.
- Some farmers recognised that there is a need for a longer-term study to continue exploring the potential of these SICS.

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Challenges identified by farmers when establishing tillage radish:

- Germination varies depending on soil types
- Tillage radish appears to need herbicide to terminate it successfully

Challenges identified by farmers surrounding no-tillage management:

- Weed control
- Needs combining with irrigation for optimal management adoption
- Difficult to use a no-till system without using glyphosate

Key findings

- The no tillage treatment was more susceptible to adverse environmental conditions, which could lead to crop failure.
- Tillage radish did not have a clear effect in any of the parameters considered.
- Earthworm populations have benefitted from no tillage.
- After a conversion time, conservation agriculture could reduce production costs, while maintaining high yields.

Fact sheet authors

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