

# Greece study site experiment: EFFECTS OF TILLAGE ON SOIL EROSION RATES IN OLIVE ORCHARDS

## The problem

Olives are the most important crop grown on the island of Crete, covering 64% of the arable land and representing 86% of the tree plantations on the island. Conventional practices often lead to on-site and off-site environmental problems, such as soil erosion. There is a need to find practices that prevent soil erosion without reducing the profitability of the crop.

## The proposed solution

The aim of the study site experiment was to compare different tillage practices in olive orchards, as tillage is known to affect soil erosion rates. Moreover, less tillage can improve soil health by reducing organic matter decline, keeping soil microbiology intact, and limit compaction through less machine passes across fields, as well as reduce fuel use and related emissions. The experimental plots were located in an olive orchard at Biolea in Astrikas region, Crete, Greece.

## Experimental design

The experiment compared tilled plots and no-till treatment in two areas. Two olive varieties were studied in the experiments, *Olea europaea* and Koroneiki, located in an organic farm of 0.29 ha.

The following measurements were made:

- Soil texture
- Saturated hydraulic conductivity
- Water stable aggregates
- Bulk density
- Mineral Nitrogen
- Available Phosphorous
- Exchangeable Potassium/Sodium/Magnesium
- SOC
- Soil pH
- Soil electrical conductivity
- Earthworm numbers
- Weather (rain rate, temperature)

Soil loss rate assessments were undertaken through cross sections measurements.



Sediment fence



Tilled plot



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## Results

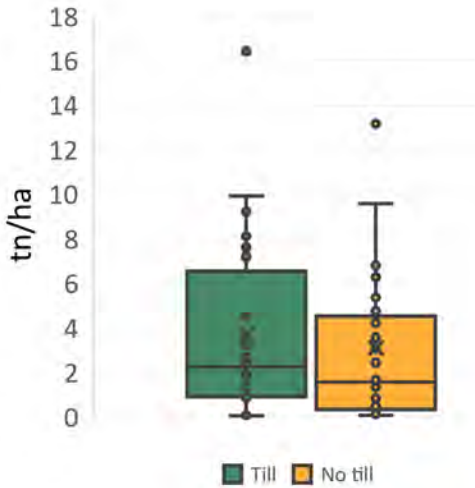


Figure 1. Soil erosion (tn/ha)

Field measurements showed that the no-till treatment had a considerable impact on soil erosion rates. Soil erosion was reduced by 22% on average (Fig 1).

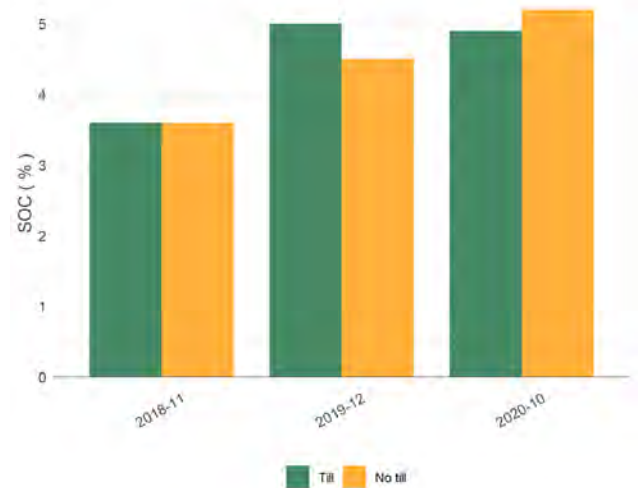


Figure 3. Soil Organic Carbon (%)

The soil organic carbon rate had an increasing trend in both plots from 2018 to 2020, and was slightly higher at the last year, which is probably due to the animal manure application (Fig 3)

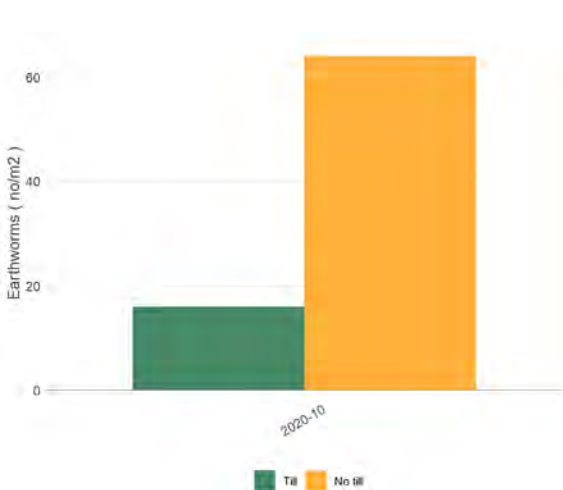


Figure 2. Earthworm numbers

The number of earthworms were substantially higher in the non-tilled plot compared to the tilled one, in the 2020 measurement (Fig 2).

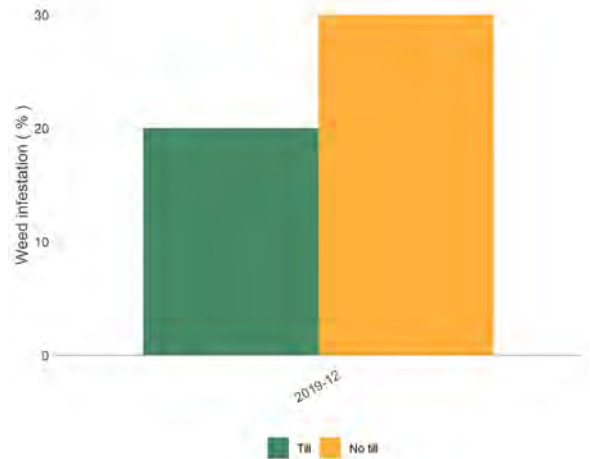


Figure 4. Weed infestation (%)

Weed infestation was slightly higher (10%) in the non-tilled plot compared to the tilled one, which cannot be assumed as a considerably higher hazard (Fig 4).

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## Results

- Soil loss rate monitoring revealed that the application of no-till treatment reduced mean soil erosion by over 20%, roughly from 4 to 3tn/ha, during the 2 years experiment (November 2018 to December 2020).
- Considerably more earthworms were observed in non-tilled plot compared to the tilled ones, indicating better soil health and condition.
- Top soil bulk density was slightly higher in the no-till plot. Bottom soil bulk density was found at the same levels in both plots.
- Exchangeable Mg had an increasing trend in both plots from 2018 to 2020.
- Mineral Nitrogen and available Phosphorus concentrations were lower in the no-till plots, both in 2019 and 2020.



Figure. Cross section measurements for the erosion identification

## Key findings

- Intensified tillage contributed significantly to increased soil erosion and affected the rooting system of the crop, causing exposed tree roots.
- The biological health and condition of the no-till plots were clearly better compared to the tilled plots.
- Apart from tillage, irrigation also increases soil erosion since irrigated trees are less resilient to water stress due to shallow roots.
- High content of soil organic carbon concentration was measured at both plots.
- Water and solute movement as well as soil aeration are appropriate even in the case of no-till.

## Conclusions

- No tillage practice is substantially beneficial for controlling soil erosion, improving soil health and keeping good soil structure.
- Olive farmers should consider reducing tillage practices in olive orchards, control the tillage depth, and at the same time limit its application especially during severe drought periods.

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