Spontaneous groundcover on olive grove management: effects on water infiltration and soil aggregate stability

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INTRODUCTION

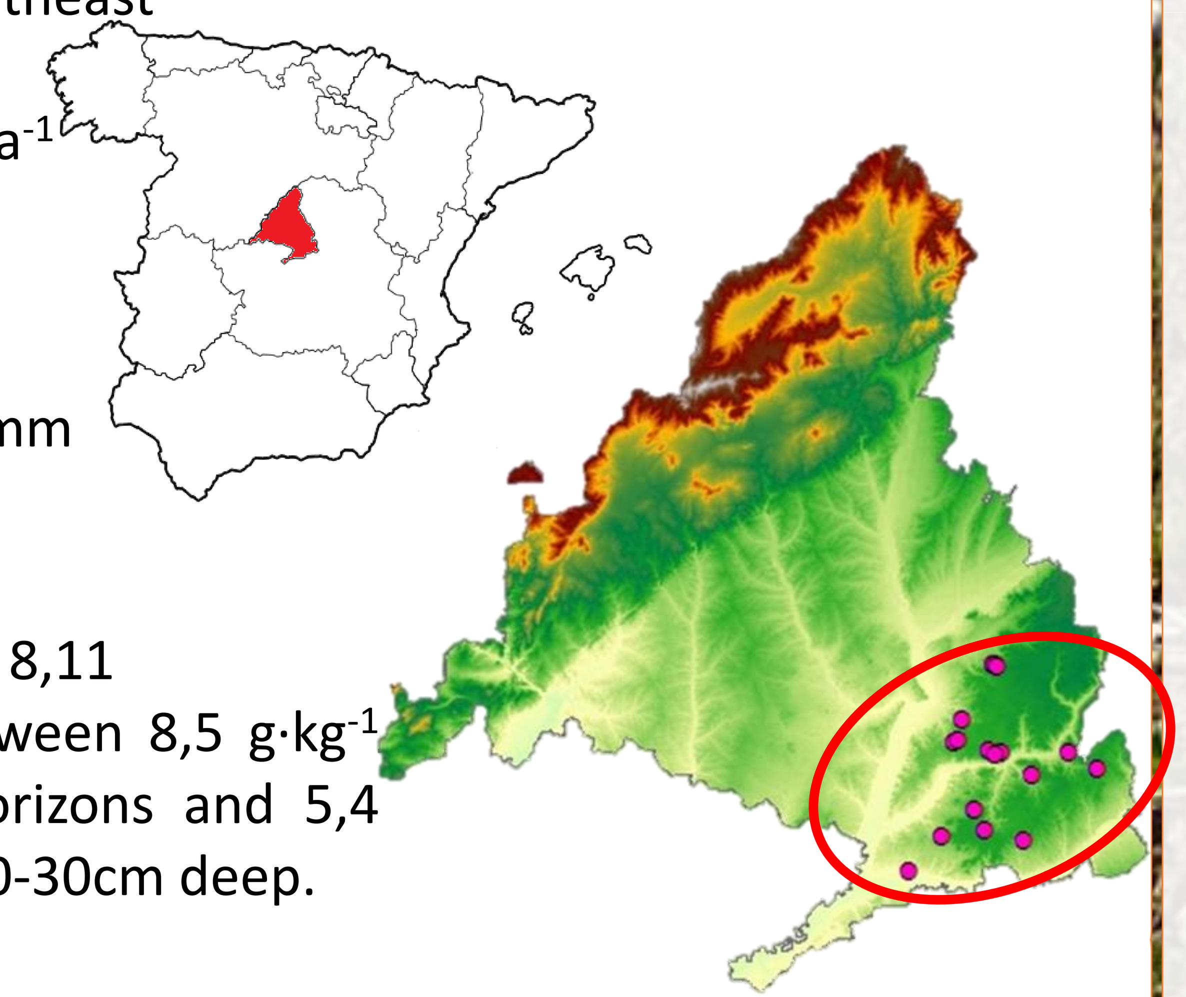
Traditional olive grove management based on frequent tillage promotes erosion and soil structure loss driving to degraded and impoverished soils. Due to the location of olive groves in slope areas and the climate of central Spain, with long periods of drought and extreme rainfall events, the erosion of bare soils is enhanced. Therefore, a shift to a more sustainable management model is needed, **proposing groundcovers as an alternative to frequent tillage**, aiming to **increase soil organic carbon**, **protecting and retaining soil** from erosion and **increasing soil health**, at the same time, **enhancing other ecosystem services** such as the increase in soil biodiversity.

MATERIAL AND METHODS

Study area

16 pairs of olive groves from different farmers in Southeast Madrid Region.

- Low-density framework: 12x12 m spacing ~ 70 trees·Ha^{-1}
- Each plot pair:
  - Spontaneous groundcover management (GC) .
  - Traditional tillage management (TLL).
- Climate: Contiental Mediterranean AT=14,7°C ; P=370mm
- Soil: 2 Calcisols, 1 Cambisol, 2 Gypsisols, 5 Leptosols, 5 Luvisols and 1 Regosol
- Texture: 5 Loam, 9 Clay loam, 2 Silt loam.
- pH: 7,49 - 8,11
- SOC : Between 8,5 g·kg^{-1} on top horizons and 5,4 g·kg^{-1} at 20-30cm deep.



Soil sampling

Four depths: 0-5 cm, 5-10 cm, 10-20 cm and 20-30 cm.
Samples were air-dried in the laboratory and sieved to obtain the different soil fractions.

Soil Analyses

Water-stable aggregates, expressed as the percentage of micro-aggregates wet sieving resistant (< 2 mm diameter). (Kemper and Rosenau method, 1986).

Water infiltration rate, using a simple ring infiltrometer (Ø=12.5 cm), measured "in situ" following the method described in USDA (2001).

Data analyses

ANOVA with a general linear model for a factorial block design with split plots (Statgraphics Centurion XVIII).
Differences between means according to Fisher's LSD test for p-value < 0.05.

RESULTS AND DISCUSSION

Groundcovers increase the infiltration rate almost twice in GC plots (109 mm·h^{-1}) than in TLL plots (52mm·h^{-1}), $p<0,05$.

Groundcovers significantly improve soil infiltration capacity and water storage capacity by improving soil structure, increasing organic matter content and soil porosity (He et al. 2020). Tillage could improve infiltration rates temporarily, however, it results in the degradation of soil structure in the long term, promoting surface crust formation, which can reduce the water infiltration rate, accelerating the processes of runoff and erosion and reducing water availability in the rhizosphere (Palese et al. 2014; de Almeida et al. 2018).

Percentage of water-stable aggregates under 0-5 cm depth increased the most (49% under GC regarding 38% under TLL plots, $p<0,05$). Tillage affects soil aggregation through physical disruption. Aggregation is key for soil structure, providing resistance to erosion, protection of organic matter and microhabitats for microbial processes (Helgason, 2010). Water-stability and the pores between aggregates affect infiltration, drainage and storage of water in the soil (Tisdall, 1994)

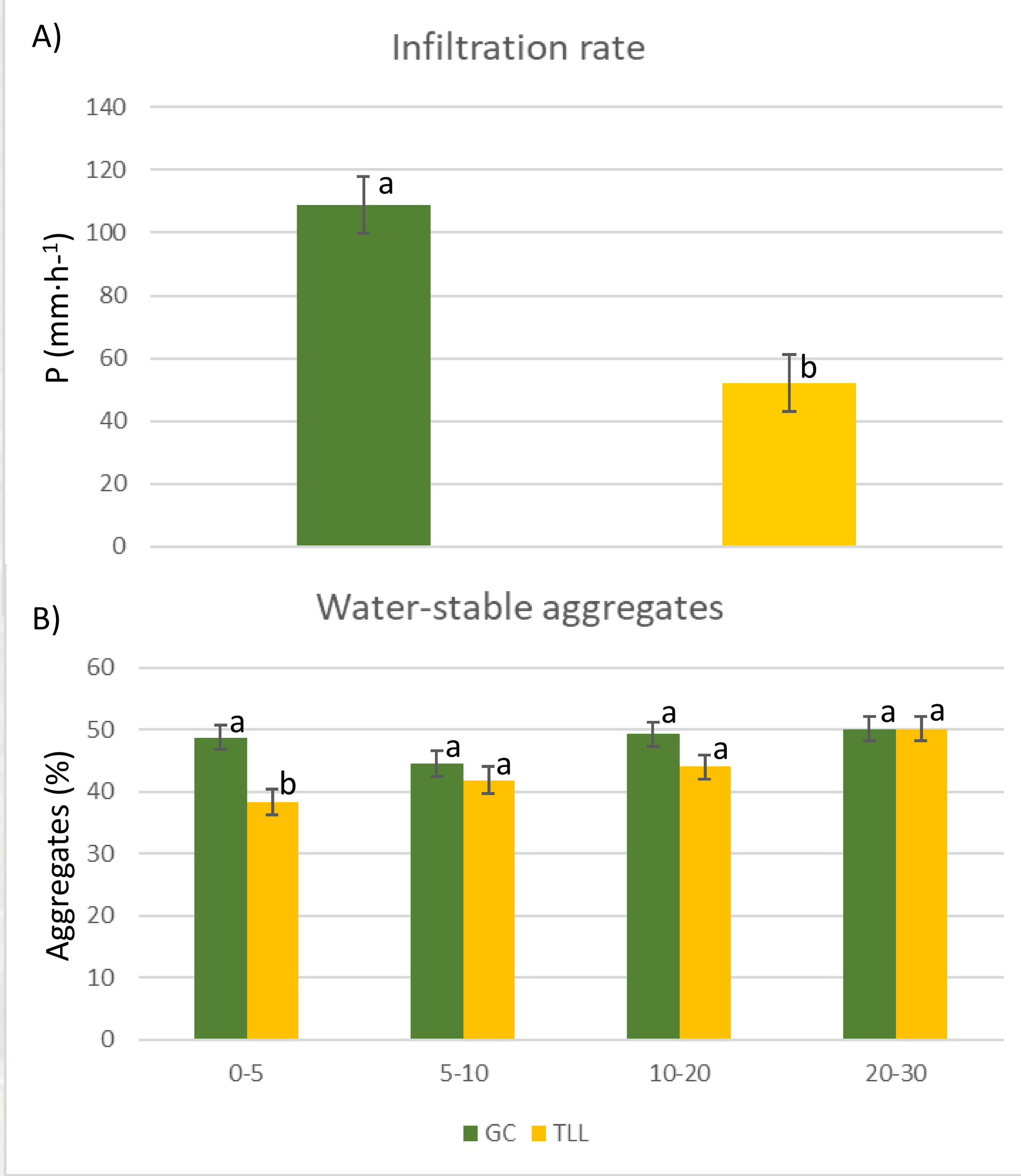


Figure 1: A) Average infiltration rates by soil management; B) Average of percentage of water-stable aggregates by depth and soil management. Where GC: Spontaneous groundcover management and TLL: Traditional tillage management. Different letter means statistically significant differences according to LSD test (p<0.05).

Therefore, using groundcovers as olive grove management improves rainwater infiltration, enhancing water storage to be used by the olive tree, and allows the formation of soil aggregates that control soil erosion and host a large number of soil microorganisms thus, improving their functions of decomposition of organic matter and within the nutrient cycling, contributing to improve soil health.

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