Mulching as best management practice to reduce surface runoff and erosion in steep clayey olive groves in Locri, Southern Italy

Year of issue

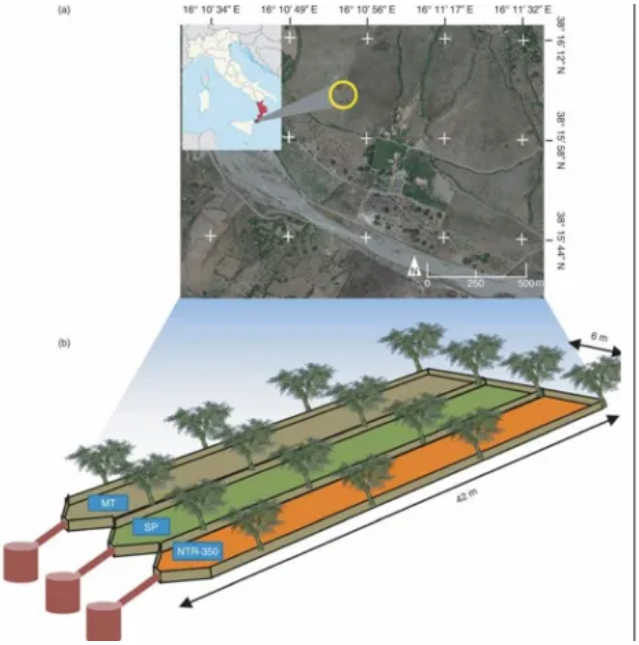
2025

Summary

This study assessed saturated hydraulic conductivity (Ksat), surface runoff (SR) and soil erosion (SL) under rainfed conditions, at plot scale, over two years, under four different management practices: total soil cover with netting (SP), mechanical tillage (MT) and mulching with plant residues at doses of 3.5-10^3 and 17.5-10^3 kg ha^{-1} of dry matter (NTR350 and NTR1750), in an olive grove in Calabria (Southern Italy). Overall, the results quantified the impact of mulching with pruning residues, applied at different doses, providing useful guidelines to control and mitigate the hydrological response of clay and sloping soils in Mediterranean olive groves, analysing the environmental benefits and associated economics.

Hypothesis – that not working the soil and mulching with pruning residues can significantly reduce runoff and water erosion and improve soil properties compared to conventional tillage – has been confirmed.

Photo Gallery



Location

38.2671, 16.1872

Project

NWRM

Sector

Agriculture

Installation Date

2015

Implementation status

Completed

Contact

Università degli Studi Mediterranea di Reggio Calabria

Overview

Location of the project

The experimental site was located in an olive grove close to Locri

Country

Italy

NUTS2 Code

Calabria

Sponge measures implemented in the case study

Mulching

Cover crops

Minimum tillage

Objectives

The study aimed to mitigate erosion and improve infiltration using low-cost, low-impact mulching. It was not designed to handle specific return-period storm events but rather frequent Mediterranean short-duration storms.

Involved partners

Authority type	Authority name	Authority responsibility

National water authority	Government agencies	Responsible

Site Information

Climate Zone

Warm temperate dry

Precipitation

1350.00 mm

Temperature (°C)

17.00 °C

Runoff

25.00 mm

Elevation range

114 m

Slope range

20%

Soil type

Cambisols

Vegetation class

Spontaneous grass cover the soil of the olive grove, olives trees

WFD Ecological status

Bad

WFD Chemical status

Good

Water quality status

Arid zone, lack of water

Design and Implementation

Project scale

Micro

Project area

252 m²

Principles

The project tested and compared four soil management techniques:
• SP (full cover with netting)
• MT (mechanical tillage)
• NTR350 (mulch at 3.5 t/ha)
• NTR1750 (mulch at 17.5 t/ha)
Key sponge measures included the use of locally available olive pruning residues as mulch. Soil infiltration was enhanced and runoff reduced, especially under NTR1750.

Factor constraints

Biophysical limitations:
• Slope and high clay content were constraints
• Favourable conditions: available mulch, structured experimental plot, consistent rainfall patterns
Favourable conditions: Sufficient pruning residues and simple plot access

Financing

Total cost

100000.00 €

Total cost information

Approximately €20,000 for direct field costs

Financing authorities

Authority name	Comments
Italian Ministry of Education and Research	Budget part of the PON project 'Sustainable Models and New Technologies for the Promotion of Olives and Extra Virgin Olive Oil Produced in Calabria'.

Compensations

Non

Policy and Governance

Policy description

In Mediterranean areas, olive trees are often cultivated on steep hillsides. These areas are particularly prone to high rates of runoff and soil loss due to the inherent climatic conditions, characterised by intense and infrequent rainfall that is often violent and destructive.
When olive growing is practised on soils with a high clay content, runoff and erosion rates can become unsustainable.

To reduce erosion and improve the water retention capacity and physical properties of soils in olive groves, less impactful agricultural practices such as cover crops or mulching with pruning residues can be successful.

These alternative management methods are inspired by the paradigm of conservation agriculture, a system of principles and practices that can integrate sustainability into the agricultural production system to protect soil, water quality and biological resources.
water quality and biological resources.

Land ownership

Land owned by an agricultural enterprise

Target remarks

Extend this practice to regional level with the help of regional economic contributions to farmers

Requirement directive remarks

Directive 2000/60/EC - Nature restoration law

Part of a wider plan

Non

Public consultation

Non

Has contractual arrangements

Non

Impacts and Monitoring

Monitoring System

Monitoring parameters

Precipitation measured at Antonimina station (1 km from site)

Runoff and soil loss measured directly post-rainfall

Saturated hydraulic conductivity measured with double-ring infiltrometer

Lab analysis of soil and water samples

Maintenance

Maintenance requirements

No maintenance required

Impact Assessment Methodology

Biophysical impact assessment method

The impacts were assessed using direct measurements of runoff and erosion and modelled using SCS-CN and Horton models, as well as two models from the USLE family (MUSLE and USLE-M).

Socio-economic Impacts

Direct benefits

Local supply of pruning residues

Low-tech implementation

Biophysical impacts: Hydrology

Information on retained water

A clear reduction in runoff and soil loss was observed in mulching practices compared to mechanical tillage (MT), with a decrease of 20 to 32% in the runoff coefficient.

Enhanced soil moisture retention.

Biophysical impacts: Biodiversity

Information on improved biodiversity

Higher vegetation cover in mulched plots vs. mechanical tillage. Vegetation cover was highest under SP (33%) and lowest under MT (12%) and mulching treatments (22–25%).

Biophysical impacts: Water & Soil Quality

Information on water quality overall

The use of pruning residues as mulch in moderate quantities, combined with temporary cover crops, appears to be the best strategy for protecting clay soils in olive groves located on slopes and subject to water scarcity : 75 to 80% in soil erosion (SL), with more pronounced reductions in the NTR1750 treatment.

This practice has significantly improved water infiltration and soil organic matter (OM) content. The average organic matter content of the soil was:
• 2.01% for NTR1750,
• 1.69% for NTR350,
• 1.34% for SP,
• 0.82% for MT.

Lessons Learned

Key lessons

The soil management practices (SMPs) tested - particularly the one with the lowest dose - can be suggested to local farmers as a sustainable cropping model, capable of promoting soil conservation without compromising expected production yields.
However, one question remains open: the evaluation of the maximum slope length beyond which pruning residues retain their efficacy against
erosion, before being swept away by concentrated runoff downstream.
Future studies may answer this question, preferably conducted on clay olive groves with different slope profiles and with varying mulching doses and frequencies, in order to identify the optimal doses, using only the pruning residues produced within the olive grove, without resorting to external sources.

Barriers

Barrier type	Barrier role	Comments
Other	Main barrier	Costs for shredding / chopping plant residues to create the Mulch

Drivers

Driver type	Driver role	Comments
Other	Main driver	Climate change in terms of increasing rainfall magnitude

Success factors

Success factor type	Success factor role	Comments

Other	Main factor	Availability of pruning and mowing residues from the grass layer

Cost effectiveness

An appropriate best management practices (BMPs) model could be proposed to olive growers to support soil conservation, offering an alternative or a complement to cover crop based strategies.

Transferability

Applicable to Mediterranean olive groves with similar soils

Requires slope-length adaptation to avoid runoff concentration

Sources

Sources

Eco scheme 2 – grass cover between tree rows in olive orchards

L’uso della pacciamatura per l’olivo

Olive grove management: Mulching branches and vegetative soil coverage

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