Cork oak stripping: carbon and water balance at tree and ecosystem level

Silvo-Pastoral System in a changing world: functions, management and people
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What is the effect of cork stripping on tree carbon and water balance?

How stressful it is to the tree?

Time needed for the tree to recover?

What is the effect at the ecosystem level?

This knowledge is useful to support decision making in montado management.
Material and methods
Experimental site
177 trees/ha
Height: 7.9m
Diameter: 24.7 cm
Age: ca. 50 anos

Eddyflux tower
Automatic weather station: air temperature, air relative humidity, PAR, rainfall, webcam

ultrasonic anemometer

Eddy covariance

NEE, ET

IRGA
Infrared gas analyser

Sapflow measurements

litter fall baskets

Phenology

Soil water content

Results

Conclusions

Introduction

Material and methods
In two years with contrasting precipitation (2014 and 2015), we assessed:

1. Tree transpiration and water status
   - Sap flow (Granier)
   - Leaf water potentials (Scholander Pressure Chamber)

2. Main stem evaporation
   - IRGA (LCPro+)

3. Branches Carbon uptake at branches and ecosystem level
   - IRGA (Li840a) and Eddyflux tower
Field trial

Before cork stripping: 3, 19
After cork stripping: 1, 7, 8, 11, 15, 24, 4

6 Control trees
6 Cork stripped trees

Eddyflux tower

6 Control trees
6 Cork stripped trees
X 2 (12/year)

2014
2015

June
July
August
September
2014 – wet year
2015 – dry year

2014 = 592 mm
2015 = 154 mm

(4 x less precipitation)
Differences in precipitation were reflected in Spring soil water content (40 cm depth).
Tree water status and transpiration

Leaf water potential (MPa)

Day relative to cork stripping

Cork stripped trees

Control

2014

Cork stripping

Flux density (hl/m²/day)

Day relative to cork stripping

(predawn)

(midday)
Tree water status and transpiration

2015

Day relative to cork stripping

Leaf water potential (MPa)

Control

Descortiçadas

Cork stripped trees

Flux density (hl/m²/dia)

Cork stripping

Day relative to cork stripping
Main stem evaporation

The pattern of water losses were similar in 2014 and 2015. This suggests a small influence of the climatic year (pp) in the main stem water losses.

Two months after cork stripping water losses were reduced to a minimum.

Main stem maximum water loss rates are negligible when compared with tree canopy transpiration values (ca. 1%).
Apparently there wasn’t a significant effect of cork stripping and/or dry year in phenology patterns.
Branches carbon uptake (light use efficiency)

Higher branches carbon uptake in 2014 than in 2015 (no differences between treatments in 2014)

In 2015 there was a clear reduction in branches carbon uptake of cork stripped trees
**2014 vs. 2015:**
30% average reduction in the ecosystem carbon uptake (summer)

NEE reduction in June (30%) suggests a clear effect due to cork stripping alone (similar $\Psi_w$)

**2015 vs. 2012:**
However NEE reduction was not so severe as in 2012 (dry year) suggesting that the ecosystem can cope with this additional stress
In a mild summer or in a wet year cork stripping does not affect cork oak carbon and water fluxes.

Main stem water loss are only significant until one week after cork stripping but represent a negligible amount.

In a dry year cork stripping leads to a significant reduction in tree transpiration (stomata close).

Cork stripping in a dry year enhances the reduction in tree and ecosystem carbon uptake although the ecosystem can cope with this additional stress (in favourable ecological conditions).
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