SOIL MICROBIAL BIOMASS AND ACTIVITY IN A CORK OAK SAVANNA

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INTRODUCTION

Cork oak savannas are composed by a sparse tree canopy and a dominant annual grassland understory that survives the hot and dry Mediterranean summers as seeds in the soil. Microbial communities can be more or less efficient at converting organic substrates into microbial biomass carbon depending on the quantity and quality of organic matter inputs (Dijkstra et al. 2006). The cork oak savannas have two distinct type of plant litter that can affect soil microbial biomass and activity differently: herbaceous litter and the more recalcitrant woody plant litter resulting from the trees.

Spatial variability of soil microbial biomass and activity of cork oak savannas were evaluated in order to understand the contribution of the tree canopy to the soil carbon dynamics of these systems

Fig.1 a) Cork oak savanna at Companhia das Lezírias

METHODS

Our study was conducted in South Portugal (coordinates 38°46' N; 8°38´ W; 25 m alt) in a cork oak (*Quercus suber*) savanna system with a Mediterranean-type of climate. Average precipitation is 623 mm. Soils are sandy soils.

In February 2009, we randomly established 8 plots under mature cork oak trees and 8 paired plots in the open grassland. From March 2009 until June 2010, two composite soil cores (0-10 cm depth) were monthly collected in each plot. Soil microbial biomass carbon (Cmic) and nitrogen (Nmic) was determined by the Chloroform fumigation method (Vance et al. 1987) and total organic carbon (Corg) with a Primacs TOC Analyser (Skalar).

Differences between groups were tested with Mann-Whitney U Statistics with Sigmaplot 11 software.

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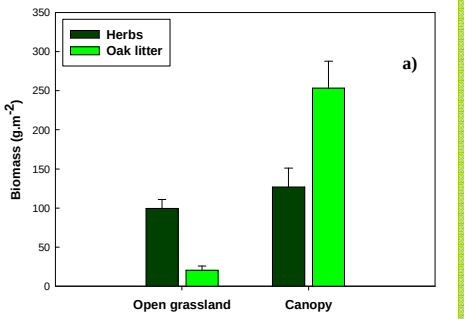
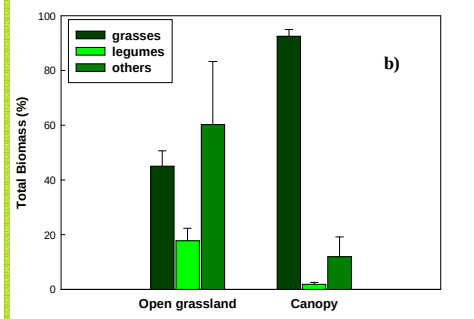
RESULTS





➔ Total biomass (herbaceous and oak litter) is higher under the canopy than in open grassland mainly due to a higher input of oak litter;

➔Grasses dominated the herbaceous layer under the canopy;

➔ Legume biomass was significantly higher in the open grassland than under the canopy;

Fig.2 a) Total herbaceous biomass and total biomass of oak litter (leaves) in open grassland and under the tree canopy; b) Percentage biomass of herb functional groups (grasses, legumes and other species) in Open grassland and under the tree canopy. Mean + s.e.

Table 1 Corg, Cmic/, qCO2, Cmic/Corg of soils in open grassland and under the canopy of cork oak trees. Values are means of 18 months of measurements, with standard errors in parentheses. * represents significant differences (P<0.05).

	Corg (g.100g)	Cmic ($mgC.kg^{-1}$)	qCO_2 ($mgCO_2$-C.mg^{-1}.Cmic.d^{-1})	Cmic/Corg (%)
Open grassland	1.18* (0.03)	493.85* (16.68)	0.051 (0.004)	4.21* (0.26)
Canopy	2.12 (0.064)	646.06 (22.65)	0.058 (0.0037)	2.87 (0.15)

➔ Cmic and Corg were higher under the canopy than in the open grassland;

➔Cmic/Corg ratio, ie, the microbial biomass-C supported by organic carbon, was ca. 1.4 times greater in the open grassland than under the canopy;

➔qCO2 was not significantly different between open grassland and tree canopy

DISCUSSION

- tree canopy increased organic carbon in the soil (Corg) in a consistent way with the higher aboveground biomass production under the canopy;
- higher Corg is associated with higher Cmic under the canopy . Soil microbes are often limited by C and an increase in C pool is likely to support larger microbial biomass (Cmic) (Liao and Boutton 2008). Under the tree canopy soil moisture is higher and temperatures milder (data not shown) which can also positively affect Cmic;
- lower Cmic/Corg ratio under the canopy can be associated with organic matter of lower quality (eg. more oak litter, less legumes);

References

Dijkstra *et al.* 2006 *Soil Science Society of America Journal* 70: 770-777.
Liao and Boutton 2008 *Soil Biology & Biochemistry* 40: 1207-1216
Vance et al. *Soil Biol Biochem*. 19: 703-707