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# Resilience and resistance of microbial communities against drought events, in a mature agroforestry system in Mediterranean area



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1. UMR Eco&Sols, INRA, Montpellier, France

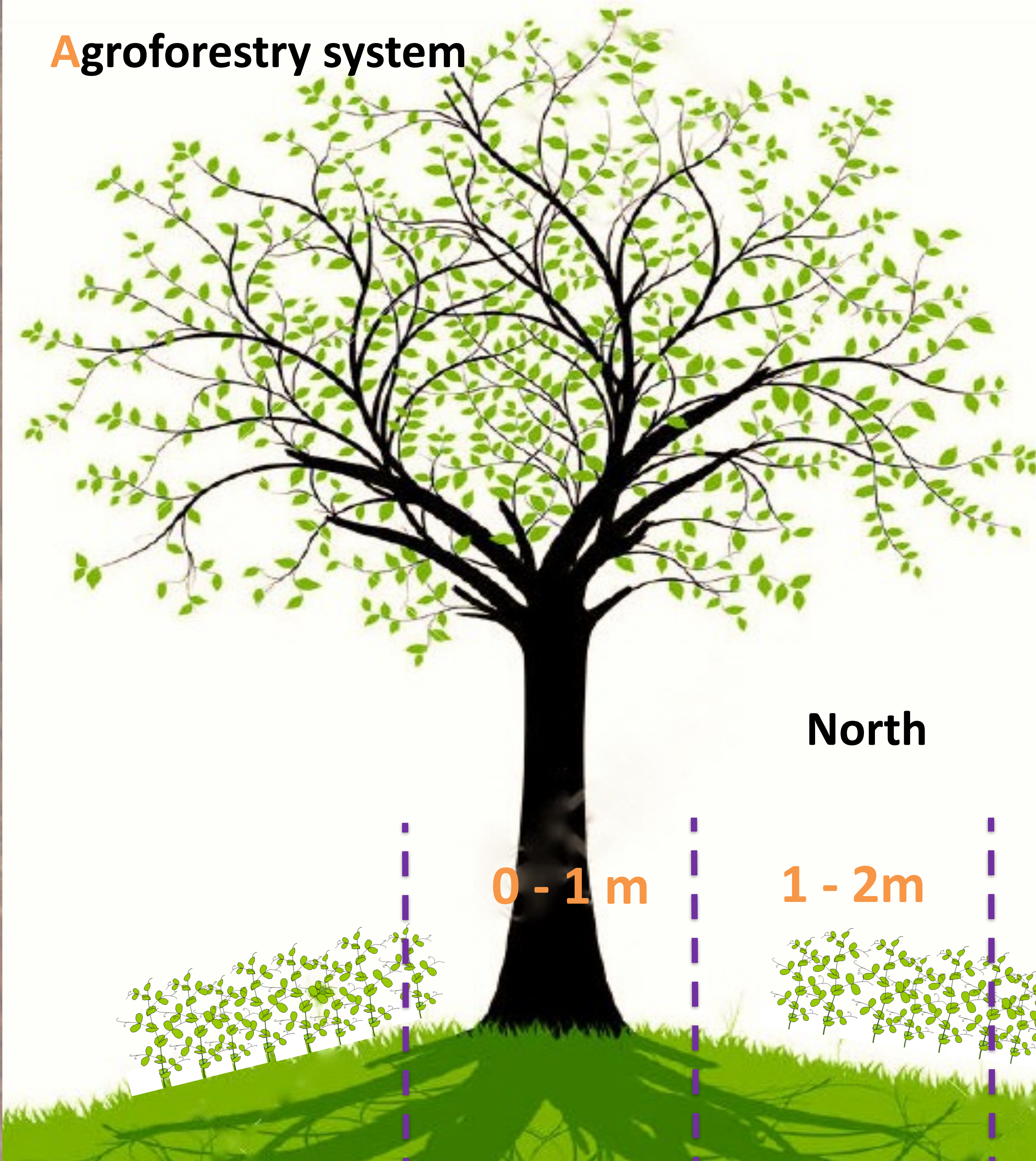
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- Agroforestry systems are known to limit soil degradation, deeply store carbon and have positive impact on different indicators of soil quality.
- What is the impact of tree-crop associations on resistance and resilience of topsoil microbial communities?
- Our aim is to evaluate the resistance and the resilience of the microbial communities of topsoil along a spatial gradient from the tree line to the center of the intercrop, and in the monocrop treatment.

## Agroforestry system



## Experimental design

- Restinclières experimental site, 15 km north of Montpellier, France. Association of 21 year-old walnut trees (*Juglans regia x nigra*) and wheat/barley/pea crop rotation.
- 5 replicates of agroforestry spot : a 13-m transect, 6.5m on north face of the tree divided in 4 sampling intervals of the topsoil ( 0-15cm ) :  
zone 1 : 0-1m , zone 2 : 1-2m, zone 3 : 2-4m, zone 4 : 4-6.5m
- 5 replicates of monocrop control
- Microcosms incubation :
  - Control treatment : 60% WHC, 25°C, dark atmosphere
  - Water stress treatment : <5% WHC, 25°C, dark atmosphere



Figure 1 : Map of France

## Carbon mineralisation

- Carbon mineralisation was measured each week during the incubation, and twice a week during the resilience stage
- Resistance and resilience index were calculated as described by Orwin and Wardle ( 2004), based on C mineralisation.



Figure 2 : Photograph of the incubation system , Montpellier Ecotron



Figure 3 :

Average cumulated C mineralisation during 29 days of incubation. Each graph represents different distances from the tree and is a comparison between control and water stress treatments.

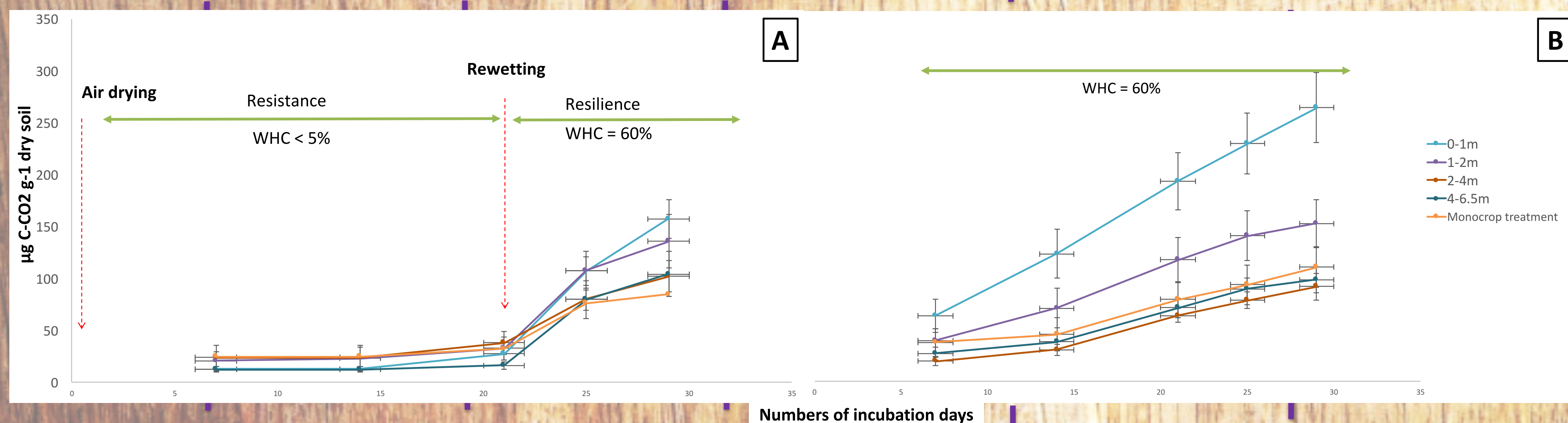


Figure 4 :

Average cumulated C mineralisation during 29 days of incubation. A represents the water stress treatment and B the control treatment.

	Day	Distance				
		0-1m	1-2m	2-4m	4-6.5m	Monocrop treatment
Rate day <sup>-1</sup> µg C-CO <sub>2</sub> g <sup>-1</sup> dry soil	Day 21 : Resistance	1.315 <sup>a</sup>	1.579 <sup>a</sup>	1.823 <sup>a</sup>	0.780 <sup>a</sup>	1.543 <sup>a</sup>
	Day 29 : Resilience	18.556 <sup>a</sup>	14.670 <sup>ab</sup>	9.125 <sup>b</sup>	12.579 <sup>ab</sup>	7.503 <sup>ab</sup>
Index	Day 21 : Resistance	0.0758 <sup>a</sup>	0.147 <sup>a</sup>	0.373 <sup>a</sup>	0.122 <sup>a</sup>	0.357 <sup>a</sup>
	Day 29 : Resilience	0.216 <sup>ab</sup>	0.607 <sup>a</sup>	0.219 <sup>ab</sup>	0.477 <sup>ab</sup>	-0.064 <sup>b</sup>

Table 1 :

Daily rate of C mineralisation at the end of the stress (Resistance) and 7 days after rewetting (Resilience) and indices of resistance and resilience based on cumulated C mineralisation. Data are mean, n=5, letters indicate significant differences (P<0.05)

- Stronger cumulated C mineralisation occurring close to the tree, decreasing with increasing distance from tree.
- Our data show difference in microbial resilience along the spatial gradient, but not difference in resistance.
- Microbial communities seem to be more sensitive to water stress and rewetting close to the tree than in the monocrop treatment.

References :

• Orwin, K.H., Wardle, D.A., 2004. New indices for quantifying the resistance and resilience of soil biota to exogenous disturbances. *Soil Biology and Biochemistry* 36, 1907-1912