Carbon flow in the rhizosphere, is it dependent on nitrogen availability or plant species?

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Rationale
The extent of the interactions between carbon (C) and nitrogen (N) cycling and the factors and mechanisms influencing them, are still poorly understood. Mediterranean Basin ecosystems offer an opportunity to fill in this gap, since they are biodiversity hotspots with high structural complexity that are threatened by anthropogenic enhanced nitrogen (N) availability. Mediterranean Basin maquis in Portugal, with low ambient N deposition (5.2 kg N ha⁻¹ yr⁻¹) and low soil N content (0.1%). Our objective was to determine the effects of the N treatments on the rate of C cycling, namely C transfer to the rhizosphere. Since the enhanced N availability is differentially influencing the co-existing plant species (Dias et al. 2011, 2012), we hypothesized that the rate of C cycling will be influenced by plant community composition and the N treatments.

Methods:
The study site is in a Natura 2000 site (PTCON0010 Arrábida/Espichel, Portugal), where background N deposition is estimated to be 0.14 kg N ha⁻¹ yr⁻¹ (3.3 kg N m⁻² yr⁻¹). The vegetation consists of 9 the more important (C. ladanifer, Genista triacanthos, Dittrichia viscosa) were selected. C. ladanifer and G. triacanthos are leguminous species, while D. viscosa, a ruderal plant species, was selected. Each treatment was replicated 3 times. One plant of each species was placed at the center of each 1 m² plot. In each experimental plot four plots containing the chosen plant species were identified; 3 plants of each species were selected.

The incorporation of the 13C pulse was influenced by the N treatments and plant species. The integration of the 13C incorporation was lower in the Mediterranean Basin maquis in comparison to Control. C. ladanifer was benefited by the NH4 availability, especially in the summer semi-arid period. The photosynthetic rates were higher in the 80AN treatment than in the Control. The leaf hydration, WI, was lower in the Control treatment compared to the N treatments. The leaf hydration, WI, was lower in the Control treatment compared to the N treatments. The leaf hydration, WI, was lower in the Control treatment compared to the N treatments.

Key findings:
1. The effect (+ or -) of the N treatments was species specific;
2. Possibly as a water saving strategy, C. ladanifer (the dominant plant species) displayed the lowest photosynthetic rates and therefore the lowest δ13C incorporation;
3. The 13C incorporation was higher in the higher N dose than in the control;
4. The 13C incorporation was influenced by the plant species and the N treatments.

Future challenges:
1. Establish a rate of C transfer to the rhizosphere taking into consideration the plant species and the N treatments;
2. Identify the soil microbial communities that are the beneficiaries of the C transfer to the rhizosphere.

References:

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