# MICROBIAL BIOMASS AND N MINERALIZATION IN MIXED PLANTATIONS OF BROADLEAVES AND NITROGEN-FIXING SPECIES

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## INTRODUCTION

- Mixed-species plantations with nitrogen fixing secondary species in abandoned agricultural lands are a cultural intensification process that can improve de performance of the broadleaf species, due to a greater availability of nitrogen in the soil provided by the accessory species, since nitrogen availability is frequently the most limiting factor for plant growth in temperate forests.
- The aim of our studies was to better understand the effects of black locust on the consociation with wild cherry. To reach this objective we measured soil microbial biomass carbon (SMB-C) and nitrogen (SMB-N) as well as the dynamic of nitrogen mineralization. We also determined the ratio of SMB-C to soil organic carbon (SMB-C/Corg) and dehydrogenase activity as indicators of soil organic matter quality or availability, and the metabolic quotient ($qCO_2$) as a measure of microbial efficiency.

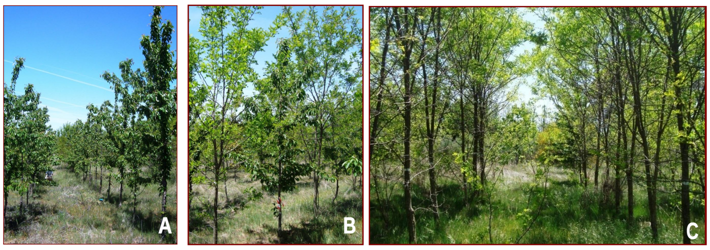


**Figure 1 -** The experimental design: A - Pure of wild cherry (PP), B - Mixture of wild cherry and black locust (MPR), C - Pure of black locust (PR).

## RESULTS

- Net N-mineralization rate were, at the end of this study, about three times greater in pure black locust than in the pure cherry and about one half times more than admixture. (Fig. 4A).
- In general, the average daily net N nitrification (Fig. 4C) rate were higher than net ammnofication (Fig. 4B) in all study periods, except for July-September in treatments PR.
- In April, microbial biomass C was significantly higher in mixed MPR than in pure cherry plantation soil. This tendency was maintained in June however there were no significant differences between treatments in this period (Table 1). The metabolic quotient ($qCO_2$) had no significant differences among the treatments.
- Dehydrogenase activity was higher in pure cherry soil (Fig. 4D), however there was no significant differences between treatments. This can be an evidence of a stress situation in pure cherry plantations.

**Table 1**. Soil microbial Biomass C (SMB-C), SMB-C /Corg and metabolic quotient ($qCO_2$) in experimental plantation, in the upper 10 cm soil layer. Means (SE)

| Treatments | SMB-C | SMB-C:Corg | $qCO_2$ | SMB-C | SMB-C:Corg | $qCO_2$ |
|---|---|---|---|---|---|---|
| | $\mu g\ g^{-1}$ soil | mg g-1 | $mgCO_2$-$Cmg^{-1}$Cmic $d^{-1}$ | $\mu g\ g^{-1}$ soil | mg $g^{-1}$ | $mgCO_2$-$Cmg^{-1}C_{mic}\ d^{-1}$ |
| | | April 2008 | | | June 2008 | |
| Pure cherry | 353.80b | 32.58a | 0.08a | 343.3a | 30.30a | |
| | (18.29) | (6.43) | (0.07) | (68.41) | (3.84) | |
| Pure black locust | 460.87ab | 41.92a | 0.251a | 359.8a | 33.58a | |
| | (39.03) | (3.18) | (0.06) | (34.39 | (4.13) | |
| Mixed MPR | 533.60a | 41.61a | 0.177a | 436.6a | 34.38a | |
| | (34.14) | (5.66) | (0.03) | (20.55) | (5.66) | |

Each value represents mean (n=4); standard errors of means are included in parenthesis. Similar letters indicate no significant difference among sites at P>0.05

## CONCLUSIONS

- These results showed a positive impact of black locust species on the net daily nitrogen mineralization and on the microbial biomass carbon, suggesting the existence of facilitation process in the mixed *Prunus avium* x *Robinia pseudoacacia* plantations.

## MATERIAL AND METHODS

- The present study was conducted in an 11-years-old trial of mixed plantation located in Uva – Vimioso (41º34'12''N; 6º30'7'' W; altitude 750 m) Northeast of Portugal.
- The experimental design includes the following treatments: pure of wild cherry, *Prunus avium* (PP); pure of a secondary N-fixing species, the black locust, *Robinia pseudoacacia* (PR), and a mixture of wild cherry and black locust (MPR) alternately in the line (intimate mixture). Each plot has 6 lines with 12 trees and a buffer strip line. The spacing is 3.5 x 2 m
- The dynamics of nitrogen mineralization was studied *in situ* in the experimental plantations from February 2008 to September 2008, using a method adapted from Raison et al. (1987). Four replicate cores per site were sampled periodically.
- Soil microbial biomass C (SMB-C) and N (SMB-N) were determined on fresh soil samples using the chloroform fumigation-extraction method (Vance et al., 1987).
- Soil respiration was measured in a laboratory incubation experiment.. Dehydrogenase activity was measured using the method adapted from Solaiman (2007)

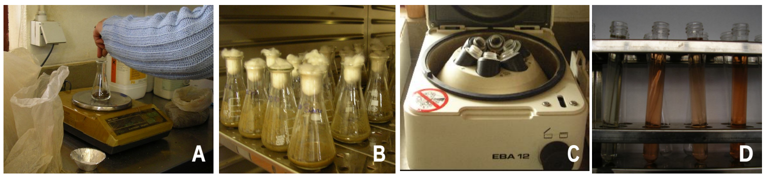


**Figure 2** – Determination of dehydrogenase enzyme: A – Weight of 5 g of soil; B - Incubation for 12 h.; C – Centrifugation and D - Color development for reading in a spectrophotometer at 464 nm.

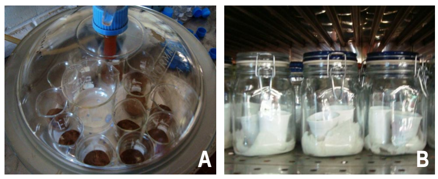


**Figure 3** – Determination of microbial parameters: A – Microbial biomass – Dessicator with soil samples and chloroform; B – Hermetically closed bottles with alkaline solution and soil samples for quantification of soil respiration.

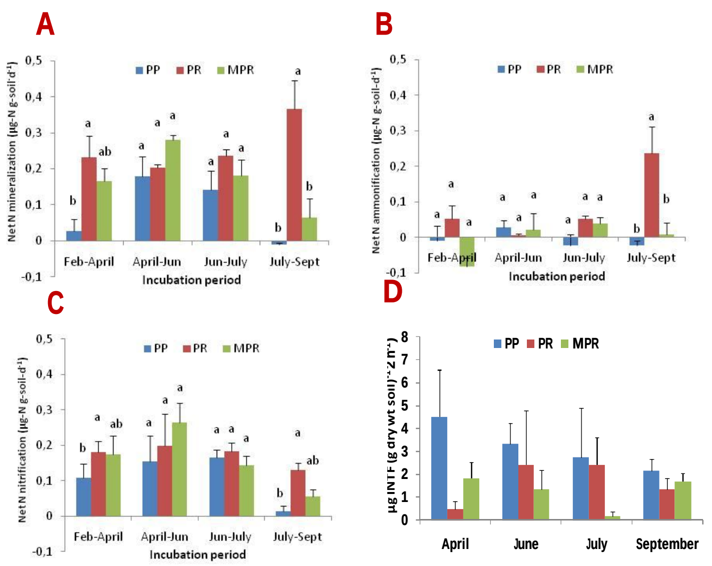


**Figure 4**. Daily average of net N mineralization (A), net ammonification (B) nitrification ($\mu$g-N g-soil$^{-1}$ day$^{-1}$) (C) and dehydrogenase activity measurements (D) in the upper 10 cm layer. Vertical bars are standard errors (n=4); Different letters, in same period, indicate that mean values differ significantly (p<0.05)

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