Influence of plant functional groups on microbial residue accumulation processes in two different soil types

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Background and research questions

We studied the influence of plant functional groups on soil microbial residues (necromass) and nutrient cycling by means of stem girdling (SG) and understory removal (UR). Bacteria and fungi play fundamentally different roles in forest ecosystems. However, little is known about the specific role of these two functional groups in different soil types in tropical Eucalyptus ecosystems.

- How does the loss of plant functional groups alter microbial residue accumulation in soil?
- What is the specific contribution of microbial residues to nutrient cycling under different soil types?

Experimental setup

- Study area - semi-arid region of Tamil Nadu state, India
- Five (E5) and fifteen (E15) years old Eucalyptus plantation - clay loam and sandy loam soils
- Two functional groups - Eucalyptus and *Andrographis paniculata*-dominated understory
- Three treatments - stem girdling (SG), understory removal (UR) and control (CL)
- Soil sampling - March 2010 in a grid design; sampling area (6×6 m)
- Microbial community composition - PLFAs; microbial residues - amino sugars

Study area - South India

Results and discussion

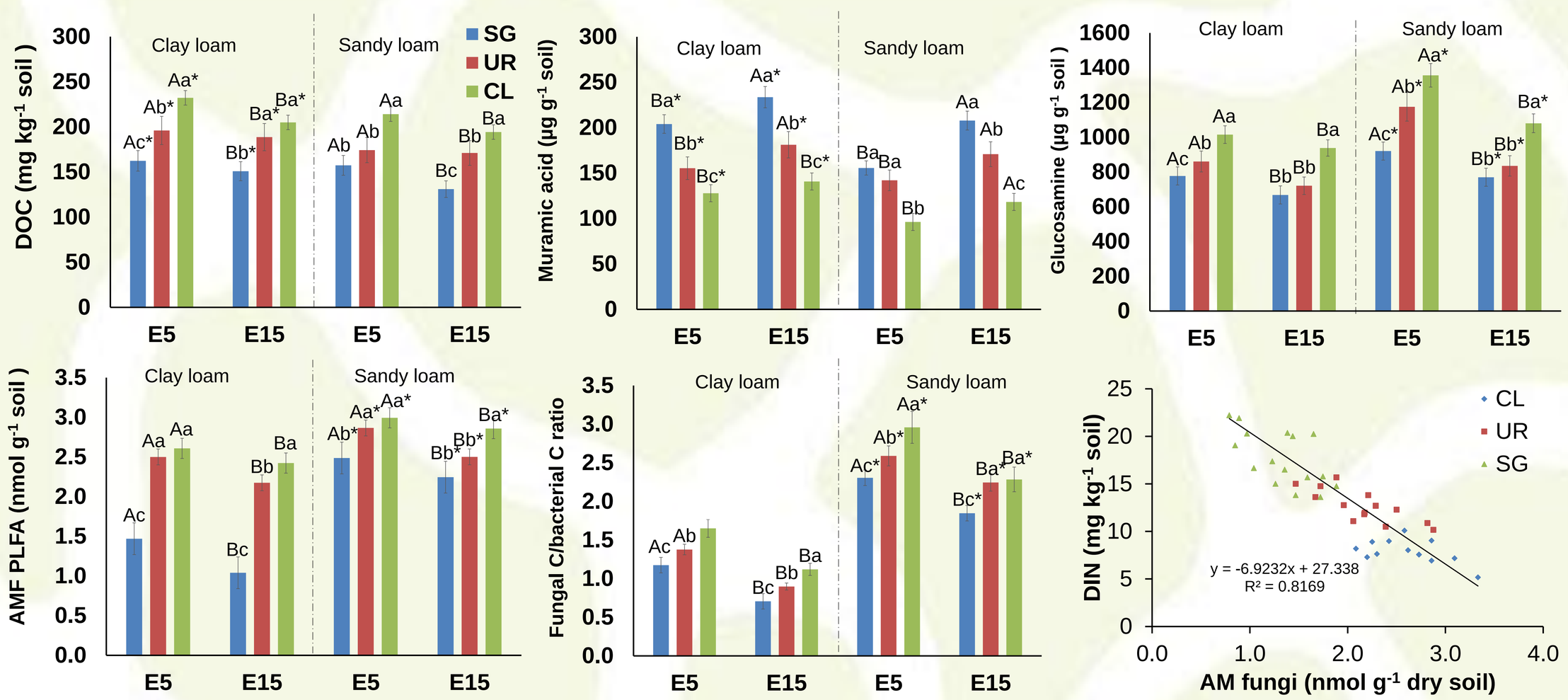

Fig. 1. Mean (a) dissolved organic C, (b) muramic acid, (c) fungal glucosamine and (d) AMF PLFA concentrations and mean (e) fungal C/bacterial C ratio in soil among three experimental treatments (SG - stem girdled; UR - understory removal; CL – control), two soil types from 5 and 15-year old plantation. Means and standard errors were calculated from n = 3 replicated plots per treatment. Different lower case letters indicate significant differences between treatments at the same stand age while different capital letters indicate significant differences between the stand age at a given treatment (Tukey's HSD test, P < 0.05). Asterisks indicate significant differences between soil types (P < 0.05). Relationships between (f) arbuscular mycorrhizhal fungal (AMF) biomass and dissolved inorganic N leaching for the three treatments n=96.

- The SG and UR treatments promoted bacterial residues in both soil types and stand ages
- The arbuscular mycorrhizal fungi (AMF) biomass and fungal C/bacterial C were significantly higher in sandy loam than in clay loam soil
- The E5 was dominated by fungi (AMF biomass and fungal C/bacterial C), while the E15 was dominated by bacterial residues
- N leaching decreased with increasing AMF biomass and Fungal C/bacterial C ratio in both stand age and soil types

Conclusions

- A reduction in labile C input through root disturbance decreased the dominance of AMF and fungal residues
- The higher nutrient availability and smaller pore size in clay loam soil might have increased accumulation of bacterial residues as compared to fungal residues
- Our study highlights the potential of microbial residues (necromass) to assess ecosystem services and disservices, such as N leaching from soil.

References and Acknowledgments

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