Minimizing the long-term effect of *Eucalyptus grandis* on soil C and N stocks in a Brazilian sandy soil with a N_2 fixing tree

Introduction

Mixed plantations of *Eucalyptus* spp. with leguminous trees can increase soil carbon accumulation, but results may vary according to structure (% of leguminous trees and spacing), aboveground growth potential, land-use history due to belowground interactions, and plantation age.

Most studies with mixed plantations in Brazil have been carried out in the 1st or 2nd rotations.

This study, however, aims to explore the long-term effects of the presence of *Acacia mangium* (acacia), a nitrogen-fixing species, on C and N stocks in a mixed plantation with *Eucalyptus grandis* (eucalyptus).

Methods

In the 3rd rotation, pure plantations of *E. grandis*, with (120 kg ha^{-1}) (E100+N) and without nitrogen fertilization (E100), and of *A. mangium* (A100), as well as a mixed plantation of both species (E50:A50), but with the same plant density per hectare (1,100 plants ha^{-1}), had their soils sampled (0–10, 10–20, and 20–30 cm depth). At the same time, a nearby *Cerrado* area was also sampled.

The samples of bulk and fractionated soils were chemically characterized by dry combustion using a Perkin Elmer 2400 CHN analyzer, after being finely ground in a mortar, for total C and N analysis (g kg^{-1}). They were also physically characterized for bulk density determination (g cm^{-3}).

Soil C stocks (Mg ha^{-1}) were calculated, correcting for soil mass (Veldkamp, 1994; Sisti et al., 2004). Subsamples from each layer were subjected to physical fractionation of soil organic matter (Cambardella and Elliott, 1992).

The attributes (C and N contents and stocks of the layers and fractions) were subjected to ANOVA and Tukey test (5% probability).

Conclusion

Rotation with acacia and mixed planting may bring benefits to the management of *Eucalyptus* spp. monocultures. It is expected that the rotation of *E. grandis* with *A. mangium* will increase soil C and N stocks in sandy-textured soils, due to the N_2 fixation capacity of *A. mangium*. Although the consortium of these species does not lead to an increase in N stocks after four rotations, the higher C content in the MOAM fraction indirectly demonstrates the contribution of N to a more efficient stabilization of C.

Results and discussion

Table 1: Total soil C and N stocks (Mg ha^{-1}) in each treatment.

Treatment	C stocks	N stocks
	Mg ha^{-1}	
E100	31,55 b	1,90 b
E100+N	34,21 ab	1,94 b
E50:A50	33,20 ab	1,86 b
A100	39,51 ab	2,37 a
CE	49,07 a	2,66 a

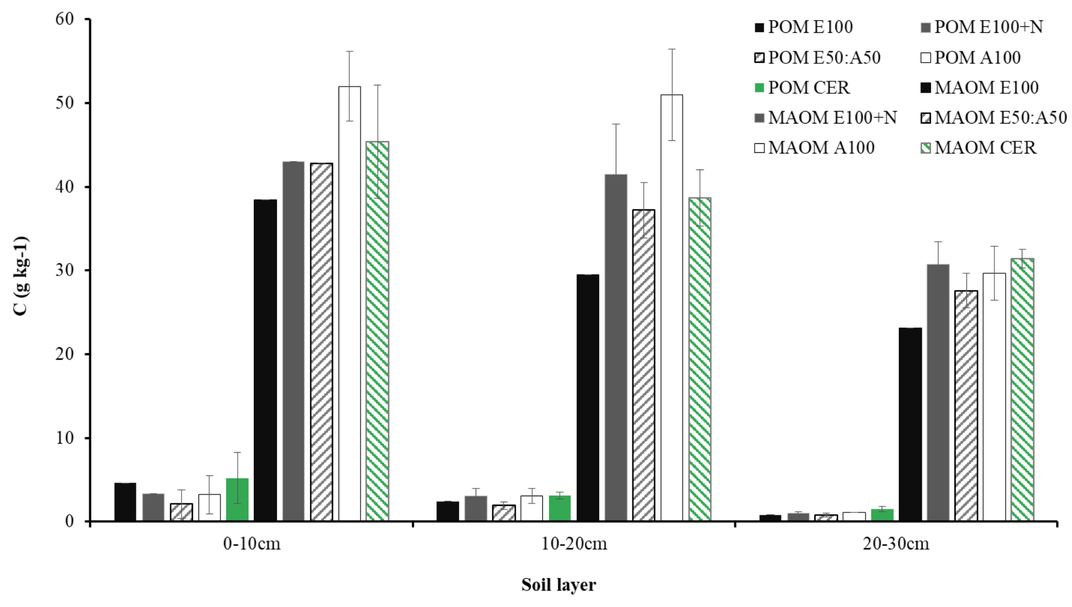

Figure 1: C content of particulate organic fractions (POM) and those associated with soil minerals (MOAM) from the surface layers of pure plantations of *Eucalyptus urograndis* (E100 and E100+N) and *Acacia mangium* (A100) and mixed species (E50:A50), and from native *Cerrado* areas (CER), in the third rotation.

- Compared to the reference C stock (0-30cm) of the Cerrado soil (49.2 Mg ha^{-1}), all treatments reduced the C stocks, with E100 causing the greatest loss (preserving 64% of the stock) and A100 the least one (preserving 80%). Regarding the soil N stock, A100 preserved 88%, while E100 preserved 71% of the original N stock found in the Cerrado soil (0.27 Mg ha^{-1})
- Despite the low clay content (140-160 g kg^{-1}) of the soil, total organic C predominated in the fraction associated with minerals (~94%);
- Soils from A100 exhibited the highest C contents in the MOAM fraction;
- The mixed planting showed the lowest average C content in the MOP across all depths, with intermediate values for MOAM.

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