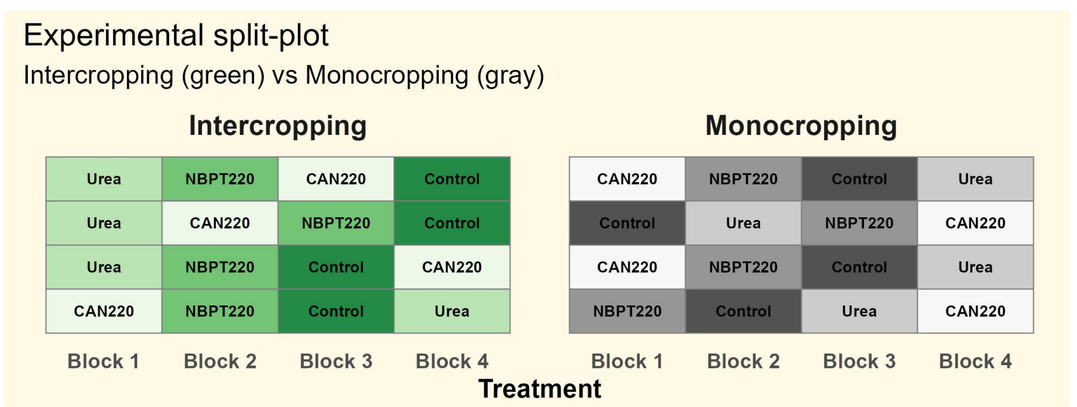
Carbon Sequestration And Organic Fractions In A Maize Silage And Brachiaria Intercropping System In Tropical Soil

Introduction

Agricultural soils play an important role in the global carbon cycle, particularly in tropical regions where rapid organic matter turnover accelerates soil carbon loss. In Brazil's Cerrado biome, long-term monocropping has led to significant declines in soil organic carbon (SOC). Intercropping maize with *Urochloa ruziziensis* is emerging as a promising strategy to increase belowground C inputs and improve soil health. This study tested the effects of intercropping and different nitrogen (N) fertilization regimes on carbon fractions and microbial activity in a Typic Hapludox.

Methods

The experiment was conducted in southeastern Brazil:



Measured indicators: Soil biological (MBC, BR, qCO_2, FDA); Physical (bulk density); Organic carbon (total C, light fraction); Silage yield. The data underwent analysis through ANOVA ($\alpha = 0.05$) and Tukey's test & PCA was used to evaluate multivariate responses.

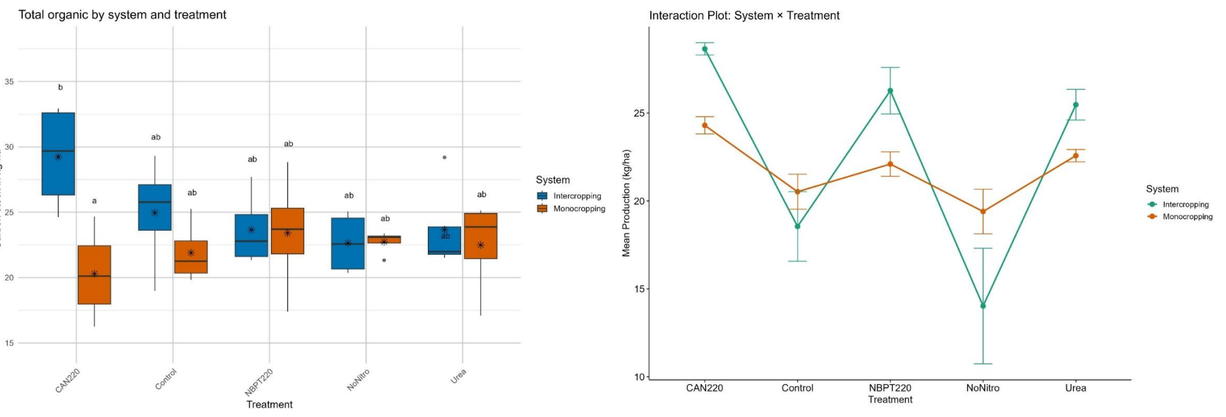
Results and discussion

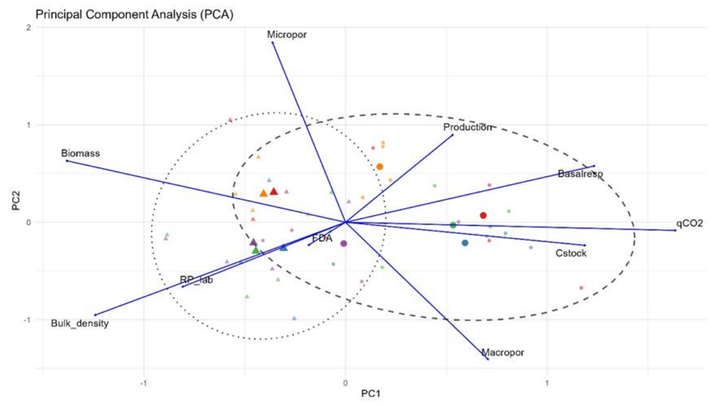
Table 2 - Two-way ANOVA summary for microbial and carbon variables.

Variables	*System p-value*	*Treatment p-value*	*Interaction p-value*	*Shapiro p-value*	*Levene p-value*
Microbial Biomass carbon	0.0055**	0.5344	0.9433	0.5782	0.7815
Basal respiration	<0.0001***	<0.0022**	0.0033**	0.8865	0.2537
Microbial metabolic quotient	<0.0001***	0.4523	0.2818	0.298	0.4361
Fluorescein diacetate activity	0.7366	0.2311	0.0694	0.7111	0.059
Carbon stock	0.021*	0.803	0.082	0.3819	0.8026
Light-fraction organic carbon	<0.0001***	0.1706	0.0209*	0.0499*	0.3151

Notes: Significance levels: *p < 0.05, **p < 0.01, ***p < 0.001. Shapiro-Wilk test assesses normality of residuals; Levene's test assesses homogeneity of variances.

Letters in box-and-whisker plots (Figures 6–9) reflect Tukey–HSD groupings at $\alpha = 0.05$ and are shown only where the omnibus F-test indicated a significant effect.





Microbial activity: Intercropping increased basal respiration (+48%) and qCO_2 (+89%) without increasing MBC → higher microbial turnover.

SOC trends: Slightly higher SOC in surface soil with intercropping, especially under CAN. Light fraction C declined (likely enhanced mineralization).

Silage yield: Intercropping was more responsive to N form. CAN and NBPT led to 8–12% higher yields than conventional urea.

PCA: Nitrate-based and stabilized N fertilizers under intercropping clustered with indicators of better soil structure and microbial function.

Conclusion

Intercropping reduces organic matter loss and improves soil resilience, supporting sustainable agriculture and aligning with SDGs 2, 13 and 15. Despite the short study duration, results highlight its potential for carbon mitigation, underscoring the need for long-term research on stabilization processes in tropical soils.

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