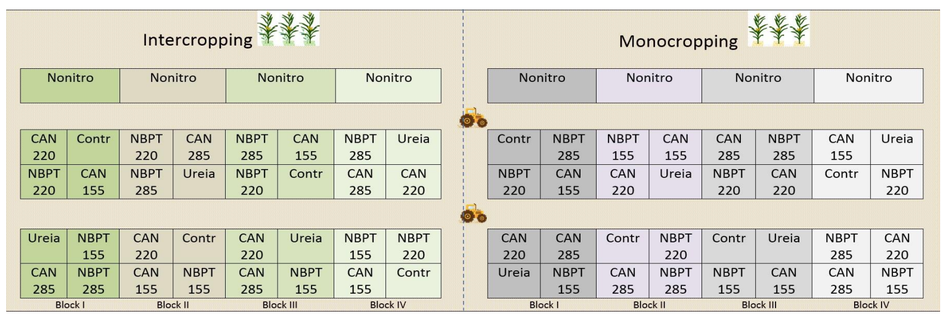
# Integrating Corn–brachiaria Intercropping For Enhanced Soil Carbon Sequestration And Sustainable Agriculture In The Cerrado

## Introduction

Corn silage systems in Brazil's Cerrado face rapid soil degradation due to organic matter loss and poor nitrogen management. This study evaluated whether intercropping corn with *Brachiaria ruziziensis*, combined with targeted nitrogen fertilization, can improve soil structure, increase carbon stocks, and enhance microbial activity, while sustaining high yields. Conducted over two seasons on a tropical Oxisol, the research integrated soil health indicators and multivariate analysis to assess the potential of intercropping as a regenerative, climate-resilient farming strategy.

## Methods

*The field experiment was conducted on a Typic Hapludox in Nazareno, MG/Brazil. The study compared 2 cropping systems: monocropped corn and corn intercropped with Brachiaria ruziziensis. Data were analyzed using ANOVA ($\alpha$ = 0.05) and Tukey's test.*

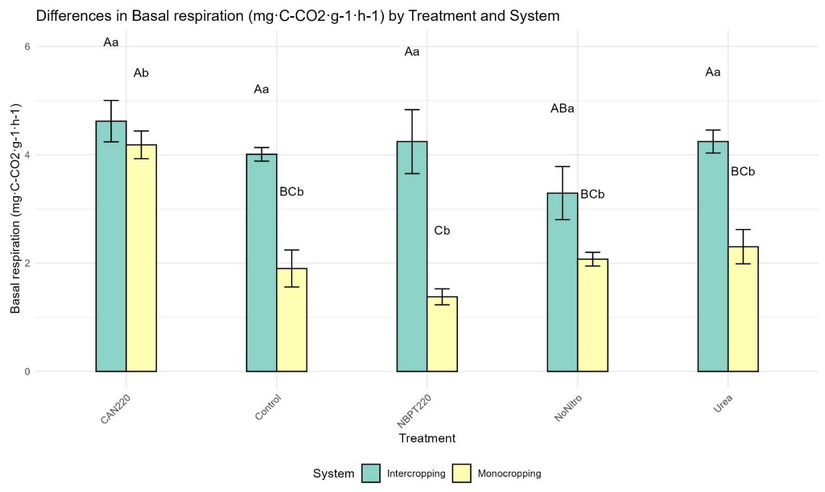


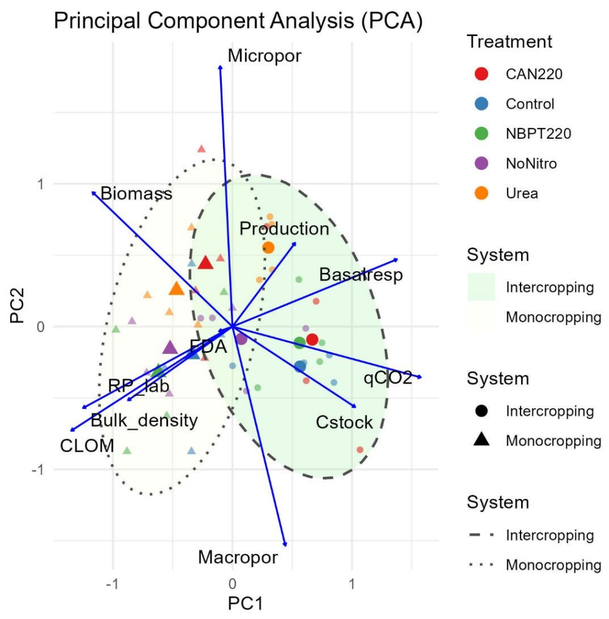

## Results and discussion

*Table 1: Three-way ANOVA for soil physical variables (n = 4 blocks × 5 treatments × 2 systems = 40 experimental units; repeated depths per unit, df = 1,20 for fixed effects).*

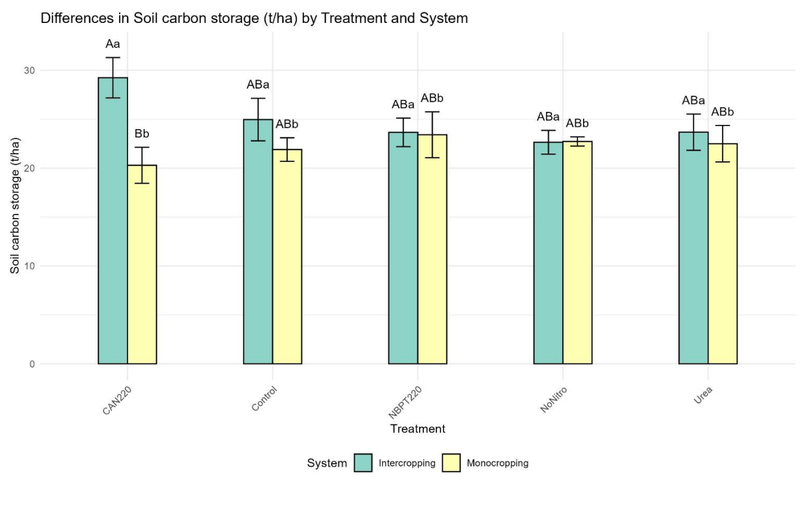
| *Effect* | *Bulk density* | *Penetration resistance* | *Microporosity* | *Macroporosity* | *SE Bd (g cm⁻³)* | *SE PR (MPa)* | *SE MiP (%v/v)* | *SE MaP (%v/v)* |
|---|---|---|---|---|---|---|---|---|
| ***Cropping system*** | $F_{1,20} = 4.6$, $p = 0.044$ * | n.s. | n.s. | n.s. | 0.026 | 0.212 | 0.75 | 1.02 |
| ***Nitrogen treatment*** | n.s. | n.s. | n.s. | n.s. | 0.026 | 0.212 | 0.75 | 1.02 |
| ***Depth*** | $F_{1,20} = 11.7$, $p = 0.0027$ ** | n.s. | $F_{1,20} = 67.2$, $p < 0.0001$ *** | $F_{1,20} = 8.8$, $p = 0.0077$ ** | 0.026 | 0.212 | 0.75 | 1.02 |
| ***Interactions*** | all n.s. | | | | | | | |

*Because interaction terms were non-significant, we interpret marginal means pooled over treatments or depths as appropriate.*




*Intercropping with Brachiaria significantly improved soil health compared to monocropping, increasing surface soil carbon stock (up to 9.6 t/ha with CAN) and boosting microbial activity, as shown by higher basal respiration (up to 89%) and $qCO_2$ values.*




✓ *PCA linked intercropping to high basal respiration, carbon, and yield. Intercropping also reduced bulk density, while nitrogen source did not affect soil physical properties.*

## Conclusion

The corn–Brachiaria intercropping system, combined with strategic nitrogen use, offers a viable path toward regenerative agriculture in the Cerrado. It supports high yields while improving soil health and carbon sequestration, aligning with SDGs 2 and 13. This approach bridges productivity with sustainability and promotes long-term climate resilience.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