Impacts of Legacy and Contemporary Nitrogen Inputs on N_2O and CO_2 Emissions in *Miscanthus* and Maize Cultivated Soils

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Background/Objective

- Perennial bioenergy crops such as *Miscanthus x giganteus* (Mxg) are attractive due to their high yields and low fertilizer input requirements.
- However, better understanding of the trade-offs between economic (yield) and environmental (nutrient and greenhouse gas emissions) factors is needed to optimize management.
- This study aims to better understand the impacts of historical and contemporary fertilizer application on Mxg nutrient cycling in comparison to maize.

Approach

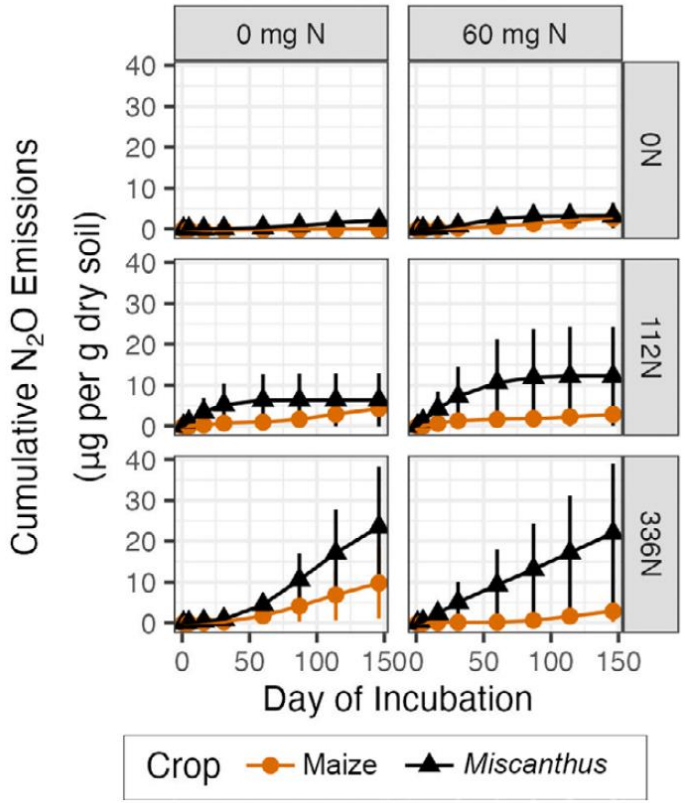
Mxg and maize soils were collected in 2020 from plots planted in 2015 and maintained with annual fertilizer application rates of 0, 112, and 336 kg N ha^{-1} y^{-1}. Two N amendment treatments (0 and 60 mg N kg^{-1}) were applied to a full factorial soil incubation experiment from which greenhouse gas emissions, net N mineralization, and nitrification rates were quantified. Incubations were subsampled to quantify bacterial N cycling genes.

Results

Mxg soils had significantly increased cumulative N_2O emissions relative to maize soils, particularly at higher legacy fertilization rates, while contemporary N had no significant effect. Bacterial *amoA* gene abundance, which plays a significant role in nitrification in nutrient-rich soils, also increased with higher legacy fertilization rates in Mxg soils but was unaffected by contemporary N. In maize soils, legacy and contemporary N did not significantly affect N_2O emissions. However, cumulative CO_2 emissions were significantly influenced by the interaction of incubation day and legacy N fertilization, and *amo*A gene abundance increased significantly with legacy N but was unaffected by contemporary N.

Significance/Impacts

These findings demonstrate the greater importance of fertilization history over contemporary N in mediating soil N_2O emissions, particularly for perennial crops.



Cumulative N_2O emissions across contemporary (0, 60 mg N) and legacy (0, 112, 336N) treatments for Mxg and maize.

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