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Biochar: Production, Characterization and Applications

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Effect of biochar addition on carbon dioxide and nitrous oxide emissions from a temperate agricultural soil

Maren Oelbermann
University of Waterloo, Canada

Effect of biochar addition on carbon dioxide and nitrous oxide emissions from a temperate agricultural soil

M. Mechler, M. Oelbermann*: University of Waterloo

R.P. Voroney: University of Guelph

K. Reid: Agriculture and AgriFood Canada

C. Brown: Ontario Ministry of Agriculture, Food & Rural Affairs

INTRODUCTION

- Amending agricultural soils in temperate locations with bichar is a more recent approach
- Research still in its infancy
- Knowledge gap remains on the effect of biochar on GHG emissions
- Most GHG emissions studies to date conducted over the short term (4 months or less)
  - Field and laboratory
- Short-term studies do not capture temporal variation in GHG emissions

OBJECTIVES

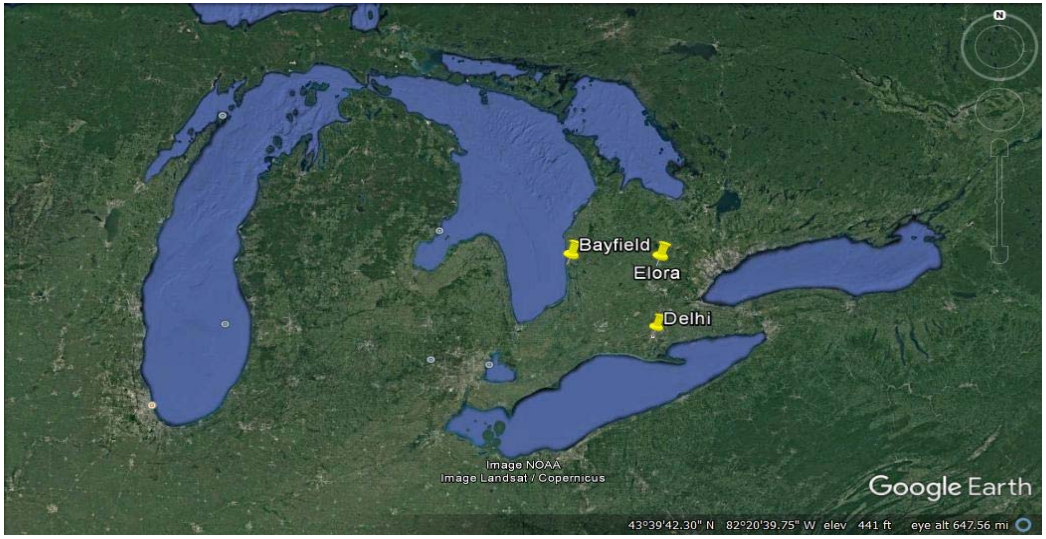
To evaluate soil CO_2 and N_2O emissions in a conventional agricultural production system amended with biochar and under a maize (*Zea mays*) crop in southern Ontario

STUDY SITE

- Bayfield, ON
  - 43°34'45"N, 81°39'48”W

- Commercial poultry farm

- Maize-soybean rotation
  - Addition ofp oultry manure on 3-year rotation
  - Poultry bedding: switchgrass
  - Addition of 135 kg N/ha in years maize is produced



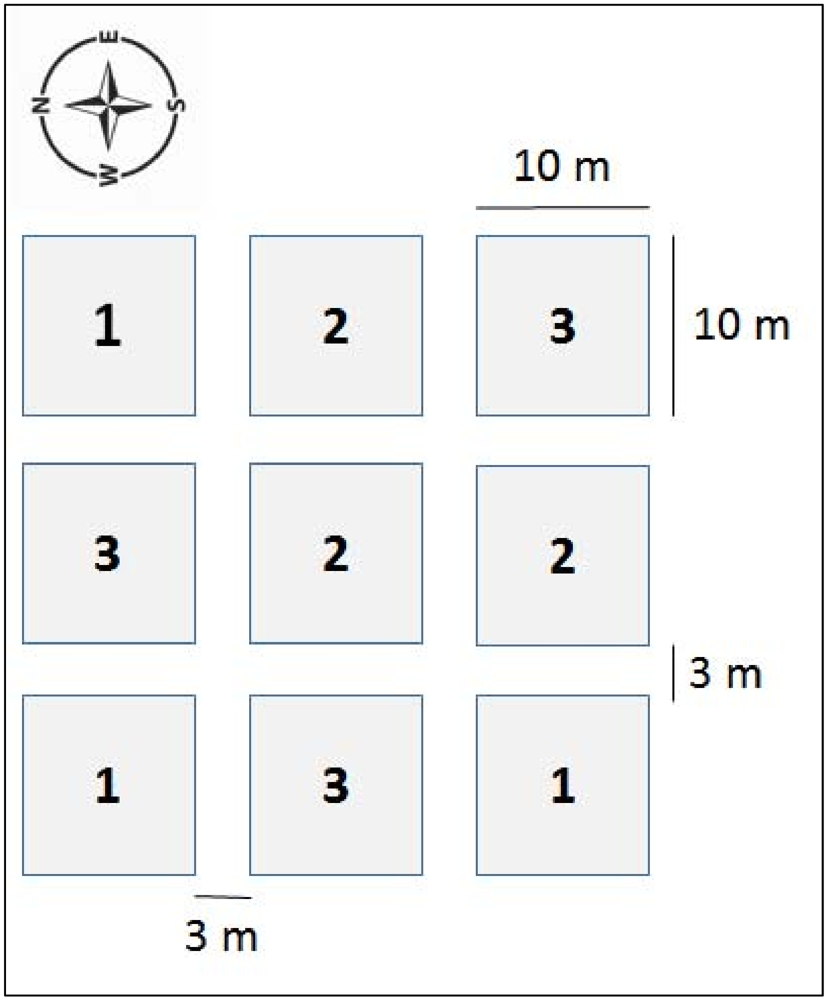
Soil

Grey-brown Luvisol
(Light) loam texture

Site

247 masl
1.5 % slope

Experimental Design



Randomized complete block design with three treatments and three replications.

Treatment 1 (M+N): 6t/ha poultry manure plus 150 kg/ha N fertilizer.

Treatment 2 (M+B): 3t/ha poultry manure plus 3 t/ha biochar.

Treatment 3 (M+N+B): 3t/ha poultry manure, 3 t /ha biochar, 150 kg/ha N

METHODS

- Bi-weekly GHG collection
  - May to November 2016
  - Static chamber (2 chambers per treatment replicate)
  - T=0, 15 & 30 mins
- Bi-weekly
  - Soil temperature
  - Soil moisture
  - Soil samples (NH_4 & NO_3)
- GHG analysis on Agilent gas chromatograph
- Soil moisture & temperature using WET sensor
- N-fraction analysis using UV-Vis Spectrophotometry

BIOCHAR USED IN THIS STUDY

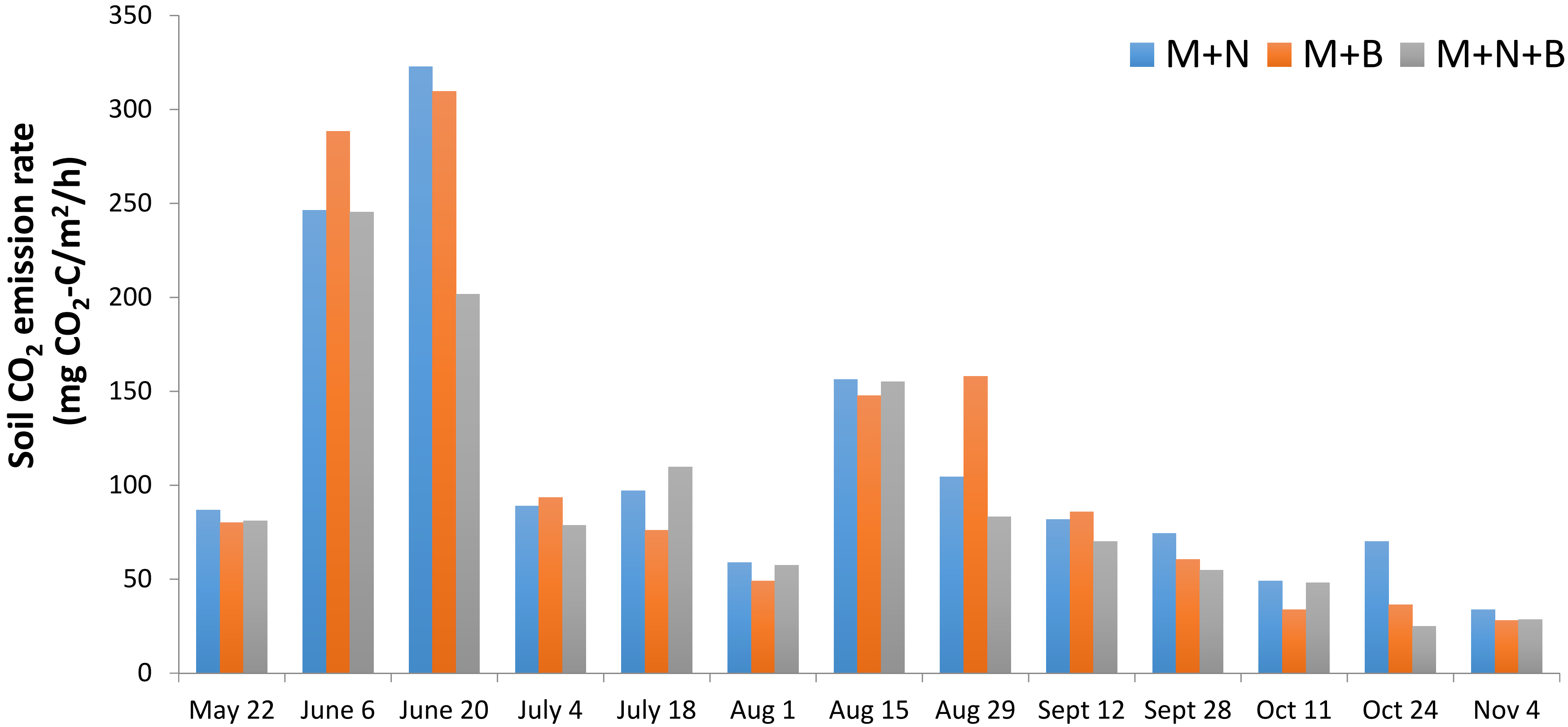
- Mayan Gold Biochar
  - Titan Carbon Smart Technologies
  - Spruce-Pine mix

Biochar Composition

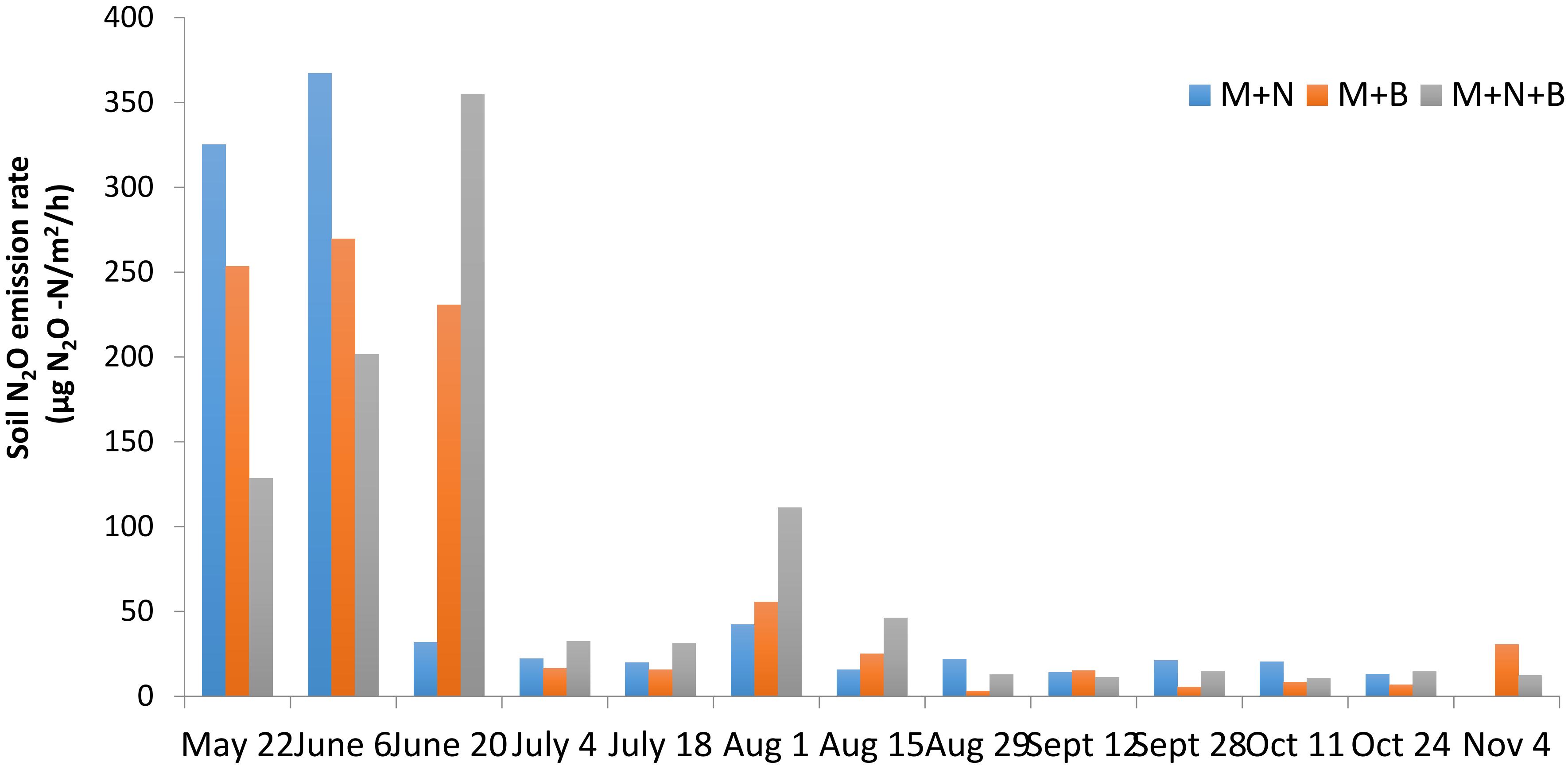
Carbon Content	80%
Ash Content	12%
pH	7.2
Nitrogen	1500 ug/g
Phosphorus	500 ug/g
Potassium	7000 ug/g

Non-toxic, neutral pH, high carbon content, high surface area, low nutrients, trace metals and micro-nutrients, user friendly (low dust).

Results: CO_2 Emissions



Soil N_2O Emissions



Mean CO_2 and N_2O emissions from May to November 2016

Treatment	CO_2 Emissions ($mg\ CO_2$-$C/m^2/h$)	N_2O Emissions ($\mu g\ N_2O$-$N/m^2/h$)
M+N	113	76
M+B	111	57
M+B+N	95	71

No significant differences among treatments

Correlations

	Moisture	Temperature	NH_4	NO_3
CO_2	-0.240**	0.482**		
N_2O	0.433*	0.364*	0.386**	0.360**

*Significant at p=0.05

**Significant at p=0=0.01

Conclusions

- Biochar addition did affect GHG emissions
  - Treatments containing biochar showed a trend of lower GHG emissions (but was not significant)

- Significant correlation for all treatments
  - Very strong correlation between CO_2 emissions and soil moisture for all treatments
  - Strong correlation between N_2O emissions and soil moisture for all treatments
  - Very strong correlation between N_2O emissions and soil NH_4 and NO_3 content

- Further sampling (second season) currently underway
  - This study will have three years of GHG data once completed (2016 under corn, 2017 under soybean and 2018 under corn)

- Long-term studies necessary to determine temporal variation in GHG and how this correlates to fluctuations in soil temperature and N

Acknowledgements

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