Influence of Biochar Amendment on Greenhouse Gas Production in Two Fertilized Prairie Soils

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INTRODUCTION

• The utility of biochar to improve numerous soil physical, chemical, and biological properties (e.g., bulk density, cation-exchange capacity, pH, microbial community activity, etc.) is well known.

• However, previous research has concentrated on tropical soils (old and highly-weathered, acid pH, low organic matter content and fertility), while the influence of biochar application on the relatively young and fertile soils of Saskatchewan is largely unknown.

OBJECTIVE

• Determine the effect of a willow (Salix) biochar soil amendment on the measured N2O, CO2, and CH4 emissions from two Prairie soils having contrasting organic matter content, with and without fertilizer N addition, over a six-week incubation period.

MATERIALS & METHODS

• Orthic Black Chernozem (Meota Association) and Brown Solodized Solonet (Kettlehut Association) loam soils were sampled from the Ap horizon, dried, and thoroughly homogenized prior to use.

• Treatments: control; willow biochar (20 Mg/ha), produced using slow pyrolysis (300-600 °C); urea (100 kg/ha); biochar plus urea.

• Pots were maintained at 75 °C field capacity and incubated (20 °C) for six weeks.

• Variables measured included: PRS™-probe NO2-/N and NH4+/N supply rates, along with weekly N2O, CO2, and CH4 emissions.

RESULTS

• The ability of biochar to decrease soil N availability in the Brown soil by the end of the incubation, with or without fertilizer N, may be due to immobilization by adding a biochar with an 82 and < 1 % carbon and nitrogen content, respectively. Conversely, the initially higher soil N supply in the Black soil with biochar plus urea compared to urea only was surprising and could reflect an enhanced urea hydrolysis in the presence of biochar and/or enhanced biochar N release caused by the fertilizer.

• The decreased N2O emissions following biochar addition, with (both soils) or without (Black soil) fertilizer N, is likely due to its influence on soil N availability.

• The capacity of biochar to make both soils stronger CH4 sinks could result in part from the production of a more favourable environment for methanotrophic bacteria activity.

• The lack of differences in CO2 fluxes, with or without fertilizer N, suggests that the biochar effect on N2O and CH4 fluxes may be largely the result of its influence on soil enzyme activity.

• Further research is required comparing biochars with different physical/chemical properties (e.g., C:N, surface area, CEC, etc.), along with studies verifying the operative processes.

DISCUSSION & CONCLUSION

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Figure 1. Mean (n = 5) cumulative total N (N2O-N+NH4+/N) supply rates and N2O, CO2, and CH4 fluxes during a six-week incubation following willow biochar addition (20 Mg/ha) to soils having contrasting organic matter content, with and without fertilizer N (100 kg/ha). Total N supply rates (within week) and gas fluxes with the same letter are not significantly different (P >0.05) using LSD.