EFFECT OF BIOCHAR ADDITION ON CARBON DIOXIDE AND NITROUS OXIDE EMISSIONS FROM A TEMPERATE AGRICULTURAL SOIL

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Amending intensively managed temperate soils with biochar is a more recent approach to agriculture, with research is still in its infancy. A knowledge gap remains on the effect of biochar on greenhouse gas (GHG) emissions, as most studies conducted to date were short-term (<4 months) in the field or used laboratory incubations; neither of which capture temporal variations in emissions. Therefore the objective of this study was 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, Canada. The treatments include: poultry manure (6 t/ha) and nitrogen fertilizer (135 kg/ha) (MN); manure (3t/ha) and biochar (3t/ha) (MB); and manure (3 t/ha), fertilizer (135 kg/ha) and biochar (3 t/ha) (MNB). Results show that after the first year of biochar addition, CO_2 emissions were not significantly different ($P<0.05$) among treatments with values ranging from 113 mg CO_2-$C/m^2/h$ in the MN treatment to 111 mg CO_2-$C/m^2/h$ and 95 mg CO_2-$C/m^2/h$ in the MB and MNB treatments. However, CO_2 emissions were significantly different among seasons, with the greatest emissions occurring in the spring, followed by the summer and autumn. Although the MB treatment had lower N_2O emissions (57 µg N_2O-$N/m^2/h$) compared to the MN (76 µg N_2O-$N/m^2/h$) and MNB (71 µg N_2O-$N/m^2/h$) treatments, these differences were not significant ($P<0.05$). However, N_2O emissions were significantly greater ($P<0.05$) in the spring compared to the summer and autumn. Correlation analysis showed that CO_2 emissions were significantly negatively correlated ($P<0.05$) to soil moisture ($r^2=0.0004$), and significantly positively correlated ($P<0.05$) to soil temperature ($r^2=0.232$). N_2O emissions were significantly (positively) correlated ($P<0.05$) to soil moisture ($r^2=0.004$), temperature ($r^2=0.055$), and soil NH_4^+ ($r^2=0.114$) and NO_3^- ($r^2=0.103$) in all treatments. Results suggest that after the first year of biochar addition, GHG emissions were similar or lower (MB and MNB treatments) compared to the conventional (MN treatment) agroecosystem management practices without biochar.