N_2O, CO_2 E CH_4 EMISSIONS FROM SOIL DURING AGRO-BIOFUEL PRODUCTION IN SÃO PAULO STATE, BRAZIL

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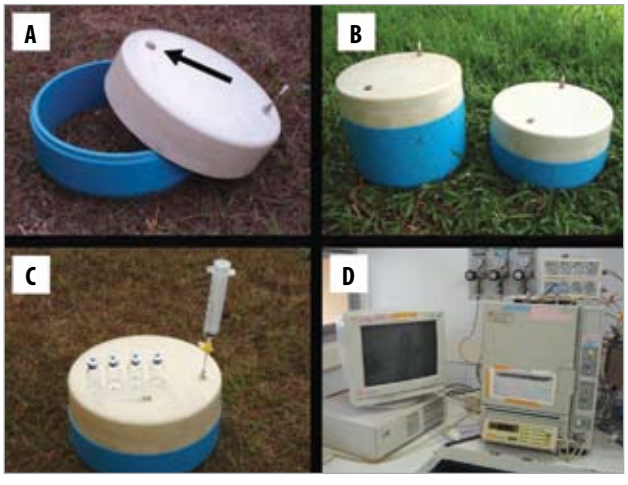

Figure 1. Chambers used for the collection of N_2O, CO_2 and CH_4 (A,B) showing flasks utilized for the storing the samples (C), details of the orifice that equilibrates the internal and external pressures of the chamber (A - arrow) and collection of the sample utilizing a 60 ml syringe (C) and gas chromatograph equipment (D)

Brazil is the world's largest producer of sugarcane, with an annual crop yield of over 470 x 106 metric tons in 2006-2007, planted in approximately 7 million ha. About half of sugarcane in Brazil is planted in the state of São Paulo, where sugarcane is the main agricultural product and contribute to about 27% of the state's GDP.

With about half of the global ethanol production, Brazil is already the largest contributor in the international ethanol trade. Yet, production is predicted to continue to expand due to geopolitical instability in oil producing countries and an increasing commitment from developed countries to the Kyoto Protocol to reduce emissions of carbon dioxide and other green house gases.

According to estimates from models and numerical analyses, Brazilian ethanol ranks among the best biofuels in terms of net energy produced for the amount of fossil fuel used in the production and, consequently, of CO_2 emitted. Also, sugarcane crops in Brazil grow with less nitrogen fertilizers than other biofuel crops, such as corn, which results in lower levels of nitrous oxide, a potent green house gas, during the production of Brazilian ethanol. However, the lack of real measurements and actual data about emissions of green house gases (GHG: N_2O, CO_2, CH_4) associated with the production ethanol in Brazil hinders our capacity to properly quantify its effectiveness at reducing emissions of GHG. Studies estimates that soil emissions of GHG, which are not associated with the consumption of fossil fuels, account for more than 50% of the total emissions. Meanwhile, *in situ* estimates of nitrous oxide ($N\text{-}N_2O$) emissions from fertilizer application in sugarcane fields in Brazil are in the order of 1%. If confirmed with further *in situ* measurements in a more comprehensive study, these low GHG emission can have important implications for the sugarcane industry in Brazil. In this project, we propose to determine *in situ* emission of GHG from soils, according methodology presented in *Figure 1*, planted with sugarcane in the state of São Paulo during its productive cycle to improve and expand existent estimates. *In situ* measurements of GHG in Brazilian sugarcane fields are practically non-existent, probably because N losses from fertilizers as N_2O ($N\text{-}N_2O$) are assumed to be insignificant in comparison to other losses, and because fossil fuel use during sugarcane production is low because much of the management practices in Brazil rely on manual labor. With eminent changes about to occur in the sugarcane ethanol industry in Brazil, these assumptions need to be revised and new data collected to guarantee the low emission.

SUMMARY OF RESULTS TO DATE AND PERSPECTIVES

According to estimates of GHG emissions generated from the burning of agricultural residues in Brazil since 1994, sugarcane accounted for about 97% of the emissions. However, the lack of field data and measurements from different systems of agricultural production create large uncertainties in emission calculations.

In this project, we expect to produce a complete assessment of GHG emissions from soils in sugarcane crops in the state of São Paulo. By evaluating the variability of emissions as a function of management practices and climatic variation during measurements, we also expect to determine the hot spots and hot times for GHG emission during the sugarcane crop cycle so that strategic plans can be targeted to minimize these emissions.

Overall, we plan to produce reliable and realistic data on GHG emissions from sugarcane soils in São Paulo in order to calibrate and validate soil emission models that can be used to estimate emissions of GHGs from sugarcane plantations. By improving present estimates, predictions of the GWP of ethanol produced in Brazil can be properly assessed and compared to other forms of biofuels. We understand the complexity of representing the wide range of conditions for GHG emissions from the approximately 140 sugarcane mills in the state of São Paulo, where sugarcane grows under different management practices, climatic conditions, and soil types. However, by including different experimental treatments with a wide range of management practices and rates of fertilizer application and use of agricultural waste, we should be able to address the complexity of the system.

MAIN PUBLICATIONS

Chiaradia JJ, Chiba MK, Andrade CA, Carmo JB, Oliveira A, Lavorenti A. Chiaradia JJ. 2009. CO_2, N_2O and CH_4 fluxes in a ultisol treated with sewage sludge and cultivated with castor bean. *Revista Brasileira de Ciência do Solo*. **33**:1863-1870.

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Carmo JB, Keller M, Dias J D, Camargo PB, Crill P. 2006. A source of methane from upland forest in the brazilian Amazon. *Geophysical Research Letters*. **33**:1-4.

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