Site-Specific N_2O Emission from Soil Related to the Addition of Sugarcane Residues

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INTRODUCTION

Improved information on greenhouse gas (GHG) emissions and mitigation potential in the sugarcane sector is necessary to manage these emissions and identify responses that are consistent with the status of economically and environmentally friendly source of energy (do Carmo, *et al.*, 2012). The sustainability of the sugarcane industry in the production of renewable energy requires efficient use of inputs and nutrient cycling in the production system, aiming reduction and mitigation of environmental impacts and GHG emissions (Goldemberg , 2007; Lisboa, *et al.*, 2011).

In the sugarcane sector, GHG emissions from the agricultural system originate from several sources, the most important being: a) conversion or land use change and its effects on C and N stocks of ecosystems; b) fertilization and irrigation; c) management of waste, including burning before harvesting; and d) operations in planting. Decomposition of industrial and agricultural waste such as straw and sugarcane vinasse contribute to 29% of GHG emissions resulting from the formation N_2O and CO_2, while another 10-20 % correspond to emissions of CO_2 and N_2O by the use of nitrogen fertilizers (Figueiredo, et al., 2010).

In Brazil, as manual harvesting is been gradually substituted by mechanized methods, the sugarcane crop residue left on the soil surface is increasing (do Carmo *et al.*, 2012). The maintenance of the crop residues in the field, increase the organic matter content of the soil and creates favorable conditions for the establishment of a microclimate in those areas, since no abrupt changes occur in the temperature and humidity of the soil, favoring the establishment of a biological community that decompose straw, and allowing the reuse of nutrients. Concerning conservation management practices, the ideal amount of crop residues to be left on the field is still unknown, which can differ regarding soil characteristics, environment, and sugarcane variety. However, the maintenance of the straw in the field can change the GHG flow, which may have important reflection on global carbon and nitrogen equivalent system.

Despite the importance of the subject, data are still limited and controversial related to the interaction between sugarcane residue left on the field and the emission of N_2O from fertilized soil (Figueiredo, et al., 2010). Thus, an understanding of how fertilization and different levels of trash interfere in the GHG emissions, to arrive at a consensus emission factors for the sugarcane sector, is vital to the overall carbon balance in ethanol production and can be decisive for an international acceptance of this fuel in the short and medium term.

METHODS

The gas samples were collected during the 2012/2013 cropping seasons, from a commercial sugarcane field in Araras, São Paulo state, Brazil, planted with the RB-845210 sugarcane variety in the 4th cut, grown in soil classified as a clayed Oxisol. In the ratoon cane experiment, the influence of 12.8 ton ha^{-1} accumulate crop residues left on the field was compared to a control plot, without residue. After the residue material was placed onto the soil, the experimental plots were fertilized with 100 kg N ha^{-1} (ammonium nitrate). Gas samples were collected every other day after fertilizer application since the middle of November. Samples were collected using PVC chambers installed in the experimental plots, according to the chamber technique described by Davidson & Schimel (1995) and Allen *et al.* (2010).

RESULTS AND DISCUSSION

As expected, daily fluxes of N_2O in plant cane varied among treatments (Fig. 1), increasing in the first month after the fertilizer application, decreasing exponentially to near background after this period. N_2O daily fluxes with the addition of crop residue were higher than the control plot, without sugarcane trash.

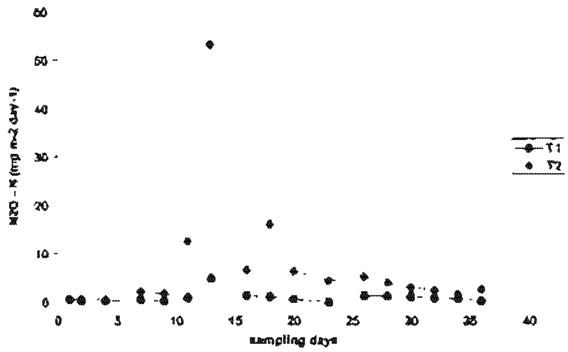

Fig. 1. Daily mean fluxes of N_2O measured in ratton cane with crop trash left on the soil surface. (T1) no crop residues and (T2) 12.8 ton ha^{-1} of crop residues

CONCLUSIONS

The study found higher N_2O emission associated with the amount of crop residue left on the soil surface for the specific site studied. Therefore, more studies are needed to provide information for managing residue accumulation in sugarcane fields for soil conservation and restoration.

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