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Sugarcane agriculture expansion in Brazil: nitrous oxide emissions as a consequence of synthetic fertilizer applications.

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Sugarcane is a bioenergy crop widespread in Brazil to be responsible to supply ethanol as an alternative source for fossil fuels consumption. As the highest sugarcane producer in the world, Brazil has been observed the consequences of the increased demand for ethanol: sugarcane crops are expanding mainly toward Brazilian Midwest. Such region has extensive low-intensity pastures in which livestock is carried out. Livestock to meat production is also relevant to Brazilian economy, hence, it is expected an increase of high-intensity pasture to compensate sugarcane expansion. Furthermore, soils of low-intensity pasture are often cited as carbon sinks with low greenhouse gases emission rates, in this agricultural ecosystem emission dynamics may be alter since for land use change from low-intensity pasture to sugarcane it is necessary tillage and fertilization. Thereby, researchers are trying to understand if the sugarcane sustainable life cycle could be affect by it expansion to pasture areas. Taking to account the above mentioned a field experiment was set up in São Paulo State to quantify N_2O fluxes and estimate emission factors in sugarcane over four years, as well as, in low-intensity and fertilized pasture due synthetic fertilizer applications. Treatments were sugarcane with (S_{+F}) and without (S_{-F}) fertilizer, low-intensity pasture (P_{LI}) and fertilized pasture (P_F) (n=4). Soil characteristics were similar to the entire experimental area. Sugarcane planting follows the conventional soil tillage system while to pasture treatment there were no till-operations. Fertilizer sources where NH_4NO_3, superphosphate and KCl and the rates follow Brazilian agricultural practices. To quantify N_2O fluxes gas samples were collected during more or less intensive events from October 2013 to September 2018. Gas samples were collected from PVC cylindrical chambers. Soil temperature and weather conditions were also recorded. During sampling events, four samples were collected from each chamber and stored in vials at 1, 10, 20 and 30 min-intervals. Gas concentrations in vials were determinated by gas chromatography and fluxes calculations according Carmo et al. (2013). Generally, fertilized treatments (S_{+F} and P_F) showed highest N_2O fluxes and annual emissions. During the four years sampled, N_2O fluxes peaked at 22.77, 15.32, 21.65 and 4.5 mg m^{-2} day^{-1}in S_{+F} and at 0.67, 14.40, 12.77 and 1.57 mg m^{-2} day^{-1}inP_F. What means that, in S_{+F} maximum fluxes were 27.01, 94.78, 97.97 and 80% highest than in S_{-F} and in P_F, except to 2013, were 61.11, 31.42 and 26.11% highest than P_{LI}. From 2013 to 2018 emissions factor in S_{+F}were 0.46, 0.18, 0.16 and 0.11% and in P_F were 0.41, 2.24, 0.56 and 0.46%, such sugarcane results are lower than 1% IPCC estimations but agreed with Brazilian observations. N_2O emissions factors in the first year were higher in the sugarcane than in pasture, after this, in the ratoon periods, were always higher in pasture. By now, the data indicate a potential negative effect of pasture fertilization on greenhouse gas emissions and confirm the sustainable profile of the sugarcane.