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N2O emission from urine in the soil in the beef production in Southeast Brazil: soil moisture content and temperature effects

Arlete Simões Barneze, Andre Mancebo Mazzetto, Caio Fernandes Zani, Marcos Siqueira Neto, and Carlos Clemente Cerri

Centre of Nuclear Energy on Agriculture, University of São Paulo, Piracicaba-SP, Brazil

Pasture expansion in Brazil has shown an increase in 4.5% per year, and a total cattle herd of about 200 millions in 2010. Associated to animal husbandry there are emissions of N_2O (nitrous oxide) and other gases to the atmosphere. The liquid manure contributes to emitte 5% of the total N_2O emissions. The urea content of cattle urine will readily hydrolyze to form ammonium after deposition to the soil. Nitrous oxide may then be emitted through the microbiological processes of nitrification and denitrification. Important factors can influence on these processes and consequently in nitrous oxide emissions, as soil water content and temperature (Bolan et al., 2004; Luo et al., 2008). The main goal of this research was to determine the soil water content and temperature influence on N_2O emissions from urine depositions on the soil. In order to achieve the objective, soil incubation experiment was conducted in laboratory conditions at three levels of water-filled pore space (40%, 60% and 80% WFPS) and two temperatures (25ºC and 35ºC) with and without urine, with five replicates each. The soil used in this study was collected from the 0-10 cm layer of a grassland field in Southeast of Brazil and classified as Nitisols. For each measurement, the Kilner jar was hermetically sealed by replacing the lid and a first gas sample was immediately taken (time-zero, t_0 sample) using a syringe and stored in a pre-evacuated gas vial. After 30 minutes the headspace of each jar was sampled again (time-thirty, t_30 sample). The lids were then removed and kept off until the next sampling day. Nitrous oxide concentrations in the sampled air were measured using a SRI Gas Chromatograph (Model 8610C). Gas fluxes were calculated by fitting linear regressions through the data collected at t_0 and t_30 and were corrected for temperature and amount of soil incubated. Gas measurements were carried out up to 55 days. To determine the statistical significance, Tukey tests were carried out at 0.05 probability level. Nitrogen mineralization and nitri?cation were higher at the higher temperature and higher soil water content. Significant effects of urine application and moisture were found ($P<0.05$) on the cumulative N_2O emissions. Nitrous oxide emissions were greater from the urine treatments, with greatest emission reaching of 36 mg m^{-2} from the highest moisture content and the highest temperature. The values on experimental conditions may not exactly represent field situations, but the trends relating to soil moisture content are relevant. An improved understanding of the influenced factors is a key to proposing good practices for grassland livestock production systems leading to the reduction of such emissions.

References

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