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Ammonia and Greenhouse Gases Emission from Slurry Storage with Impermeable Cover and Landspreading of Cattle Slurry

M. Viguria[a], A. Sanz-Cobeña[b], D.M. López[a], H. Arriaga[a] and P. Merino[a]
[a]NEIKER-Tecnalia, Berreaga 1, parcela 812, E-48160 Derio, Spain
[b]Technical University of Madrid, ETSI,Ciudad Universitaria, 28040 Madrid, Spain
mviguria@neiker.net

Intensive farm systems handle large volume of livestock wastes, resulting in adverse environmental effects, such as gaseous losses into the atmosphere in form of ammonia (NH_3) and greenhouse gases (GHG), i.e. methane (CH_4), carbon dioxide (CO_2) and nitrous oxide (N_2O). In this study, the manure management continuum of slurry storage with impermeable cover and following cattle slurry band spreading and incorporation to soil was assessed for NH_3 and GHG emissions. The experiment was conducted in an outdoor covered storage (flexible bag system) (study I), which collected the slurry produced in 7 dairy cattle farms (2,000 m^3 slurry) during 12 days in the northern Spain. Thereafter, stored slurry was mixed and removed from the storage during 2 hours in order to be applied to land. The land experiment (study II) consisted on a rectangular plot (2 ha) where 145 m^3 of slurry was applied to a bare soil at a rate of 323 kg TN ha^{-1} using a tanker fitted with trailing-hoses. One day after slurry application, fertilized soil was turned by means of a moldboard plough machine. The mass-balance integrated horizontal flux (IHF) technique was used for estimating gas emissions based on NH_3 concentration measurements from masts supporting passive flux samplers (PFS) at different heights and GHG concentrations from grab air samples. Furthermore, the backward Lagrangian stochastic (bLS) technique (Windtrax 2.0 software) was compared with NH_3 emission estimates from the IHF technique along the manure management continuum. Our results showed low NH_3 and GHG emissions from the flexible bag storage system, with the highest NH_3 and N_2O emissions caused by slurry removal from storage. After slurry band spreading to soil, NH_3 emission peaked within the first 10 hours (271.5 g N ha^{-1} h^{-1}). Slurry landspreading led to higher CO_2 and N_2O emissions than covered storage, contributing to 75% and 99% of total emissions, respectively. Differences on NH_3 estimates between the bLS and IHF techniques were high in study I and II, which could be attributed to the low NH_3 emissions registered and insufficient plot coverage by the PFS under changing wind directions. In conclusion, the flexible bag system was found to be an effective method of gas emission mitigation in outdoor slurry storage. A delay in incorporating slurry to soil reduced the efficacy of incorporation on NH_3 abatement. Average NH_3 concentration and wind direction within 24 hours could result in uncertain bLS estimates under changing wind directions.

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