Assessment of losses from animal excreta on wet soils

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Up to 41 % of a potent greenhouse gas (GHG) nitrous oxide (N_2O) produced from Irish agriculture comes from excreta deposited by grazing animals. Currently, Ireland uses the IPCC default emission factor (EF) of 2 % to estimate excreta-derived N_2O. However, N_2O can vary greatly with type and composition of excreta, soil type and timing of application. Urine constituents hippuric acid (HA) and benzoic acid (BA) have previously shown potential to reduce N_2O.

The aims of this work were to (1) quantify N_2O and EFs from grazing returns, (2) assess impact of environmental drivers on N_2O (3) and assess potential urine-N_2O mitigation by manipulating grazing timing and urine composition.

Two experiments were conducted. In the first experiment, a randomised split-plot design with five replicates, real ruminant urine and dung were applied to three pasture soils of varying properties (well, moderately and imperfectly drained) in spring, summer and autumn. Nitrous oxide was measured with a manual static chamber method for 365 days following treatment application. In the second experiment, a randomised block design with six replicates, urine with incremental additions of minor constituents hippuric acid (HA) and/or benzoic acid (BA) was applied to pasture and N_2O measured using the same method for 66 days.

The average N_2O emission factor was 0.31 % and 1.18 % for cattle dung and urine, respectively. N2O loss was driven by rainfall, temperature and soil moisture, with highest N_2O EFs in autumn and from the imperfectly-drained soil. These N_2O EFs were lower than the current default value and highlight that N_2O emissions from animal excreta deposited on pasture by grazing animals in Ireland may be over-estimated. Country-specific N_2O emission factors for ruminant excreta will feed directly into the refinement of Ireland's national GHG inventory. This will, in future, allow disaggregation of EFs between types of excreta, soil type and timing of deposition.

Manipulation of ruminant urine by adding HA and/or BA was found to have no effect on N_2O emissions in situ. Although manipulation of hippuric and benzoic acids concentration in urine had no mitigating effect, other urine manipulations, such as reducing N content or inclusion of novel inhibitory products might prove successful.

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