Beyond Direct N_2O Emissions:
Reducing NH_3 Emissions to Achieve Greenhouse Gas Reductions from Agricultural Soils

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Graduate Student Position Available in the 4R Nutrient Stewardship NSERC Industrial Research Chair Program

Department of Soil Science, University of Manitoba, Canada

January 2024

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We are currently seeking several candidates for training leading to M.Sc. and Ph.D. degrees in **Indirect N_2O Emissions**, specifically ammonia (NH_3) loss from agricultural soil. A major gap in Canada's ability to achieve net-zero emissions by 2050 is reducing emissions of ammonia losses from fertilizers. Hydrolysis of urea fertilizers at the soil surface results in NH_3 emissions, a fraction of which is converted to N_2O upon deposition to soil and is thus a major indirect N_2O source. Subsurface placement of urea fertilizers can reduce NH_3 emissions, but this application method may be prevented by soil conditions, high moisture, and established roots. Alternatively, urease inhibitors can reduce NH_3 losses from surface-applied urea, but their effectiveness and the effect of soil type is unknown. There is also concern that urease inhibitors may cause "pollution swapping", where reducing indirect N_2O emissions by preventing hydrolysis of urea fertilizers keeps NH_3 in the ground leading to increased nitrification and ultimately an increase in direct N_2O emissions.

Successful applicants will undertake graduate research to address one or more of the following objectives: (1) develop an accurate and feasible micrometeorological method of estimating NH_3 emissions, (2) develop and verify the suitability of a new quantitative dosimeter method for estimating NH_3 emissions, (3) determine the benefit of urease inhibitors to reduce greenhouse gas emissions (NH_3, N_2O, CO_2), (4) establish the most effective urease inhibitors and concentrations and soils to use them in, and (5) investigate if pollution swapping is a real concern for the Prairies and if eligibility of single inhibitor products in cost-share programs can be removed and thus encourage adoption of the inhibitors and realize reduction in N_2O emissions.

Students will assist with experimental design, setup and maintenance, sample collection, sample analysis and processing. Ph.D. candidates will learn hard skills in the operation, troubleshooting and maintenance of gas sampling systems as well as micrometeorological monitoring systems (3-D sonic anemometers, weather stations including soil moisture and temperature monitoring, and data logger programming,) as well as MATLAB programming for two methods of micrometeorological flux estimation (flux-gradient, dispersion) as well as footprint analysis of area contributing to flux measures. All students will also report results to farmers and industry through field tours and presentations.

Students must have excellent oral and written skills in English. If an M.Sc. student, a 4-year equivalent B.Sc. in agriculture or the natural sciences is required and course work and field experience in agriculture or soil science an asset. If a Ph.D. student, a research-intensive M.Sc. with at least one resulting publication in English in a peer-reviewed journal is required. If the research was in the field of agriculture, the paper must be from a reputable agronomy, crop or soil science journal. Stipends of $24,000/yr for two years to M.Sc. students and $28,000/yr for four years to Ph.D. students are available. Training is funded by several government and industry sources supporting projects led by the 4R Industrial Research Chair Program.

Interested in these opportunities? Send a detailed CV, statement of relevant experience and if you are interested in pursuing an M.Sc. or Ph.D., your availability, and list of three referees and their contact information to Dr. Mario Tenuta, Professor of Applied Soil Ecology, at mario.tenuta@umanitoba.ca. Please use the subject heading "**Indirect N_2O Emissions**".

The laboratory is committed to a training environment with gender equality, diversity, and encouragement of participation of Indigenous and Metis peoples and minorities. Learn more about the 4R Industrial Research Chair Program, the University of Manitoba and the City of Winnipeg.