Graduate Studies Opportunities in 4R Nutrient Stewardship and Greenhouse Gas Emissions

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The 4R Nutrient Stewardship Industrial Research Chair Program, under the leadership of Dr. Mario Tenuta in the Faculty of Agricultural and Food Sciences, University of Manitoba, is currently seeking candidates for training leading to M.Sc. and Ph.D. degrees. For more information on the opportunities described below, eligibility, and how to apply, click here.

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

Background: 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.

Project Summary: 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.

Read more about these opportunities here.

Positioning Canada's Potato Industry for Improved Sustainable Production

Background: The need to reduce greenhouse gas emissions from agriculture is great, but potato producers are rightly concerned that reducing N_2O emissions may negatively impact yield, supply, quality, and profitability.

Project Summary: The successful applicant will undertake graduate research to quantify greenhouse gas emissions reductions achievable using 4R nitrogen (N) management practices and improved N use efficient potato varieties in Canada, without sacrificing the yield and quality of fresh and processing potatoes. The student will assist with experimental design, setup, sample collection, sample analysis and processing. They will also report results to farmers and industry through field tours and presentations. Ph.D. candidates will also be responsible for synthesizing results from data collected at three additional field sites in Alberta, New Brunswick, and Prince Edward Island.

Read more about this opportunity here.

A Prairie Assessment of Nitrogen Stabilizers and Split Fertilizer Application in Sustaining Spring Wheat Yield, Protein, and Production Economics While Reducing N2O Emissions

Background: Spring wheat is Canada's second most valued export grain commodity and restrictions in nitrogen (N) fertilizer use to significantly reduce nitrous oxide (N_2O) emissions would severely impact sustainability of farms across the Prairies. Past research in Canada and globally have shown practices from the 4R Nutrient Stewardship framework can reduce emissions.

Project Summary: The successful applicant will undertake graduate research to determine the benefit of combinations of 4R practices including split application, inhibitor-treated urea, and reduced rate urea addition to agronomic performance of and reduced N_2O emissions from Canadian Western Red Spring Wheat. The student will assist with experimental design, setup, sample collection, sample analysis and processing. They will also report results to farmers and industry through field tours and presentations. Ph.D. candidates will also be responsible for synthesizing results from data collected at four additional sites in Alberta and Saskatchewan.

Read more about this opportunity here.

Precision 4R Management: Improving Nitrogen Use Efficiency, Greenhouse Gas Emissions, and Production Economics of Canola

Background: Commercial farm fields are heterogeneous for soil properties in space and time. Consequently, yield and N_2O emissions from nitrogen (N) fertilizer additions are also variable in fields. To address this spatial and temporal variability, Precision Agriculture was developed to improve nutrient use efficiency by matching N addition-induced yield response to landscape position and soil properties within a field.

Project Summary: The successful applicant will undertake graduate research to determine the extent to which N_2O emissions reductions and improved profitability of canola can be achieved by combining the Precision Agriculture practice of tailoring N rates with the 4R Management practice of using a nitrification inhibitor, a management approach we call Precision 4R. The student will assist with experimental design, setup, sample collection, sample analysis and processing. They will also report results to farmers and industry through field tours and presentations. Ph.D. candidates will also be responsible for synthesizing results from data collected at two additional field sites in Saskatchewan.

Read more about this opportunity here.

Micrometeorology and Net Greenhouse Gas Emissions of Two Long-Term Agricultural Study Sites

Background: Reducing greenhouse gas emissions from agricultural fields is an important step towards achieving 30% reductions below the 2005 level in Canada by the year 2030. Past research in Canada and globally have shown practices from the 4R Nutrient Stewardship framework can reduce emissions. One of these practices is applying fertilizer amended with a nitrification inhibitor.

Project Summary: The successful applicant will undertake graduate research to determine the extent to which whole-year N_2O and CO_2 net emissions reductions from long-term field study sites can be achieved through applying nitrogen fertilizer with a nitrification inhibitor. N_2O fluxes are determined using the flux-gradient method. The two study sites are located on heavy clay soil and lighter sandy soil; the project will focus on comparing emissions from two contrasting soil types of the Canadian Prairies. The student will assist with experimental design, setup and maintenance, sample collection, sample analysis and processing. They will also report results to farmers and industry through field tours and presentations.

Read more about this opportunity here.