BENEFICIAL MANAGEMENT PRACTICE (BMP) FOR GREENHOUSE GAS MITIGATION

REDUCTION OF NITROUS OXIDE (N_2O) EMISSIONS IN IRRIGATED POTATO IN MANITOBA

"Consider 4Rs (rate, source, placement, timing) practices to optimize crop N use"

WHAT SHOULD WE DO?

- Consider 4Rs (rate, source, placement, timing) practices to optimize crop N use
- Select lowest rate of N to optimize yield based on other 3 Rs
- Consider residual soil nitrate, mineralization, yield goal and N loss potential of field in determining N rate
- Use split applications of urea or fertigation rather than single application of urea
- Use controlled-release urea (ESN) instead of granular urea
- Use stabilized granular urea or nitrification inhibitors
- Band granular urea and ESN rather than broadcast incorporation
- Avoid excess moisture conditions after application of N fertilizer

Field trial investigating fertilizer N management on N_2O emissions from irrigated potato in Carberry, MB (photo: S. Parsonage)

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WHY SHOULD WE DO IT?

- Irrigated potato production in Manitoba requires relatively high rates (> 150 kg N/ha) of fertilizer N application, which can have major impact on N_2O emissions
- The 4R fertilizer BMPs, which are based on the strategy of applying the right source of nutrients at the right rate, time, and place, maximize crop productivity and profitability, and minimize N_2O

Chambers for measuring N losses as nitrous oxide (N_2O) emissions from soil in irrigated potatoes, Carberry, MB (photo: S. Parsonage)

Sprinkler irrigation from potato test plots at CMCDC, Carberry, MB (photo: S. Parsonage)

WHERE SHOULD WE DO IT?

- In Manitoba, the majority of potato production is on the coarse-textured soils in the Black Soil zone; use of BMPs in these soils is more critical
- Fertilizer BMPs can apply to other potato production regions but local expertise is needed to make recommendations for specific conditions and goals

POTENTIAL ADVANTAGES:

- Reduces atmosphere N_2O emissions which thus reduces agriculture's overall contribution to global GHG emissions
- Reduces erosional and runoff N loss which helps protect surface water quality
- Reduces underground N loss which helps protect groundwater quality
- Improves N fertilizer use efficiency, improving crop tolerance to root diseases and consequently encouraging maximum yields
- Improves crop photosynthesis CO_2 capture and carbon sequestration by balanced plant nutrition with fertilizer BMPs

POTENTIAL DISADVANTAGES AND UNCERTAINTY:

- Application of 4R fertilizer BMPs sometimes requires more costly equipment or equipment modification
- Enhanced efficiency fertilizers such as ESN are more expensive than conventional urea fertilizer
- Banding sometimes increases N leaching losses
- In some cases, if banded fertilizer is too concentrated, it may result in ammonia toxicity to tuber pieces
- Benefits are more evident under environmental conditions where fertilizer N is susceptible to losses, i.e. wet and warm soil, rain or irrigation following fertilizer
- Limited regional data is available characterizing N_2O emissions from irrigated potato production in Manitoba

HOW DO WE KNOW THIS?

- The concept of fertilizer BMPs using the 4Rs (right product, rate, time, and place) is not new. However, 4R fertilizer BMPs are more important today than ever before to achieve productivity, profitability, and sustainability of production systems while minimizing N losses into the environment.
- Manitoba is the 2nd largest potato-producing province growing roughly 20% of Canada's potatoes. The majority of potato fields in Manitoba receive irrigation and higher rates of synthetic fertilizer N than other crops. The higher water and N inputs to potato fields increase potential N losses to the environment, especially as N_2O emissions.
- Site-specific fertilizer BMPs for irrigated potato production systems are necessary to reduce greenhouse gas emissions and optimize economic returns to growers. Our collaborative research groups aim to develop and implement such BMPs into irrigated potato production systems in Manitoba.

"4R fertilizer BMPs are more important today than ever before to achieve productivity, profitability, and sustainability of production systems while minimizing N losses into the environment"

RESEARCH HIGHLIGHTS

Baron K. and Tenuta M. (2014) Developing Best Management Practices to Mitigate Greenhouse Gas Emissions from Irrigated Potato Production in Manitoba. Final report. AAFC #: 3000528623.

- The report synthesized and summarized the results of recently completed greenhouse gas emission studies conducted in a potato production system in Manitoba and other temperate regions. It implemented the 4R strategy and proposed a list of BMPs for mitigating emissions from irrigated potato production in Manitoba.

Gao X., Tenuta M., Nelson A., Sparling B., Tomasiewicz D., Mohr M.M. and Bizimungu B. (2012) Effect of nitrogen fertilizer rate on nitrous oxide emission from irrigated potato on a clay loam soil in Manitoba, Canada. Can. J. Soil Sci. 93:1-11.

- This paper reported a 2-yr field study investigating the effect of fertilizer N rate on N_2O emissions from irrigated potato production in Manitoba. Averaged across two years, increasing application rates of urea from 80 to 160 and further to 240 kg N ha^{-1} doubled or tripled cumulative N_2O emissions, as well as the yield based N_2O intensity (g N_2O-N Mg^{-1} marketable yield). The paper highlights the importance of selecting the optimal rate of N to reduce N_2O emissions without affecting yield.

Soil Ecology Laboratory. 2016. Mitigation of Nitrous Oxide Emissions from Irrigated Russet Burbank Potato in Manitoba Using 4R Management Approaches. Manuscript in preparation.

- Field studies were conducted to examine the effect of N rate, source and placement on N_2O emissions from irrigated potato production in Manitoba. Again, elevated N_2O emissions were found with high rates of fertilizer N. Interestingly, peaks in N_2O emissions frequently were delayed with banding or ESN treatment. Results also showed the marketable yield responded little to increased rates of urea/ESN.

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