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Canada

Effect of the preceding crop on nitrous oxide emissions during the potato year in two-year potato rotations

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Introduction

- Global GHG emissions have increased by 70% from 1970 to 2007 (Rogner et al. 2007)
- N_2O is important because it has a global warming potential 296 times greater than CO_2 (IPCC 2007)
- 87% of N_2O emissions in Canada result from agricultural activities (Environment Canada 2004)
- In humid regions, N_2O is produced primarily by denitrification according to the following reaction:

$$NO_3^- \rightarrow NO_2^- \rightarrow NO \rightarrow N_2O \rightarrow N_2$$

- There is limited information available on the effect of crop rotation on the controlling factors of denitrification and subsequently on N_2O emissions

Objective

- Determine the effect of the preceding crop on N_2O emissions in potato production in two-year potato rotations

Materials & Methods

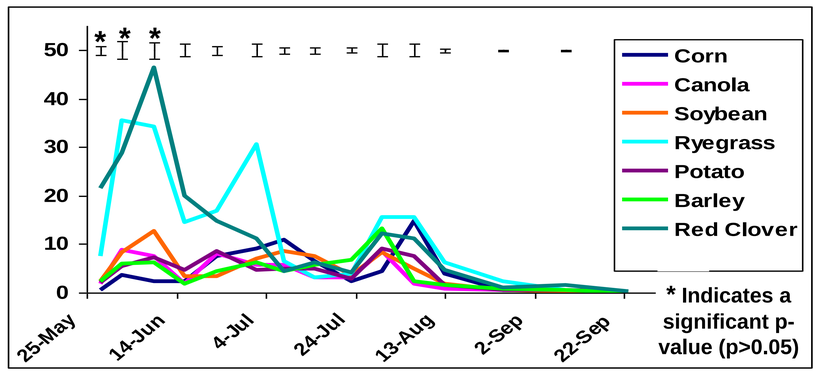
Table 1: Experimental treatments

Treatment	2007	2008
1	Barley	Potato 193N
2	Italian ryegrass	Potato 193N
3	Corn	Potato 193N
4	Potato	Potato 193N
5	Soybean	Potato 193N
6	Canola	Potato 193N
7	Red Clover	Potato 193N
8	Barley	Potato 0N
9	Red Clover	Potato 0N

- Weekly measurements of N_2O flux were taken in the hill and furrow using non-flow through, non-steady state, vented and insulated chambers with a total volume of 1.6L

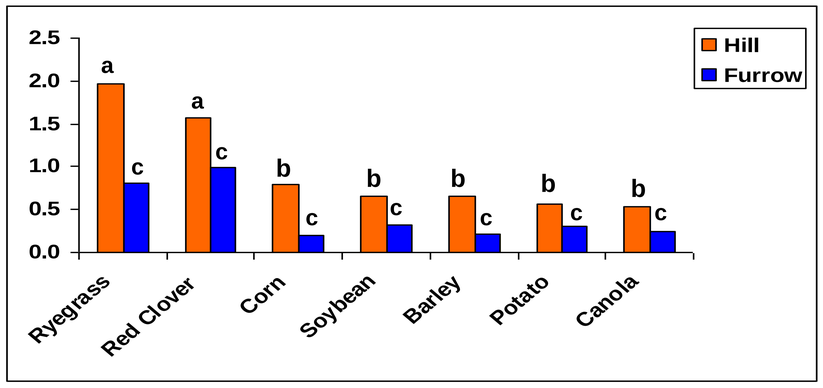
Results & Discussion

Figure 1: Average daily N_2O emissions (g N_2O-N $ha^{-1}d^{-1}$) by preceding crop



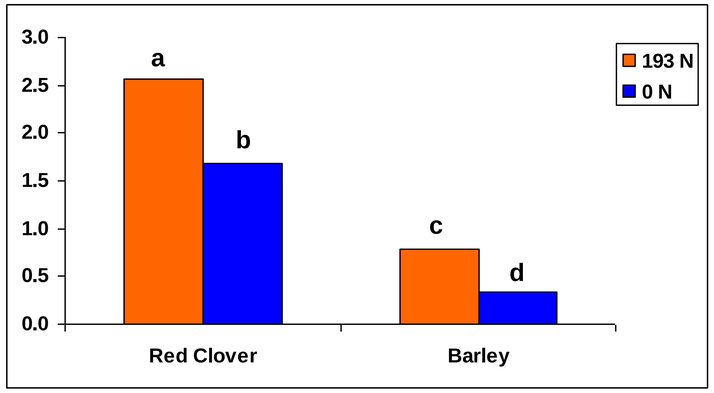
- There was a significant effect of preceding crop only on the first three measurement dates where red clover and annual ryegrass produced N_2O emissions three times higher when compared with all other preceding crops
- Increased emissions from preceding crops of red clover and ryegrass may indicate higher carbon availability, leading to greater soil respiration and oxygen depletion, which creates favorable conditions for denitrification activity

Figure 2: Cumulative N_2O emissions (kg N_2O-N ha^{-1}) by preceding crop and location



- Hill locations in plots with preceding crops of annual ryegrass and red clover had cumulative N_2O emissions 2.7 times higher than all other preceding crops. There was no treatment effect in the furrow locations.
- The increased cumulative emissions from the potato hills compared with the furrow may be attributed to increased soil available nitrate due to mineral N fertilizer placement at planting. Soil in the hill is less compact when compared to the furrow location, which allows for increased gas diffusivity and therefore increased N_2O emissions.

Figure 3: Cumulative N_2O emissions (kg N_2O-N ha^{-1}) from plots with preceding red clover or barley, and with or without N fertilization



- N_2O emissions were, on average, 3.8 times higher from plots with preceding red clover when compared to plots with preceding barley crop
- Fertilized plots emitted 1.6 times more N_2O when compared to unfertilized plots

Conclusions

- Preceding legume and non-legume forages produced the highest N_2O emissions which may reflect increased carbon inputs from the preceding forage crops
- Choice of rotation crop and fertilizer N management both have a significant effect on N_2O management in potato production

References

Rogner, H.-H., Zhou, D., Bradley P., et al. (2007). Introduction. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz et al. (eds)], Cambridge University Press, Cambridge, UK. **IPCC, 2007: Climate Change 2007: The Physical Science Basis**. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S. et al. (eds.)]. Cambridge University Press, Cambridge, UK. **Environment Canada. 2004**. Canada's Greenhouse Gas Inventory 1990-2002.Greenhouse Gas Division, Environment Canada, August 2004.

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