The Effects of Nitrogen Fertilizer Rates on Greenhouse Gas Emissions and Potato Production in Delta, British Columbia

Chantel Chizen[1*], Maja Krzic[1], Sean Smukler[1], and T. Andrew Black[1]

[1]Faculty of Land and Food Systems, The University of British Columbia, Vancouver, Canada

INTRODUCTION

- 10% of Canada's total greenhouse gas (GHG) emissions (mainly CO_2, N_2O, and CH_4) come from the agriculture sector, as of 2015.
- Intensive agricultural practices are being implemented to maintain yields amid environmental pressures.
- Excessive nitrogen fertilizer rates are a primary contributor to agricultural greenhouse gas (GHG) emissions in the form of N_2O.

- Data on GHG emissions from the most economically important crops in the British Columbia Fraser River delta are limited.
- The effects of climate change are predicted to intensify the current drainage and production issues in this region, thus reducing future production capability.

STUDY OBJECTIVES

Evaluate the responses of GHG emissions (CO_2, N_2O, and CH_4) and potato production to:

- Nitrogen fertilizer application rates of 0, 90, and 120 kg N ha^{-1}.
- The timing of planting associated with poor soil drainage through a regular planting date and a late planting date (18-day delay).

This study is a part of a 5-year project within the Agricultural Greenhouse Gas Program. The project aim is to quantify GHG emissions and develop best management practices and mitigation strategies in the Fraser Valley.

STUDY LOCATION

- The Fraser River delta in British Columbia (BC) is one of the most productive agricultural regions in Canada.
- Soil Type: Silt loam Gleysol

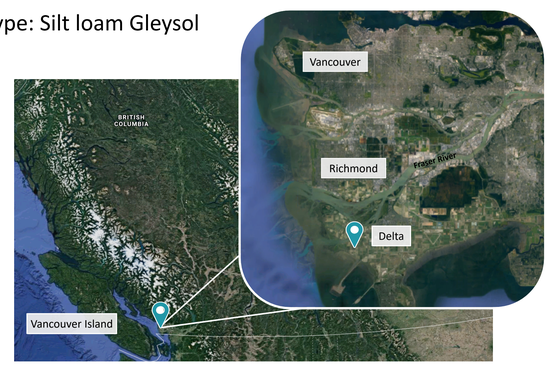

Fig. 1. Location of the study site in Delta, British Columbia.

STUDY DESIGN

- 3 fertilizer rates assigned randomly at the whole plot level.
- 2 planting dates assigned randomly at the split-plot level.
- Test crop: Kennebec potatoes

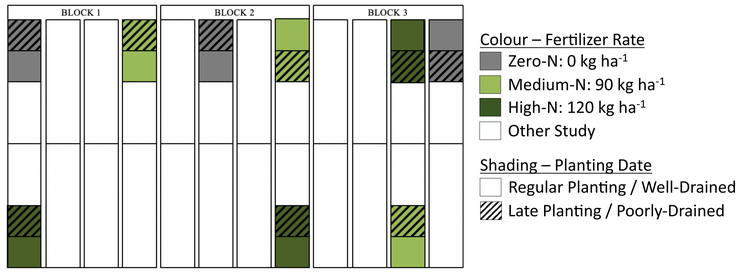

Fig. 2. Experimental layout of field site.

SAMPLING

Fig. 3. Gasmet DX 4040 and static chamber.

- GHG measurements
  - Every 2 weeks: May – October
  - Gasmet DX 4040 and static chambers (Fig. 3)
- Potato Yield

RESULTS

- The planting time had no effect on GHG emissions or yield.
- The fertilizer treatment had no significant effect on cumulative CO_2 or N_2O emissions (Fig. 4).
- There was a significantly greater CH_4 uptake in the high nitrogen fertilizer treatment compared to the other fertilizer treatments (Fig. 4).
- Potato yield in the high fertilizer treatment was significantly greater than the control, but it was not significantly different from the moderate fertilizer treatment.

Table 1. Potato yield with standard error in brackets.
Letters indicate a statistically significant difference (p-value < 0.05) between treatments, regardless of planting time as the interaction was not significant.

Fertilizer Treatment	Planting Time	Yield (kg ha^{-1})		
Control	Regular	16,166	(3593)	a
	Late	22,813	(4155)	
Moderate	Regular	29,494	(3086)	ab
	Late	34,252	(2731)	
High	Regular	35,882	(2265)	b
	Late	36,414	(6878)	

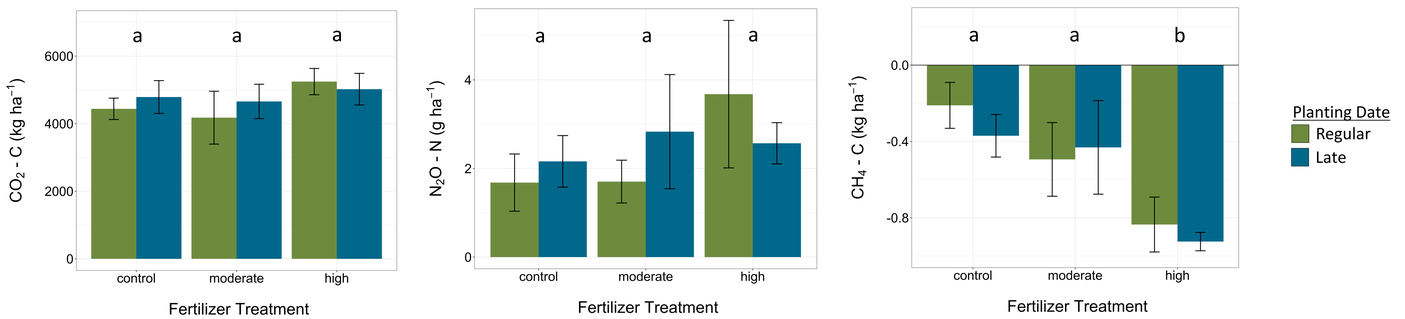

Fig. 4. Cumulative GHG emissions (CO_2, N_2O, and CH_4) at the end of the growing season, 109 days after planting. Letters indicate a statistically significant difference (p-value < 0.05) between treatments regardless of planting time as the interaction was not significant.

SUMMARY

- At the end of the growing season, there were no significant differences in cumulative CO_2 or N_2O among the treatments, while cumulative CH_4 uptake was significantly greater in the high nitrogen fertilizer treatment.
- The potato yield was greatest in the moderate and high fertilizer treatments. Further analysis will be conducted to evaluate potato quality.
- This data will contribute to existing agricultural GHG emissions records for the Fraser Valley.
- The findings will assist in the development of BMPs to improve nitrogen fertilizer use efficiency in potato production and mitigate climate change.

THE UNIVERSITY OF BRITISH COLUMBIA
Faculty of Land and Food Systems

Canada This research is supported by Agriculture and Agri-Food Canada

*For more information please contact Chantel Chizen (cchizen@mail.ubc.ca)