Pulse-wheat Rotations Influence the Potential of Nitrous Oxide (N_2O) Production in the Canadian Prairie

Navid Bazghaleh*, Jamshid Jazestani, Chantal Hamel, Yantai Gan, Adriana Navarro Borrell and Keith Hanson

Semiarid Prairie Agricultural Research Centre, Swift Current, SK, Canada S9H 3X2

*Corresponding author: navid.bazghaleh@agr.gc.ca

Key Words: Nitrous Oxide (N_2O), Crop Rotation, Pulse crops, Oilseeds, Climate change, Global Warming

Introduction

Nitrous oxide (N_2O) is a major greenhouse gas that can have a considerable impact on global warming and ozone depletion. Agricultural practices are responsible for 80 % of anthropogenic emissions of N_2O which is an intermediate in the microbial reduction of NO_3 to atmospheric N_2 (1). Inclusion of pulse crops in rotation may affect N_2O production due to the import of atmospheric N_2 into soil. This study evaluated whether the sequence of pulse-wheat influence the potential of N_2O production in the cropping system of the Canadian Prairie. Soil N_2O was generated in acetylene blocks and quantified using Gas Chromatography (GC).

Materials and methods

A field experiment was conducted with 14 treatments of pulse–wheat–oilseed crop sequences in 4-year rotation (Fig. 1) at the research farm of Agriculture and Agri-Food Canada Research Centre near Swift Current, Saskatchewan. Field plots were established on a Silt Loam, Orthic Brown Chernozem (pH = 6.5) as a randomized complete block design with 4 replicates. Plot sizes were 4 m x 12 m. Soil cores were collected at harvest of the final wheat stage (0 - 7.5 cm depth). 25 g of sieved (2-mm) soil was placed in a 100 ml flask and mixed with 25 mL of distilled water. The flask was sealed with a serum stopper. Atmospheric air was replaced with the neutral gas argon by exchanging for 20 minutes. 10 mL of headspace gas was replaced with 10 mL acetylene. The flasks were incubated at 25 ^oC in the dark. N_2O was quantified in 0.5 mL of headspace gas after 24 h using gas chromatography. Analysis of variance was used to test the effect of crop rotation on N_2O production (LSD, α = 0.05). Spearman correlation was used to detect the relationships between N_2O production and soil N content, in R.

Results and discussion

Frequent inclusion of pulses particularly chickpea and pea plants in the cropping system significantly increased the potential of N_2O production than the sequences that have higher

frequency of wheat (Fig .1).

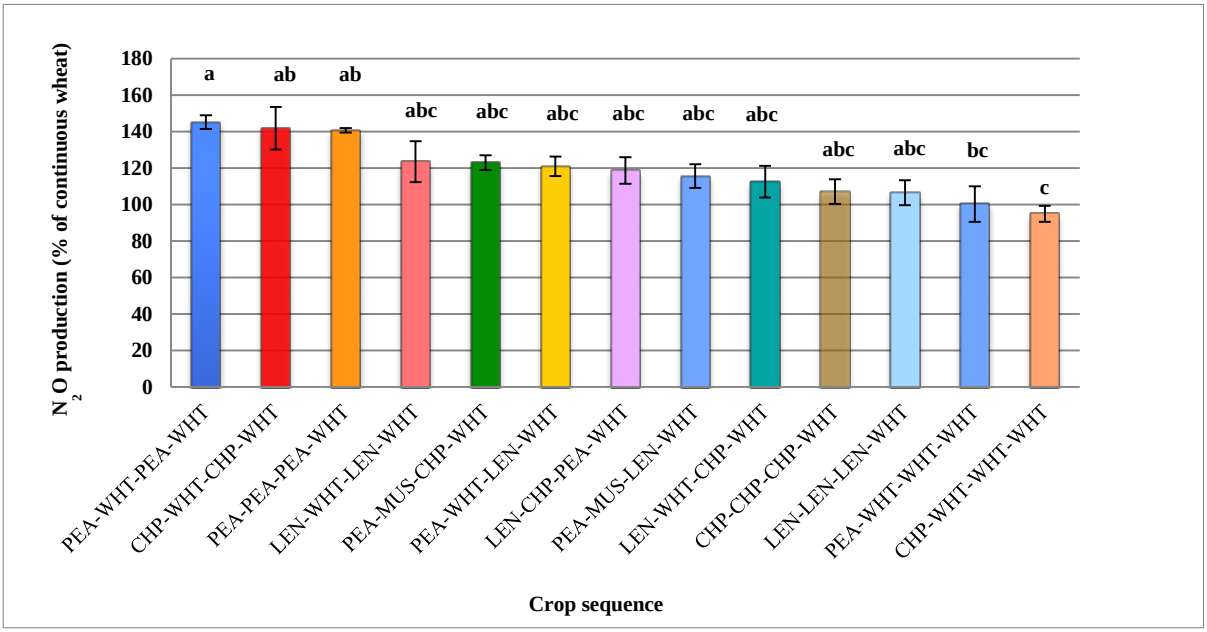

Fig. 1. The potential of N_2O production[1] in soils under 14 pulse-wheat rotations measured in year-4 wheat field. PEA: Pea, WHT: Wheat, CHP: Chickpea, LEN: Lentil, MUS: Mustard.

Spring soil N content at various depths was positively correlated with N_2O production (Fig. 2). N input into agricultural soils through biological N-fixation can potentially increase N_2O production (2).

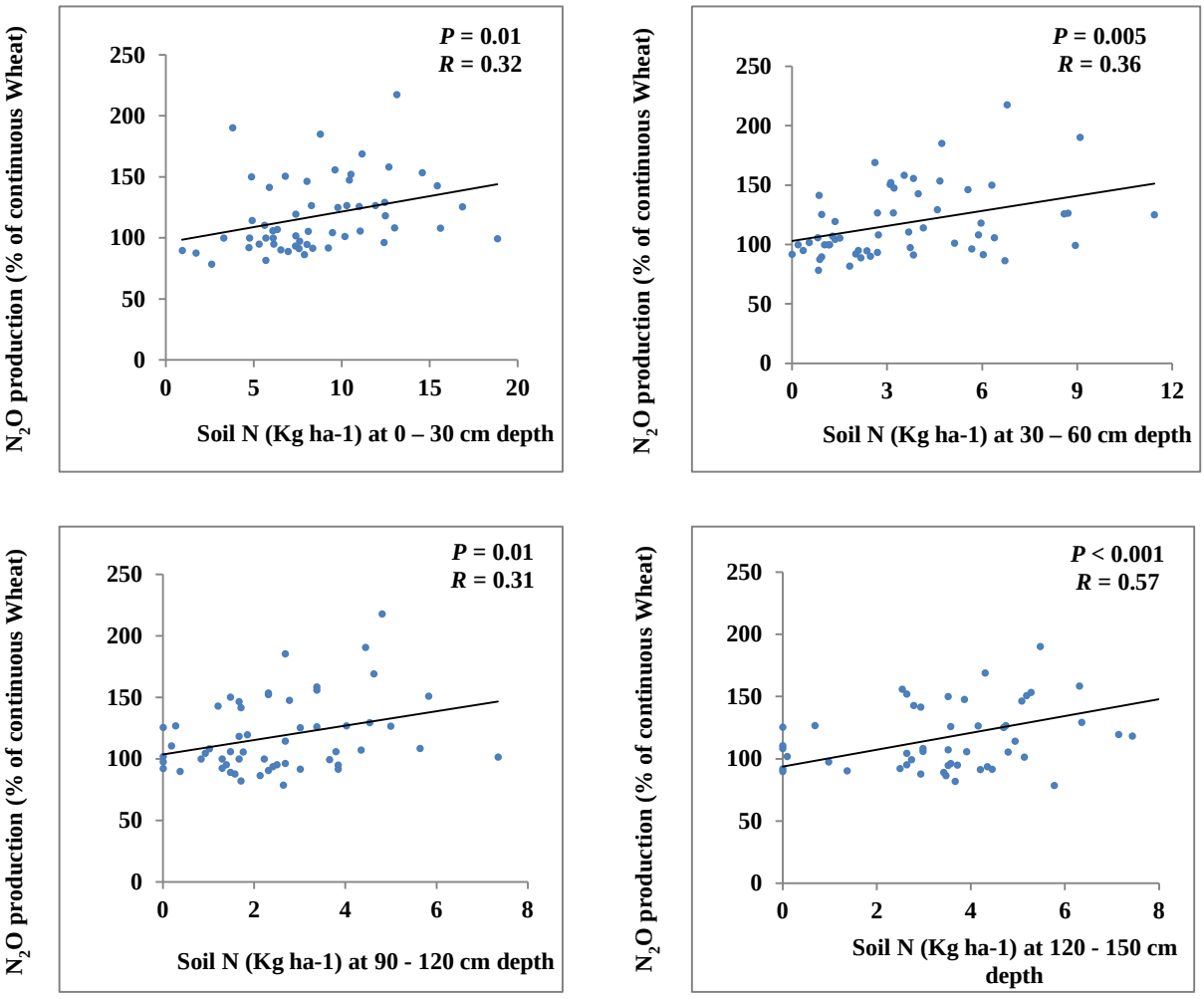

Fig. 2. Correlations between the potential of N_2O production1 and concentration of N at different soil depths at planting

Conclusion

The inclusion of pulse crops in cropping rotations can increase potential of N_2O production through importing atmospheric nitrogen (N_2) into soil.

References

1. Hickman et al., (2014). Nitrous oxide (N_2O) emissions in response to increasing fertilizer addition in maize (*Zea mays* L.) agriculture in western Kenya. *Nutrient Cycling in Agroecosystems.* 100:177–187.

2. Mosier et, al., (1998). Closing the global N_2O budget: nitrous oxide emissions through the agricultural nitrogen cycle. *Nutrient Cycling in Agroecosystems* 52: 225–248.

Acknowledgements

We thank Lee Poppy, Ray Leshures, Morgan Braun, Tori Yuzik and Fayruza Lalany for their technical assistance. The research was supported by Pulse Cluster of AAFC and Saskatchewan Pulse Growers.