Pulse-wheat Rotations Influence the Potential of Nitrous Oxide (N$_2$O) Production in the Canadian Prairie

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Introduction
Nitrous oxide (N$_2$O) 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$_2$O 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$_2$O 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$_2$O production in the cropping system of the Canadian Prairie. Soil N$_2$O 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 °C in the dark. N$_2$O 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$_2$O production (LSD, $\alpha = 0.05$). Spearman correlation was used to detect the relationships between N$_2$O 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$_2$O production than the sequences that have higher
frequency of wheat (Fig .1).

**Fig. 1.** The potential of N$_2$O 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$_2$O production (Fig. 2). N input into agricultural soils through biological N-fixation can potentially increase N$_2$O production (2).
Conclusion
The inclusion of pulse crops in cropping rotations can increase potential of N₂O production through importing atmospheric nitrogen (N₂) into soil.

References

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