The Effect of Nitrogen Fertilization and No-Till Duration on Soil Nitrogen Availability and Greenhouse Gas Emissions

Ryan Hangs[1], Jeff Schoenau[1], Guy Lafond[2], and Eric Bremer[3]

[1]Department of Soil Science, University of Saskatchewan, Saskatoon, SK; [2]Agriculture and Agri-Food Canada, Indian Head, SK; [3]Western Ag Innovations Inc., Saskatoon, SK.

INTRODUCTION

- No-till seeding practices promote sustainable crop production by improving soil physical, chemical, and biological properties. Additionally, repeated fertilizer N applications serve to increase the soil N supplying power through the build-up of potentially mineralizable N within soil organic matter.
- However, the effect of sustained fertilizer N additions on soil N availability and greenhouse gas emissions between short-term vs. long-term no-till systems is unclear.

OBJECTIVE

- Determine the effect of varying fertilizer N rates on soil N availability and N_2O and CO_2 emissions of two soils differing in no-till management history (10 vs. 32 years). An adjacent native prairie soil was included for comparison.

MATERIALS & METHODS

- Soil cores (0-15 cm) were collected at three adjacent locations with contrasting land management histories: native prairie or short- and long-term (10 and 32 years, respectively) no-till continuous multi-crop cropping systems (wheat-pea-canola), receiving five fertilizer N rates (0, 30, 60, 90, and 120 kg N/ha) for the previous nine years.
- The Orthic Black Chernozem (Oxbow Assoc.) loam soil cores were maintained at field capacity and incubated (22 ^oC) for six weeks.
- Variables measured included: PRS™-probe NO_3^--N and NH_4^+-N supply rates and weekly assessments of N_2O and CO_2 emissions.

RESULTS

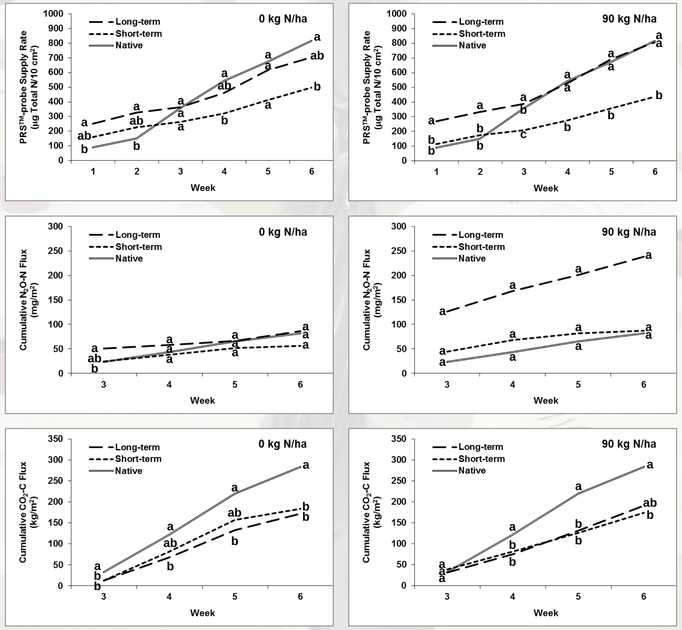

Figure 1. Mean (n = 3) cumulative total N (NO_3^--N + NH_4^+-N) supply rates and N_2O and CO_2 fluxes during a six-week incubation of soils with contrasting management histories: native prairie or short-term (10 years) and long-term (32 years) no-till continuous multi-crop cropping systems, receiving either no fertilizer N or 90 kg N/ha for the previous nine years. For each week, total N supply rates and gas fluxes with the same letter are not significantly different (P >0.10 and >0.15, respectively) using LSD.

DISCUSSION & CONCLUSION

- As incubation time progresses, the contribution of mineralization vs. residual inorganic N becomes apparent in the cumulative soil available N supply rate (Fig. 1). Mineralization contributions are greatest in the native prairie, followed by the long-term no-till soil.
- Annual fertilizer N addition of 90 kg N/ha (long-term; Fig. 1) and 120 kg N/ha (short-term; data not shown) for the previous nine years enhanced the N supplying power of the soils.
- The greater residual inorganic N in the long-term no-till soil supported initially larger N_2O-N fluxes compared to the native prairie soil, but was not sustained in subsequent weeks (Fig. 1). This effect appeared to be more pronounced with fertilizer N addition, but was not significant due to large variability in measured N_2O-N fluxes among soil cores.
- Largest CO_2-C fluxes from the native prairie soil are consistent with its high organic matter content and contributions from root respiration.
- Using modern no-till continuous multi-crop cropping systems, along with fertilizer N applications, enhance the soil N supplying power over the long-term by building-up mineralizable N.

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