Greenhouse gas emission benefit of including perennial forage in a Canadian Prairie cropping system

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Background

- Perennial crops increase C sequestration and also reduce N_2O emissions thereby reducing GHG emission
- However, very little is known about the greenhouse gas emission benefits of including perennial forages in Canadian Prairie cropping systems
- Further, if conversion of perennial to annual negates the emission benefit of the perennial due to increased C mineralization and N_2O emissions is not known.

Objective

- To evaluate short-term and long-term benefit of including perennial forage in rotation with annual crops in terms of cumulative CO_2 and N_2O emissions

Materials and Methods

Study site, treatment structure and experimental design

- The study was conducted within the framework of TGAS-MAN project in the clay soil of Red River Valley, Southern Manitoba.
- The field layout and treatment structure of the study is presented in figure 1.
- In 2008, perennial alfalfa was introduced in two plots while two plots were continuously under annual rotation.
- In 2011, alfalfa was killed and all four plots will be under annual crop rotation for two years

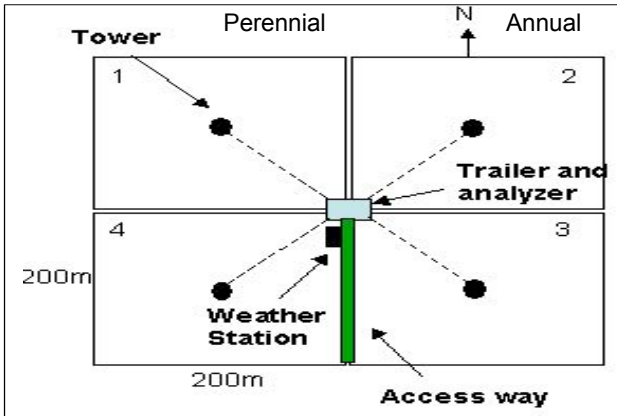

Figure 1: Treatment layout and instrumentation of TGAS-MAN study site

Flux measurement and calculation

The emission of N_2O and CO_2 was measured using micrometeorological flux gradient method. In this method, instrumentation tower located in each plot takes the gas sample from two heights . Concentration of CO_2 and N_2O in the gas sample is determined by tunable diode laser analyzer located in the centre of the experimental field (Figure 1).

The flux CO_2 and N_2O is calculated as:

$$F = -K\frac{\Delta C}{\Delta z}$$

where F is the flux of the gas in question (CO_2 and N_2O), K is the eddy/turbulent diffusivity and ΔC is the concentration gradient measured over a vertical distance z.

Results

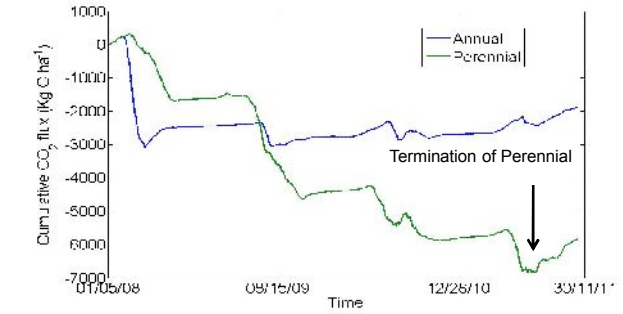

Figure 2: Cumulative C uptake by annual and perennial cropping system

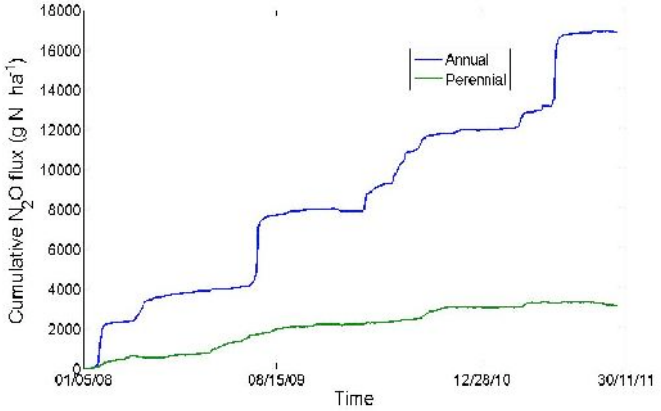

Figure 3: Cumulative N_2O emission by annual and perennial cropping system

Conclusion

- In three years, perennial increased C uptake by 4 tonnes C per ha and decreased N_2O emissions by 10 kg N per ha compared to the annual system.
- The emission will be continuously measured and net GHG budget after accounting for harvest removal will be compared between the systems