Agricultural Greenhouse Gases Program (AGGP)

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Perennial Vegetation Mitigates Greenhouse Gas Emissions from Agricultural Soils by Reducing CH_4 and N_2O but not CO_2 Emissions

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The Motivation

Reducing atmospheric greenhouse gas (GHG) concentrations and slowing the pace of global climate change is an urgent matter. Developing land use systems that reduce GHG emissions from agriculture has a large role to play in reducing GHG emissions from the agriculture landscape. This study thus evaluated the role of three agroforestry systems in reducing GHG emissions in central Alberta.

Methods

We selected 36 sites for three agroforestry systems: 12 each of hedgerow, shelterbelt (white spruce dominated) and silvopasture (aspen dominated) sites. The sites were distributed across a 250 x 300 km area centered around Edmonton, spanning from the Dark Brown Chernozemic to the Dark Gray Chernozemic soil zones. In each site, plots were set up in the forested area and in the agriculture production area (herbland, including grazed pasture and annual crop production areas). Environmental parameters and rates of emission (CO_2, N_2O and CH_4; static gas chamber method) were determined over two growing seasons in 2013 and 2014. The temperature sensitivity of soil respiration was analyzed.

The Result

Soils in the forest area had 3.4% greater CO_2 emission, 36% higher CH_4 uptake (Fig. 1), and 66% lower N_2O emission than those in adjacent herbland. When the emissions of CO_2 and N_2O and uptake of CH_4 are all considered, the forested area had a lower global warming potential. Emissions of CO_2 were silvopasture > hedgerow > shelterbelt, while soils in the silvopasture system had 15% greater CH_4 uptake (Fig. 1) and 44% lower N_2O emissions as compared with the other two agroforestry systems. The sensitivity of CO_2 emissions to temperature changes was not different among agroforestry systems, but was greater in herbland than in forest areas, indicating that soil carbon in the herbland would be less stable under a warmer future climate.

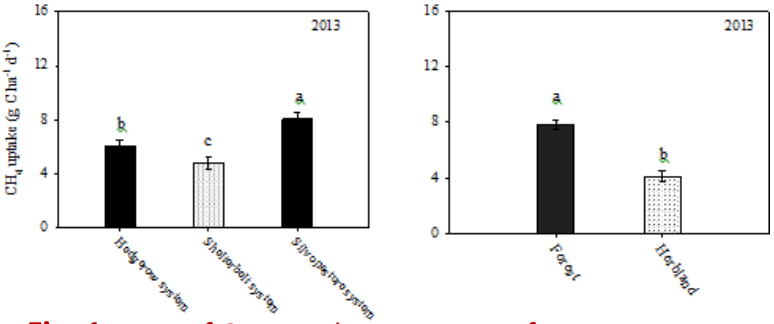

Fig. 1. Rate of CH_4 uptake among agroforestry systems and between land use types in each system

Implications

Perennial vegetation as part of an agroforestry system established on the agricultural landscape is effective in mitigating GHG emissions by enhancing soil CH_4 uptake and reducing N_2O emissions in addition to increasing carbon (biomass) storage in the forest vegetation.

Maintaining perennial vegetation cover should be encouraged to reduce GHG emissions from the agricultural landscape in central Alberta. The shelterbelt system was most effective in reducing GHG emissions and should be preferentially promoted.

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