MANAGING GLOBAL RESOURCES FOR A SECURE FUTURE

2017 Annual Meeting, October 22-25, Tampa, FL

Section: Soil Carbon and Greenhouse Gas Emissions General Poster I

Effects of crop rotation and grazing in an ICLS on greenhouse gas emissions in Northern Great Plains

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ABSTRACT

Integrated crop-livestock system (ICLS) is an alternative that alleviates some of the environmental problems resulted from intensification of crops and livestock. However, little is known about the effects of ICLS on soil surface greenhouse gas (GHG) emissions in Northern Great Plains. The objective was to monitor soil surface GHG fluxes: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) to assess the impacts of crop rotation and grazing in an ICLS on the environment. The experiment was a randomized complete block design with 3 replications at Dickinson Research Extension Center ranch located southwest of Manning, North Dakota. The crop rotation treatment included (i) continuous spring wheat (*Triticum aestivum* L.) (control), (ii) sunflower (*Helianthus annuus* L.)-spring wheat (*Triticum aestivum* L.)-cover crop-corn (*Zea mays* L.)-field pea (*Pisum sativum* L.) & barley (*Hordeum vulgare* L.), (iii) spring wheat-cover crop-corn-pea & barley-sunflower, (iv) cover crop-corn-pea & barley-sunflower-spring wheat, (v) corn-pea & barley-sunflower-spring wheat-cover crop, and (vi) pea & barley-sunflower-spring wheat-cover crop-corn. The cover crops from September to June were winter triticale (*Triticosecale Wittm*.) and hairy vetch for hay. A 7-specie cover crop in fall and winter was for cow winter grazing. The preliminary results in 2016 indicated that annual average soil surface N_2O fluxes ranged from 2.74 to 4.75 g ha^{-1} d^{-1} and highest fluxes were found in control. The rotation did not significantly impact the N_2O fluxes, but grazing significantly impacted N_2O emission. The emission was significantly higher in grazed plots (5.73 g ha^{-1} d^{-1}) than that in ungrazed plots (2.98 g ha^{-1} d^{-1}). The rotation and grazing treatments did not impact CO_2 and CH_4 fluxes. The soil CO_2 fluxes had a downward trend over time with decreases of temperatures.