Impacts of Crop Rotational Diversity and Grazing Under Integrated Crop-Livestock System on Soil Surface Greenhouse Gas Fluxes

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Abstract

Integrated crop-livestock (ICL) system is beneficial in enhancing soil organic carbon and nutrient cycling. However, the benefits of the ICL system on mitigation of GHG emissions are poorly understood. Thus, the present study was initiated in 2011 to assess the effect of crop rotation diversity and grazing managed under the ICL system on GHG emissions. The cropping system investigated here included spring wheat grown continuously for five years and a 5-year crop rotation (spring wheat-cover crops-corn-pea/barley-sunflower). Each phase was present each year. Yearling steers grazed only the pea/barley, corn, and cover crops plots in 2016 and 2017. Exclusion areas avoided the grazing in these crops to compare the GHG fluxes under grazed vs. non-grazed areas. The GHG fluxes were measured weekly from all crop phases during the growing season for both years using a static chamber. Cumulative CO_2 and CH_4 fluxes were similar from all crop phases over the study period. However, continuous spring wheat recorded higher cumulative N_2O fluxes (671 g N ha^{-1}) than under spring wheat in rotation (571 g N ha^{-1}). Grazing decreased cumulative CO_2 fluxes (359 kg C ha^{-1}) compared to ungrazed (409 kg C ha^{-1}), however, no effect from grazing cumulative CH_4 and N_2O fluxes over the study period were found. The present study shows that grazing and crop rotation diversity affected carbon and nitrogen inputs, which in turn affected soil CO_2 and N_2O fluxes. Long-term monitoring is needed to evaluate the response of soil GHG emissions to grazing and crop rotation interactions under the ICL system.

OPEN ACCESS Journal
PLOS ONE, 2019, 14(5):e0217069. https://doi.org/10.1371/journal.pone.0217069