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Conservation tillage fertilized with manures increased N2O emissions from a silty clay but not a sandy loam soil under a cool temperate environment.

David Pelster, Martin Chantigny, Normand Bertrand, Isabelle Royer, and Denis Angers
Agriculture and Agri-Food Canada, Quebec City, Canada (david.pelster@canada.ca)

While it is generally understood that conservation tillage in heavy soils under a cool, wet climate increases N2O fluxes compared with inversion tillage, the interaction between tillage and manure type on soil N2O fluxes in different textured soils is not well understood. To investigate how long-term applications of different manures interact with tillage effects on N2O fluxes, we established a long-term trial in 2009 in eastern Canada, using two tillage (conventional: inversion at 25 cm in autumn; conservation: harrow at 5 cm in spring) and three fertilizer types (liquid swine manure, liquid dairy manure and a 0-N control) arranged in a split-plot design with 3 replications. The experiment is reproduced on two contrasting soil textures (silty clay and sandy loam) located approximately 800m apart in a wheat-maize-soybean rotation. During 2016 (wheat – Triticum aestivum), 2017 (maize – Zea mays) and 2018 (soybean – Glycine max), we measured the N2O fluxes from each plot using standard non-flow through, non-steady state, manual chambers for the snow-free period (1 April through 30 November). Cumulative fluxes for the snow free periods ranged from 0.4 kg N2O-N ha-1 for the inversion tillage on the sandy loam soil during the third year when soybean was grown without fertilizer, to 7.6 kg N2O-N ha-1 for the cattle manure/conservation tillage on the silty clay soil. Conservation tillage increased soil N2O fluxes for both manure types and the 0-N control in the clay soil (mean flux for all fertilizer treatments over all three seasons were 4.7 and 2.3 kg N2O-N ha-1 season-1 for the conservation and inversion tillage, respectively); while on the sandy loam the N2O flux was similar between the conservation and inversion tillage systems (mean flux for all fertilizer treatments over both seasons were 1.1 kg N2O-N ha-1 season-1 for both the conservation and inversion tillage). Considering that soil organic C may not increase in fine-textured soils under conservation tillage in temperate, humid areas such as eastern Canada, our findings suggest that conservation tillage in fine-textured soils in the region may lead to a net decrease in the GHG balance.