

Assessing the implications of chloride from land application of manure for Minnesota waterways

Matthew A. Belanger¹, Erin L. Cortus², Gary W. Feyereisen³,
Nancy B. Bormann¹, Melissa L. Wilson¹

¹Department of Soil, Water and Climate, ²Department of Bioproducts and Biosystems Engineering, ³MN Department of Agriculture

Background

Chloride (Cl^-) contamination is a rising concern in MN ground and surface waters. Livestock waste applied to agricultural fields as fertilizer is a source of Cl^- loading through leaching. However, there is little modern data available to understand livestock waste's potential contribution to Cl^- contamination nor how manure-based Cl^- moves through different soil types in MN. To make a more accurate Cl^- mass balance, research is needed to understand variability in Cl^- by manure type (liquid vs. solid) and livestock species, as well as evaluate movement of manure-based Cl^- through different textured soil profiles.

Study Objectives

The intent is to quantify the movement of manure-based Cl^- applied to MN soils via a series of intact core leaching studies. These studies aim to:

- Compare variation in Cl^- leaching through different MN soil types.
- Compare how Cl^- leaching from manure differs from synthetic KCl fertilizer.
- Compare how Cl^- leaching differs between liquid and solid manures.

Methods

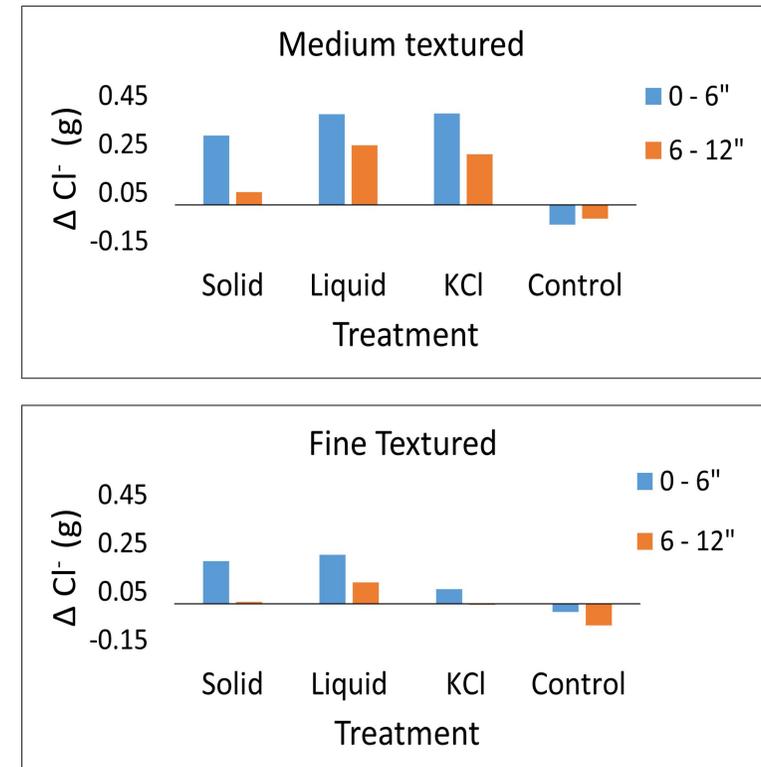
- We collected 12 x 12-in soil cores from Rosemount, MN (medium texture) and Waseca, MN (fine texture) soybean fields.
- We brought soil cores to field capacity with water prior to surface applying manure or KCl fertilizer.
- We surface applied manure on an N-based application rate, and KCl fertilizer on a K-based application rate.
- We simulated 3, 2-in rainfall events and collected leachate samples for Cl^- analysis following each event.
- We collected pre- and post-experiment soil plugs for nutrient analysis of Cl^- from a depth of 0-6-in and 6-12-in.



Medium textured (left) and fine textured (right) soils in cores seen from above.

Results

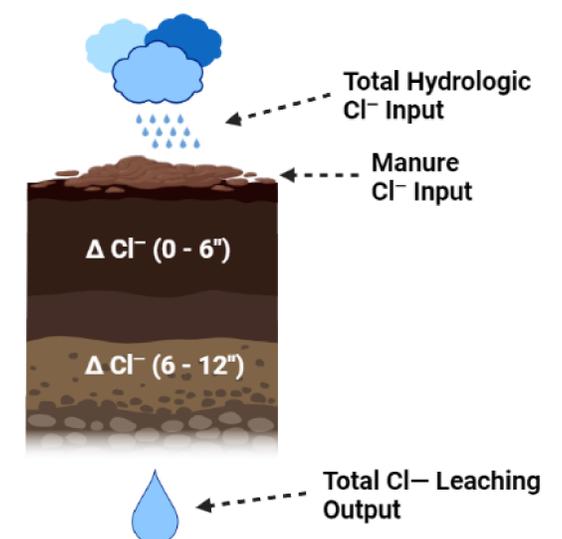
Change in soil Cl^- storage following leaching



- Medium textured soils had greater change in Cl^- storage compared to fine textured soils in top and bottom layers.
- Manure addition increased Cl^- storage in both medium and fine textured soils.
- KCl addition increased Cl^- storage in medium soils more drastically than in fine soils.
- Control soils both experienced a loss in Cl^- following rainfall events.

Future Work

- We will compare Cl^- leaching by soil type and treatment following leachate analysis.
- We will create a Cl^- mass balance (right) mapping Cl^- inputs and outputs in each core.
- We will conduct another set of leaching studies with different MN soils and manures in the future.



Acknowledgments

- This work is supported by the University of Minnesota Water Resource Center's Watershed Innovation Grants Program.
- Thank you to Scott Cortus, Thor Sellie, Eddit Alto, and Todd Schumacher for field help collecting soil cores.
- Thank you to the staff at the Southern Research and Outreach Center and the Rosemount Research and Outreach Center for field access.