Effects of Tile Drainage on Soil Salinity in Southwestern Manitoba Soils

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Introduction

Tile drainage is quickly becoming a prominent practice in Manitoba, primarily to reduce limitations of excess soil moisture on soil and crop productivity. Many producers are also interested in tile drainage to reduce and manage soil salinity. However, there is little research on the effectiveness and implications of this practice in the cold climates of the Prairies region.

Long-term monitoring of salinity in soils and runoff water is being undertaken at the Souris Plains Soil and Water Research and Demonstration Site at Hartney, Manitoba (N-12-6-23W1). Research findings are contributing to our understanding of how tile drainage affects soil salinity and water quality in this undulating landscape representative of a broad portion of the Prairies.

Methods and Materials

Electromagnetic mapping was completed within the study field using an EM38-MK2 (EM38) non-contact sensor (Geonics Limited, Mississauga, Ontario, Canada) in vertical dipole orientation for effective sensing depths of 0.75 m and 1.5 m. Mapping was completed along 25 m transects on November 10, 2020 (pre-tile installation) and October 28, 2022 (following one year of tile drainage). Uncalibrated apparent electrical conductivity (ECa) EM38 readings were converted to electrical conductivity (EC) using regression analysis and depth-weighted soil electrical conductivity (ECe) from laboratory analysis of soil samples following Wollenhaupt et al. (1986[1]). Calibrated EC maps were interpolated and converted to salinity class maps. Tile drainage was installed in the fall of 2021. Canola was grown in 2022.

Results and Discussion

Tile drainage only removes soil water above field capacity. Generally, large precipitation events are required to lead to substantial tile outflow during the growing season. In 2022, growing season precipitation was 166% of the long-term average, with 170 mm (7 in) more rainfall than normal. Most of this rainfall (84%) occurred during numerous, significant rainfall events between April 22 and July 19. These rainfall events occurred while soils were near, at or above field capacity. These conditions resulted in substantial tile outflow.

In Fall 2020, 23.9 ha (59.0 ac) of the 70.3 ha (173.6 ac) area to be tile drained was found to fall within weakly to strongly saline classes. Salinity class maps show a marked reduction in soil salinity in the study field between Fall 2020 and Fall 2022 (Figure 1), evident in three field tile drainage zones (i.e., Southwest, Northeast, South) and two research plot drainage zones (i.e., Plot A, Plot B). A 15.7 ha (38.8 ac) or 66 % reduction in weakly to strongly saline class areas was found (Figure 2).

Not surprisingly, salinity concentrations were elevated in tile outflow during this period (not presented here).

Figure 2 Change in salinity classes between Fall 2020 and Fall 2022

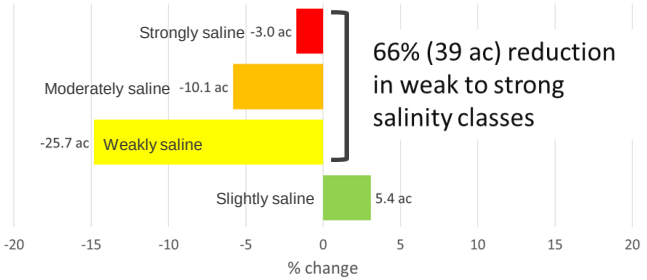
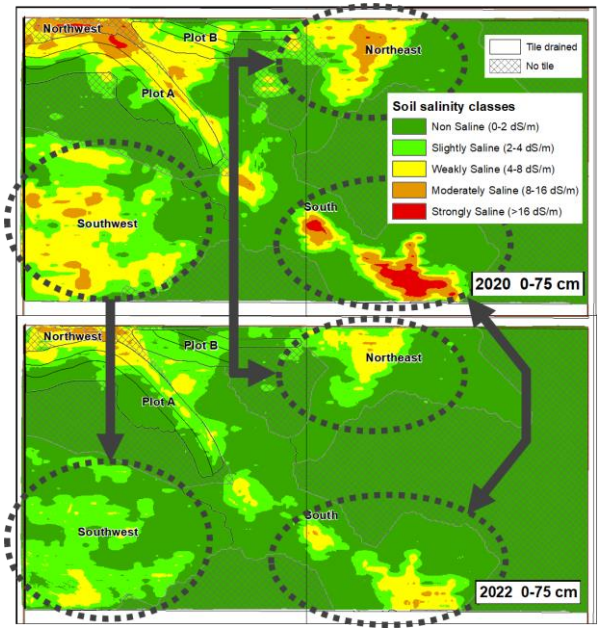


Figure 1 Degree and extent of salinity classes in Fall 2020 and Fall 2022



Conclusions

Through one growing season with conditions favourable to salt leaching and removal by tile (i.e., multiple large rainfall events occurring with soil moisture at, near or above field capacity), a substantial reduction in soil salinity was determined across the study field.

The authors caution that these results are likely not representative of salt reduction over the long-term or during seasons with precipitation at or below normal. Monitoring at the study field will confirm soil salinity changes and runoff water quality over the long-term.

1. Wollenhaupt, et al. 1986. A rapid method for estimating weighted soil salinity from apparent soil electrical conductivity measured with an aboveground electromagnetic induction meter. Can. J. Soil Sci. 66: 315-321.

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