# Perennial Crops can Improve Soil Salinity

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## Objective

A study at the North Central research Extension Center in Minot, ND and near Bowbells, ND was initiated in 2013 and 2014 respectively to monitor perennial cropping impacts on soil salinity.

## Introduction

More than 5.8 million acres of North Dakota is adversely impacted by excessive salts (Brennan and Ulmer, 2010). Salinity is caused by the translocation and accumulation of water soluble salts in the soil to a level that impedes plant growth. Salts reduce and prevent plants' ability to uptake water and nutrients. Salinity is only managed through water management. Water management strategies include drainage (subsurface and surface) or through cropping systems. Cropping system strategies include, high water use crops, full season cover crops, cover crops after harvest, and perennial cropping. These management practices encourage the leaching of surface salts (Franzen et al., 2019).

Electrical conductivity (E.C.) is the measurement of salinity where the units are mmhos $cm^{-1}$ and tested on a one-to-one (soil-to-water volume basis). When salinity is greater than two mmhos $cm^{-1}$, yield reduction is observed on salt sensitive crops like soybean (*Glycine max* L.), corn (*Zea mays* L.), and alfalfa (*Medicago sativa* L.) (Franzen et al., 2019). Salt tolerant alfalfa appears to grow well in areas up to an E.C. of three mmhos $cm^{-1}$. Salt tolerant crops like barley (*Hordeum vulgare* L.), sunflower (*Helianthus annus* L.), canola (*Brassica napus* L.), and sugar beet (*Beta vulgaris* L.) may see a yield reduction, but can still grow well when the E.C. is four mmhos $cm^{-1}$. However, salt levels greater than this can greatly reduce crop yield, crop quality, and encourage saline seep growth. When E.C. is greater than five mmhos $cm^{-1}$, salt tolerant perennial grasses like western wheatgrass (*Pascopyrum smithii* L.) and hybrid wheatgrass (*Elymus hoffmannii* L.) have the best chance of establishing and using soil moisture (Green et al., 2019).

## Methodology

Soil salinity was determined with an *in situ* Fieldscout direct soil E.C. meter (Spectrum Technologies, 2019) at the 0-15 cm depth within 72 hours of a rainfall event. Soil salinity was tested in the fall in a grid fashion spaced approximately 15 m apart. Latitude and longitude locations were recorded from every E.C. measurement with a Lowrance $H_2O$ (Lowrance Electronics, 2019) handheld global positioning system. Contour maps of the soil salinity (Figure 1) were created using QGIS (QGIS Development Team, 2002).

Alfalfa and hybrid wheatgrass were both planted at 16.5 kg $ha^{-1}$ in the areas indicated by Figure 1. Forages were sown with a no-till seeder in June following initial soil sampling. Perennials were allowed to grow throughout the project.

Comparison of means was determined using the Student's T-test procedure of SAS software version 9.4 (SAS Institute Incorporated, 2012).

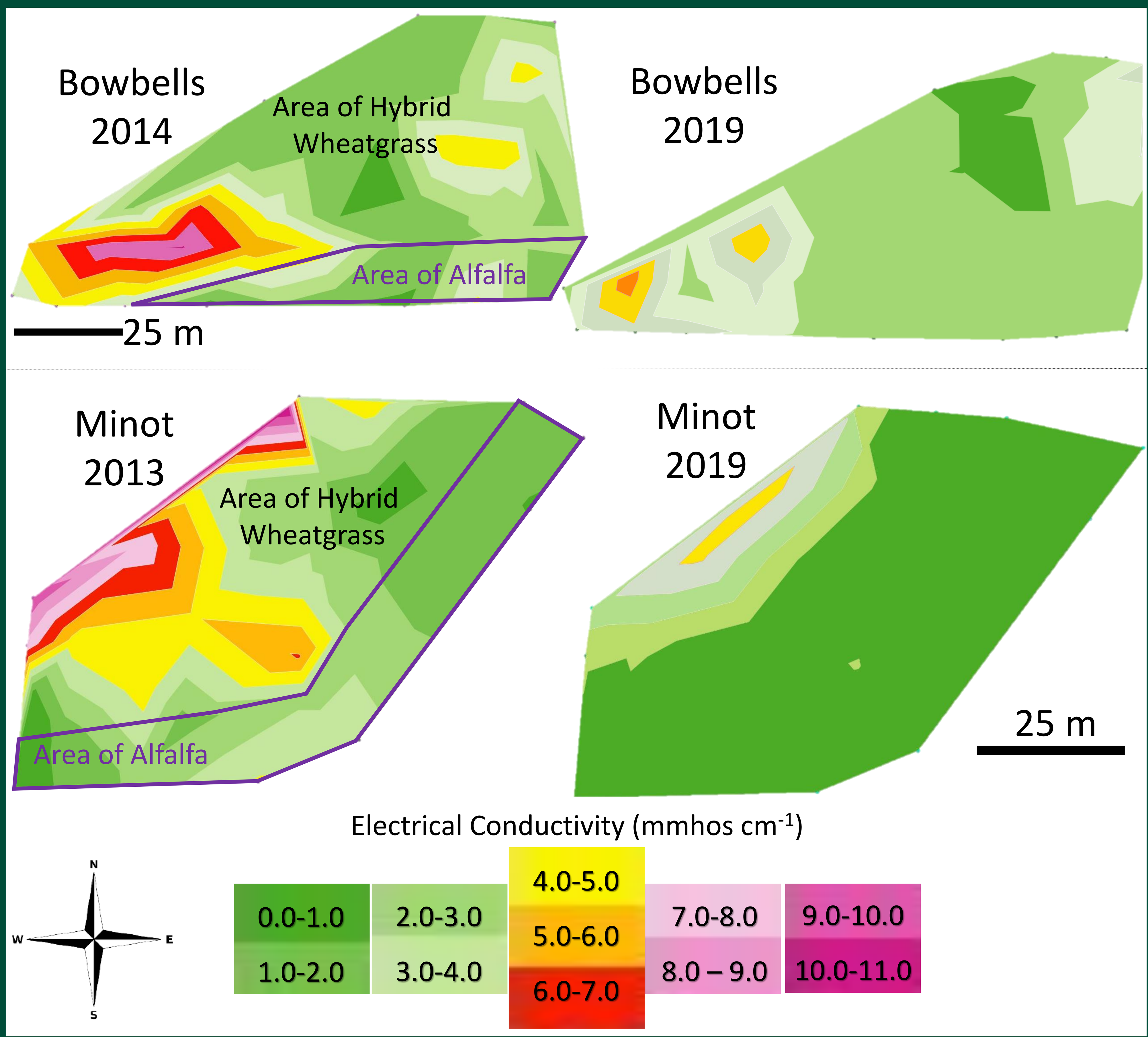


**Figure 1.** Soil E.C. maps of Bowbells (top) and Minot (bottom) environments in 2013, 2017, and 2019.

**Table 1**. Mean electrical conductivity, range, and P-value of the sites.

| Site | Year | Mean | Minimum | Maximum | Median | P-value |
|---|---|---|---|---|---|---|
| | | -Electrical Conductivity (mmhos $cm^{-1}$)- | | | | |
| Bowbells | 2014 | 2.8 | 0.5 | 8.1 | 2.1 | <0.001 |
| | 2019 | 1.8 | 0.3 | 5.7 | 1.3 | |
| Minot | 2013 | 3.2 | 0.4 | 11 | 2.7 | |
| | 2019 | 1.0 | 0.2 | 4.5 | 0.6 | |

## Results

When this study was initiated, a majority of both sites were too saline to support cash crop growth (Figure 1). Since the initiation of this project, the prevalence and severity of saline soils has greatly decreased at Minot and Bowbells (Table 1). The average E.C. at Bowbells decreased from 2.8 in 2014 to 1.8 mmhos $cm^{-1}$ in 2019. The Minot 2013 mean E.C. decreased from 3.2 to 1.0 mmhos $cm^{-1}$ in 2019. The decrease in E.C. at both sites was significant at the 0.001 level (Table 1).

## Conclusions and Implications

- Perennial cropping reduced soil salinity to levels that can support adequate growth of a majority of crops grown in north central North Dakota. However, an untreated control was not used to compare spatial variability over time.
- Perennial crops can be used as forage for livestock. However, a majority of North Dakota producers do not raise livestock. Consequently crop-only producers may not receive a cash benefit from growing forages instead of cash crops in saline areas.
- Not managing soil salinity will only exacerbate the encroachment of salinity into productive areas and further reduce crop producer's bottom line.
- Success of salinity management is dependent on precipitation, and management choice.

## References

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