Renewing soils with perennial grasses

Dr. Mark Liebig, Research Soil Scientist

Producing a sufficient amount of food, feed, and fiber while protecting environmental quality represents a significant challenge for agriculturists in the 21st century. Tailoring the most appropriate enterprises to diverse agricultural landscapes using the best genetics and management will be essential. Among the many 'tools' at the disposal of producers, perennial grasses have a unique role to play in meeting this challenge.

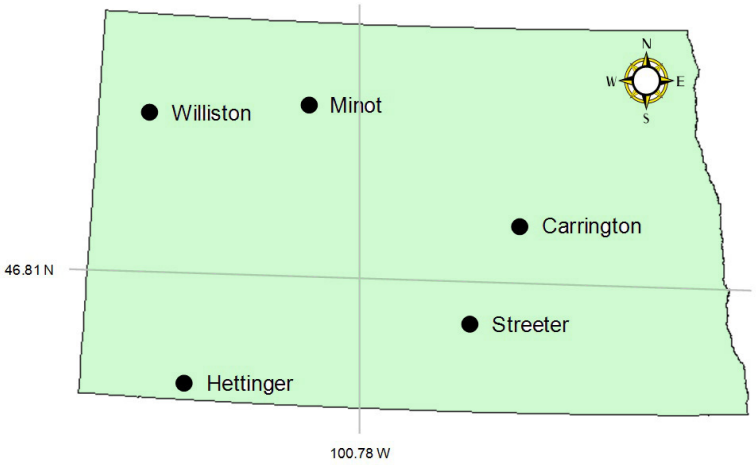

Fig 1. Locations included in study

Understanding how perennial grasses alter soil properties, and in turn, how such alterations affect the health of agricultural landscapes is crucial for creating production systems that are productive, efficient, and socially acceptable. Unfortunately, there is limited information about soil property dynamics under perennial grasses, particularly in the northern Great Plains.

To help address this need, a study was undertaken to quantify changes to soil properties resulting from different perennial grasses at five sites in central and western North Dakota over a 5-year period. The study was conducted in coordination with staff at the NDSU Central Grasslands Research and Extension Center (REC) in Streeter, and involved four other RECs in central and western North Dakota (Fig. 1).

Soil properties investigated in the study were selected for their association with water regulation (soil bulk density), salinity mitigation (electrical conductivity), buffering capacity (soil pH), nutrient cycling (available P), and soil health (soil organic carbon). Soil samples were collected in 2006, immediately before seeding, and again in 2011 following 5-years of perennial grass treatments (Fig. 2).

As a guide to the study, perennial grasses with multiple plant species were hypothesized to induce greater improvements in soil condition compared to grass monocultures.

Outcomes from the study did not support this hypothesis, as soil conditions under grass mixtures were similar to those under monocultures. Perennial grasses, however, induced changes in soil properties over the 5-yr study, with substantial declines in available P at sites with high initial P (Fig. 3), and modest increases in soil organic carbon (SOC) at sites with low initial SOC (Fig. 4).

In contrast to observed changes in available P and SOC, other soil properties changed minimally (electrical conductivity) or not at all (soil pH) (data not shown). These results were encouraging, as they implied no increase in salinity or acidification, both issues of paramount concern throughout North Dakota. Such resistance to change can have important implications for continued soil function and efficient use of agricultural landscapes.

In summary, results from this 5-year study highlighted the value of perennial grasses to remediate nutrient-laden and/or degraded soils in central and western North Dakota. Outcomes also indicated perennial grasses served to keep soil solution chemistry in a condition favorable for nutrient cycling and plant growth. Collectively, improvements in belowground condition observed in this study complemented the many aboveground benefits associated with perennial grasses on agricultural landscapes.

Adapted from Liebig, M.A., G. Wang, E. Aberle, E. Eriksmoen, P.E. Nyren, J.A. Staricka, and K. Nichols. 2017. Soil response to perennial herbaceous biofeedstocks under rainfed conditions in the northern Great Plains, USA. Geoderma 290:10-18.

Mark Liebig 701.667.3079 mark.liebig@ars.usda.gov

Fig. 2. Holly Johnson and Mark Liebig collect soil samples near Streeter, ND, September 2011 (photo credit, Carleen Soule).

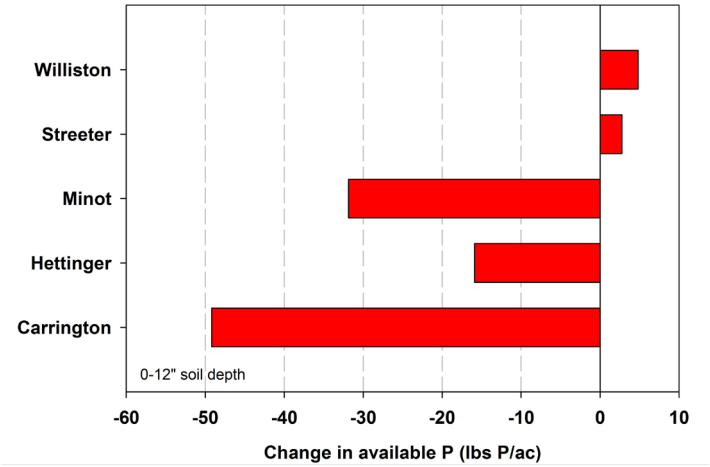

Fig. 3. Available phosphorus change over a 5 year period at each location.

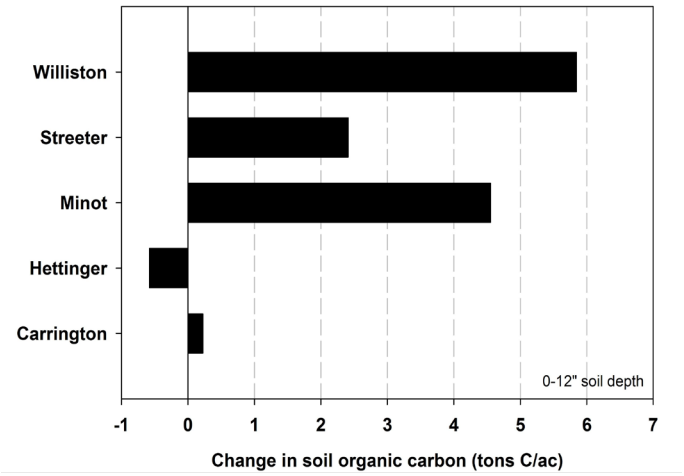

Fig. 4. Soil organic carbon change over a 5 year period at each location.