



Green Lands
Blue Waters

Kernza Field Trial Results

Pipestone and Chatfield, MN

Kernza® is a novel perennial grain crop developed through work by The Land Institute, the University of Minnesota, and others. With deep roots that stay in the ground for three years or more, Kernza helps reduce nutrient leaching that contaminates drinking water sources. Planted on vulnerable land such as Wellhead Protection Areas, Kernza offers farmers and landowners a way to profitably keep land in agricultural production while protecting their community's water sources.

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The Pipestone and Chatfield trials were lead by Dr. Jake Jungers (Sustainable Cropping Systems Lab, University of Minnesota) in partnership with Lincoln Pipestone Rural Water, the City of Chatfield, and the Minnesota Dept. of Agriculture. Fieldwork was carried out primarily by UMN Master's student Evelyn Reilly and SCS lab staff with assistance from staff at Olmsted County Soil and Water Conservation District and Lincoln-Pipestone Rural Water Association. Data analysis was carried out by Evelyn Reilly with assistance from Dr. Jungers.

Nitrate leaching from fertilizer applied to row crop agriculture poses a serious risk to rural communities in Minnesota, especially the Southern and Western parts of the state. Soil water under corn and soy can reach nitrate concentrations of 28 ppm; that water can move downward and allow nitrate to reach drinking water sources, which are undrinkable at concentrations over 10 ppm. Communities including the City of Chatfield and Lincoln and Pipestone Counties are looking for ways to avoid the health risks and water treatment costs of contamination, ideally without taking farmland out of production. Field-scale trials of Kernza are providing important data establishing the capacity of this new crop to limit nitrate leaching below the rooting zone, supporting further research, broader adoption, and State programs to incentivize plantings.

Chatfield

Chatfield sits on karst topography that is vulnerable to nutrient leaching - the loss of dissolved nutrients as water moves downward through soil. As a result, protecting the drinking water supply is a concern for city officials and Chatfield residents. As part of a pilot program, the city and farmer local Paul Novotny planted 38 acres of Kernza on Wellhead Protection Areas in the fall of 2017 with seed supplied by the University of Minnesota's Forever Green Initiative.

Soil water samples were collected from a portion of the city planting, along with grain and biomass yields and data on soil moisture. Nitrate levels in soil water were nearly 0 ppm, indicating that little nitrate was being lost through leaching, and that Kernza production could be a promising option for crop production on vulnerable land.



Stormy skies over a Kernza field in Chatfield, MN

Lincoln-Pipestone Rural Water Association Well Field near Verdi, MN



The Lincoln-Pipestone Rural Water Association (LPRWA) manages a unique 54 acre field of tillable farmland in a highly vulnerable Wellhead Protection Area land that lies over a key drinking water source. LPRWA pumps 1.8 billion gallons of water a year to rural residents in 36 municipalities in a 10-county region, and was interested in Kernza as a way to protect their groundwater from nitrate contamination. LPRWA Director Jason Overby, board member and farmer Randy Kraus, and Laura DeBeer from Pipestone County Soil and Water Conservation District were integral in planning the trial and coordinating planting and harvest.

The Pipestone planting was valuable for supply chain development, too. Grain was sold to [Perennial Pantry](#), who processed and milled it before selling it to consumers through their 2020 Kickstarter campaign and to businesses including [Bang Brewing](#) in St. Paul.

Methods

Kernza was planted in Fall 2017 at both sites, on 54 acres near Verdi, Minnesota, in Lincoln County, and on 38 acres in Chatfield, Minnesota, in Olmsted County. Neither planting was fertilized.

In summer 2018, lysimeters were installed in both fields. Lysimeters are made of a PVC pipe with a porous ceramic cap attached to the bottom and a sealed cap on top. When a partial vacuum is placed on the pipe, water is pulled in through the porous cup on the bottom and can be collected for analysis. Samples were collected from the lysimeters every 1-2 weeks during the 2019 growing season and analyzed for nitrate concentration by the University of Minnesota Research Analytical Lab and the Olmsted County MDH Lab.

Kernza grain and straw were harvested for three years, from 2018 to 2020. Small samples were taken before the grain was combined off.

Note: Kernza does need to be fertilized in order produce economically-viable grain yields over the 3 years for which it is typically harvested, but at the time this trial was initiated, more data from plot-based trials was needed to confirm that Kernza planted on Wellhead Protection land could be fertilized without contaminating groundwater. Since the completion of these field trials, a plot experiment in the Central Sand Plains region of Minnesota found that soil water nitrate concentrations remained very low even under Kernza fertilized at 100 kg N/ha (about 90 lbs N/ac). With this new evidence, next steps will include fertilized field trials.



A lysimeter installed in Lincoln-Pipestone
Photos by Evelyn Reilly



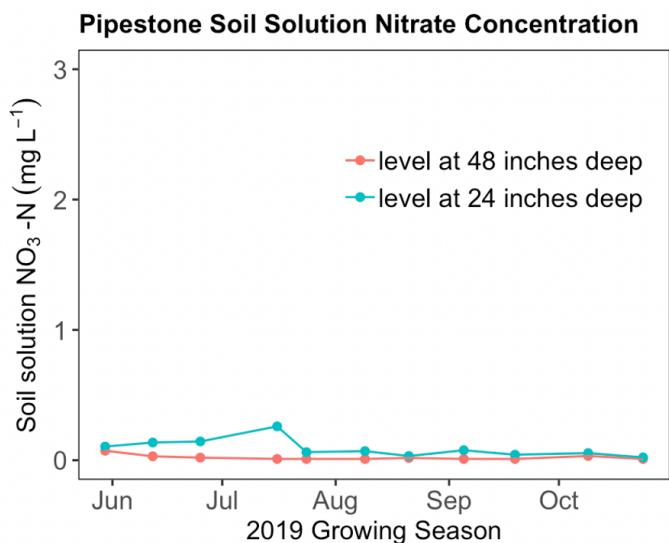
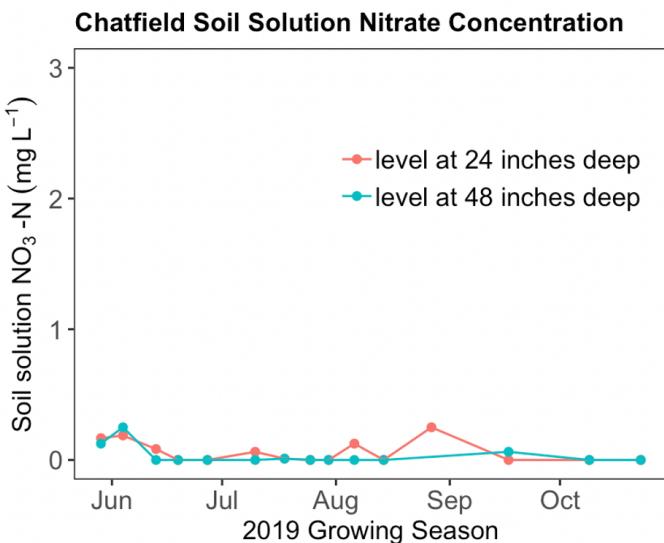
Results

Average nitrate levels in soil water samples collected by lysimeters ranged from 0 to 0.25 ppm in Chatfield and 0 to 0.14 in Pipestone, without a single individual reading over 0.5 ppm. For reference, the EPA's Maximum Contaminant Level for nitrate is 10 ppm. Below, graphs and tables for Chatfield and Pipestone show the average soil solution nitrate levels in milligrams per liter (ppm) for each sampling data throughout the 2019 growing season.

Biomass and grain yields were within expected ranges for unfertilized Kernza. Combine-harvested grain yields in 2020 were 250 lbs/ac in Pipestone and 468 lbs/acre in Chatfield. Straw yields, estimated by quadrant sampling, were 4.5 and 2.5 tons/ac in Chatfield in 2019 and 2020, respectively, and 2.2 and 1.9 tons/ac in Pipestone. A new Kernza variety, MN-Clearwater, has since been released, which produces higher grain yields than the variety used in this study.



Pipestone - Evelyn Reilly



2019 Pipestone Average Nitrate Levels (ppm)											
Date	5/30	6/12	6/25	7/16	7/25	8/9	8/21	9/5	9/19	10/9	10/24
Nitrate	0.09	0.08	0.08	0.14	0.04	0.05	0.03	0.06	0.02	0.04	0.02

2019 Chatfield Average Nitrate Levels (ppm)															
Date	5/29	6/4	6/13	6/19	6/27	7/10	7/18	7/25	7/30	8/6	8/14	8/27	9/17	10/9	10/23
Nitrate	0.15	0.21	0.05	0.00	0.00	0.04	0.01	0.00	0.00	0.05	0.00	0.25	0.03	0.00	0.00

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Green Lands Blue Waters is a vision for productive, profitable agriculture in the Upper Midwest based on the straightforward concept of getting as much value as possible from farmlands by growing crops that keep the soil covered year-round—what we call farming with Continuous Living Cover. The values from the crops we promote can be measured in yields and farm profits; but also as reduced risk, improved outlook for long-term productivity from the soil, more jobs, more wildlife, cleaner water and resiliency in the face of a changing climate.