

**Novel Approaches for Controlling Nitrate Leaching & Protecting
Nebraska Ground Water (NET 18-204)
Quarterly Report 10/1/2021 to 12/31/2021
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Project activities, Partners, and Results. Sampling of the two demonstration sites near Creighton, Nebraska concluded with harvest in October. In 2021, roughly 500 soil and water samples were collected and analyzed for nitrate and other parameters to help evaluate the efficacy of subsurface carbon injection to reduce nitrate leaching under irrigated crops. Additional samples were analyzed for a second column study to measure the long-term effectiveness of ground wood chips and other carbon sources in establishing a bioreactor beneath cropland. The majority of samples tested were collected from the field study. Figure 1 shows preliminary results of difference in average nitrate-N concentrations in lysimeter samples collected beneath treatment and controls. Overall, deep lysimeter (porewater) nitrate concentrations are significantly lower beneath test plots receiving injected carbon. Soil samples have been analyzed for nitrate and ammonia, and results will be compared to pore water nitrate and ammonia beneath treatments and controls. Results for carbon dioxide and nitrous oxide analysis from soil gas samples collected at the same time as the lysimeter samples were analyzed in the USDA ARS laboratory and will be compared to evaluate gaseous loss of nitrogen. Corn crop was sampled from both treatments and controls to determine any effect to crop yield from carbon injection. Results from benchtop column studies suggest that carbon will remain active over several growing periods.

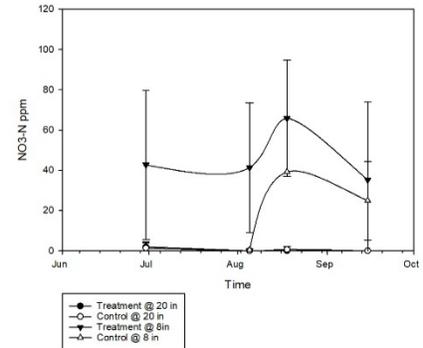


Figure 1. Seasonal variation in pore water nitrate-N concentrations collected beneath one of the demonstration sites. Treatment plots received approximately 600 lbs/acre of finely ground wood at ~14" below the surface.

Partners included Dr. Daniel Miller, USDA ARS Agroecosystems Management Unit, who will continue to study the use of subsurface carbon injection as a method for controlling nitrate leaching with his research team. Other partners on this project include Dr. Arindam Malakar, research assistant professor at the Nebraska Water Center, who assisted with field demonstration and is working with the graduate student to evaluate the results of this work. The Daugherty Water for Food Institute is providing additional funding to support the graduate student through the coming year to help ensure that the project results are summarized and reported in a refereed journal. Dr. Javed Iqbal, an assistant professor in Agronomy and Horticulture, will be conducting additional carbon injection field demonstrations in a new project funded through the USDA AFRI Critical Agriculture Research and Extension (CARE) A1701 program. The Nebraska Water Center produced a video and news article in September 2021 about the demonstration site activities that was picked up by several news outlets.

Future work. The results will be summarized for a journal article describing the utility of subsurface carbon for controlling nitrate leaching. We plan to secure additional funding to improve methods for field injection and further demonstrate this technology.