SD NREC Yearly Report – Christopher Graham

Summary of work completed

The purpose of this research is to ascertain whether additional nitrogen is needed to overcome any nitrogen tie-up by increased microbial populations during the early conversion phase of no-till practices. The study design is such, that nitrogen trials are established across sites that are considered exactly the same (ie. soils, weather, cropping history) except the years since the field was converted to no-till. We established sites ranging from one-year to 20+ years in no-till. In the eastern part of the state, the target crop is corn and, in the west, it is spring wheat.

We have completed the second year of these trials and encountered significant difficulties in establishing the sites. Like much of the state, spring wheat planting was delayed by nearly 5 weeks due to a very wet spring. While we did get all wheat sites planted, two sites (mid- and long-term no-till) were both unusable due to flooding, poor stands and lack of weed control. Hence, only one wheat site produced any useable data. We were able to get long-term and short-term no-till corn sites with N rates established in eastern South Dakota, which will be the focus of discussion here.

Results

Planting was again delayed, and harvest was as well. Soils data has yet to be compiled, but the yield data shows some interesting trends. Figure 1 is the relative yields for short and long-term NT sites. Again, these are sites located across the fence line. As the graph shows, the long-term site was relatively unresponsive to N additions. At 0 N, the long-term site averaged over 50 bu/ac higher than the short-term site. This gap was despite the long-term NT having roughly 50 lbs less soil N at planting. The gap was closed somewhat between sites at higher N rates, but the short-term site was still roughly 15 bu lower at the maximum yield level.

The yield difference between sites was similar to the results seen in 2018. This is particularly true at lower N rates. These results seem to confirm our hypothesis that more recent tillage events tie-up more soil N. Hence, where soil N is low, additional N is necessary to overcome N immobilization for short-term NT. Additionally, variability is significantly higher in the short-term N sites. Overall, variability was approximately 3 times higher in the short-term NT over the long-term site. The increased variability may be due to hotspots created by decomposing organic matter. Previous work has shown that long-term NT tends to reach a more stable equilibrium in which inputs and outputs are more closely aligned. With tillage, more carbon is exposed to oxygen increasing decomposition and nutrient release. If carbon is unequally distributed across a field, hotspots arise creating large variation in yields across the field. This is particularly true where higher N rates were used. Again, these results were similar to that seen in 2018.

Impacts

As we begin to zero in on recommendations for short-term and long-term NT, Figure 2 is an effective tool. When averaged across the entire range of N rates, one lb of N produces over two bushels of corn in the long-term NT and just .9 bu of corn in the short-term NT. At agronomically effective N rates, the N required was roughly 0.9 lb N/bu corn in the long-term NT and 1.4 lb N/bu corn in the short-term. In practical terms, for 150 bu/corn, the N recommendation under these conditions would be 135 lbs N in the long-term NT and 210 lbs N in the short-term.

However, we need to conduct an additional year of study to confirm these findings. Based on the first two years of the study, results indicate that yields tend to be much more stable across a N gradient in the long-term NT. Occasionally, the short-term NT produced higher yields at equivalent N rates, but the variability was generally much higher. At low soil N, long-term NT has shown significantly higher yields, which suggests that more N is made available through the microbial population than in short-term NT. This is an important finding in that it may be justifiable to increase N rates in corn production in the first few years after NT conversion. However, as the age of NT increases, less N may be necessary to maintain yield.

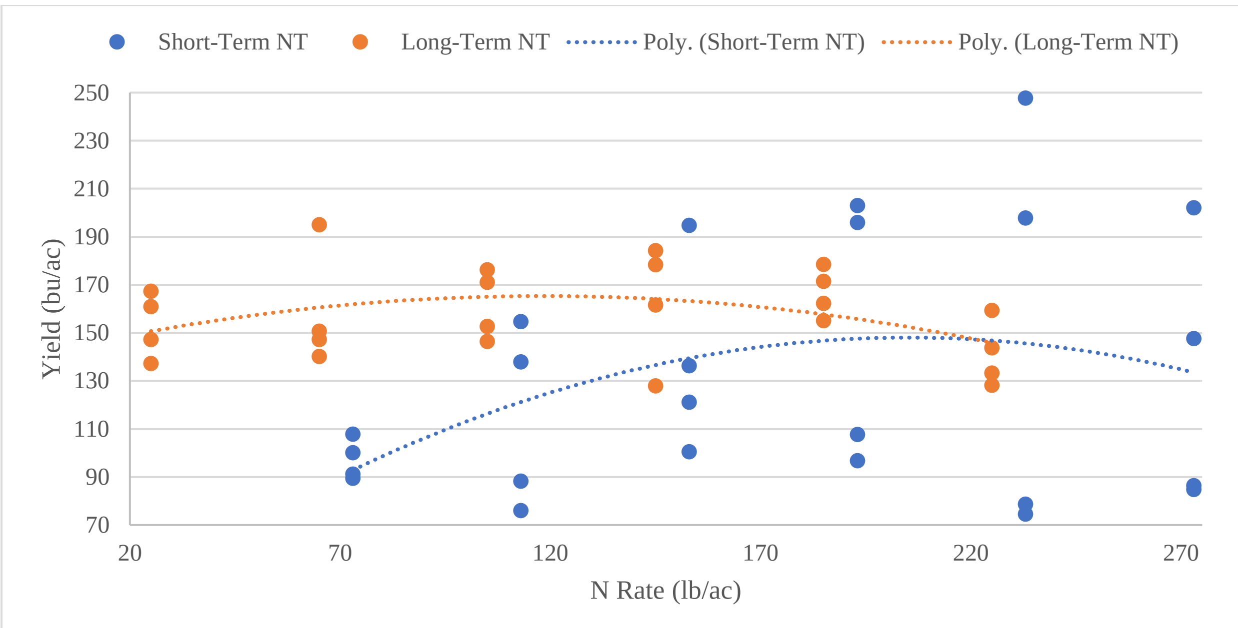

Figure 1. 2019 Corn yield for short and long-term NT sites in Garretson, SD.

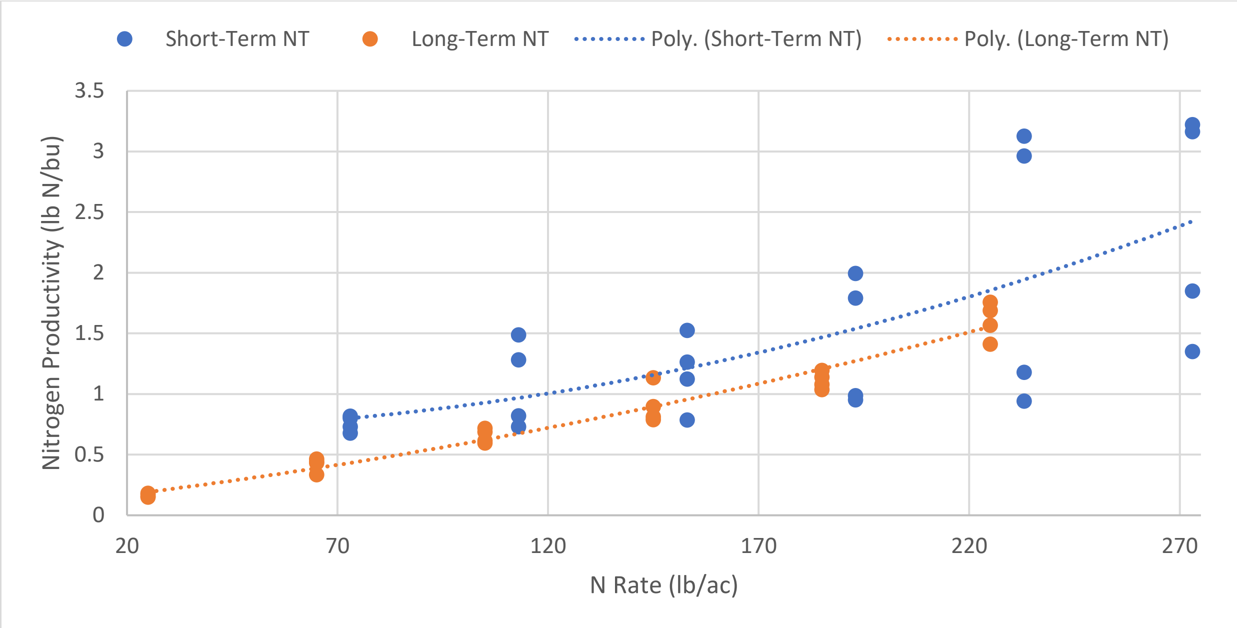

Figure 2. Nitrogen productivity for short- and long-term NT. This is the amount of N it takes to produce a bushel of corn per lb of N.

Budget

The initial budget, by category, is listed below. Of the initial funds ($41,707), there is just over 30% remaining, largely for unspent lab services. We chose to save those funds due to a lack of useable data. Lab funds will be used in the coming growing season and any lack of funding for labor will be re-directed from the PIs discretionary funds.

Table 1. Graham/NREC 2019 Yield Drag Project Funds.

	AMOUNT	
ITEM	BUDGETED	BALANCE
-	____________________	____________
SALARY, LABOR		
& BENEFITS	23,191.00	2,354.55
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TRAVEL	6,852.00	5,283.63
CONTR SERVICES	11,664.00	9,233.47
SUPPLIES	0.00	(2,902.43)
Indirect	0.00	0.00
	____________________	____________
TOTAL O&M	18,516.00	11,614.67
	____________________	____________
TOTAL PROJECT	41,707.00	13,969.22
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