**Alternative Soybean Production Management Options in Acidic Soils**

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**Objectives of the research**

Many fields in western North Dakota are having issues with pH values below 5.5. When the pH drops below these levels it impacts nutrient availability, activity of bacteria in the soil, and reduce yield from Aluminum toxicity. The best management practice for these situations in no-till is a surface application of lime, however it takes a large amount of product to change soil chemistry to adequate levels and a surface application can take time to adjust pH levels. Producers are searching for less costly short term options, especially for rented land. Work done in Oklahoma and Montana has shown phosphorous applied with the seed in wheat and durum can help growth in acidic environments and some producers in southwestern ND have applied lime directly with the seed. A comparison of lime and phosphorous treatments applied with the seed in acidic soil was conducted to observe impact on growth and yield in soybean.

1. Evaluate growth and yield differences among treatments
	1. Observe activity of rhizobacteria through ureide test
	2. Use visual scores and measurements to better understand soybean growth in relation to harvested yield
	3. Calculate the economic outcome of using different management strategies
2. Increase the knowledge base of soybean practices in southwest North Dakota
	1. Create a bulletin on soybean production in southwest North Dakota
	2. Host workshops to present data and answer production questions
	3. Host in-service training to county extension agents
	4. Use social media and other media outlets to distribute information to growers and the general public

**Completed work**

 Due to drought conditions during planting and vegetative growth there was considerable stand loss and poor growth. Thanks to some late season moisture during the flowering period we were still able to observe some differences among treatments, but it is difficult to decipher impact from drought or treatments. With poor stands and limited growth at the site along with impacts from COVID-19 we did not have any extension events at this location in 2020. We also chose to submit plant tissue samples instead of going through with the ureide test due to the limited plant growth. Some side experiments at the site have also shown some promise with the use of gypsum applied with the seed and these findings have been applied to the proposal for research in 2021. A report on this trial has been submitted to the Western Dakota Crops Day research report and will be mentioned at the DIRT workshop. Due to the poor condition of the site from drought, there wasn’t much outreach conducted with this site. The proposed location lined up for research next year is right next to a stop on the Enchanted Highway and preliminary soil sampling shows consistent pH below 5.5. Data from 2020 will be mentioned at field events at this site, depending on social distancing regulations.

**Preliminary results**

As seen in Table 1 and Table 2 both lime and P rates had a significant impact on soybean yield. There was no significance on the interaction between the two treatments. Lime showed a significant yield bump at 75 lbs in furrow with no difference between 75 and 100. This yield increase aligns with a difference in amount of aluminum found in the tissue samples for these treatments, this will be repeated in 2021 however we face drought conditions again. While we can see some differences the yield of the crop was majorly impacted by dry weather conditions in 2020. Further research is being requested for 2021 to confirm these findings. It is important to remember that these small rates of lime in furrow is not enough to have a major impact on soil pH levels.

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| Table 1. Yield and Al levels across lime treatments. |
| Lime applied in furrow | Yield | Aluminum from tissue samples |
| lbs/ac of product | bu/ac | % |
| 0 | 13.9 | 45.6 |
| 50 | 13.9 | 40.9 |
| 75 | 15.7 | 31.8 |
| 100 | 15.8 | 31.4 |
| 4000 (surface applied) | 14.5 | 51.2 |

Phosphorous treatments had a visible impact on plant stand, however this was aggravated further with dry conditions at and following planting. As P rates go up, the yield goes down as seen in Table 3. These treatments did not have a significant impact on Aluminum levels in 2020. Further research is needed, but a reduction in plant stand was expected, however with soybeans especially, stand loss doesn’t always necessarily mean yield loss. More data is needed to see how much of the impact on stand loss and yield reduction was from drought and how much was from the treatments and soil pH.

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| Table 2. Yield across P treatments. |  |
| Phosphorous in furrow | Yield |
| lbs/ac | bu/ac |
| 0 | 16.2 |
| 30 | 14.5 |
| 60 | 13.5 |

**Work to be Completed**

Data from this trial will continue to be discussed when educating on soybean production in the region. More data is needed to make solid recommendations. I plan to continue to conduct experiments on soil acidity. While liming these fields would be the preferred practice, I continue to hear from many that it is very difficult to pay for lime application, especially when the land isn’t owned by the producer.