

Acid soil management update

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No-till practices paired with heavy nitrogen (N) use have acidified the soil surface on many acres in the Northern Great Plains. Acid soil where the pH drops below 5.5 has an impact on nutrient availability, soil microbial activity, herbicide efficacy, stunted roots from aluminum (Al) toxicity and other plant/soil interactions. These areas can be improved from surface liming or lime incorporation; however, liming can be costly. We are continuing efforts to collect data on surface applications of lime at different rates in different environments and soil types. With incorporation of lime we can see a faster and deeper reaction of lime, however this tillage can negate the hard built efforts of no-till management. In a trial we have in Hettinger county, ND it was shown early in the growing season that our tillage pass was looking nice and green with all of the moisture we had, but as drought set in the tilled area dried out much faster and yield was greatly impacted. There are many factors that will go into decisions on how to manage these acid areas of fields and in some cases whole fields. Each management system is different and with each system comes different challenges. All management systems have trade-offs and you will need to decide what is best for your operation, but without lime application the acidity issue will continue to worsen. For many producers facing this issue, especially those working rented land, there is a search for alternative options to reduce yield loss on acid ground. Research has been conducted in western North Dakota on adaptive management strategies for mitigating the symptoms of aluminum toxicity and soil acidity including variety selection, in-furrow fertilizer application, and seed treatments. Variety selection showed a significant difference in yield (Table 1). Calcium in-furrow did not have an impact on yield (Table 2). Across HRSW varieties a yield bump of 1.5 bushel in 2021 and 9.3 bushels in 2022 was shown from seed placed P (0-45-0) applied at high rates (60 lb P₂O₅/ac) (Table 3). In 2021 we tried a wide range of seed treatments and foliar applications on wheat in acid soils including PGR's and biologicals that showed no response across 2 locations. The data suggests use of tolerant varieties along with in-furrow P fertilizer can be used to alleviate yield reduction of small grains on an acid soil. Ideally producers should be applying tons of lime to bring the pH above 5.5 because the variety and fertilizer may fix the yield loss but does not fix issues with pesticide breakdown and carryover, soil microbiological activity, and nutrient tie-up; all issues caused by acid soil. The implications of soil acidity reach much farther than an impact on yield but an overall attack on the ability to profitably manage your inputs. There are 3 main components in yield; plants per acre, seeds per plant, and seed size. Acidity in one way or another has an impact on all three of those components. The impacts on stand can be great as seen by many facing this issue. As seen in Figure 1 stand loss is often found in acid soils. The area to the left of the photo had an average pH of 4.8 with some spots showing a pH of 3.9 and the right side of the photo had an average pH of 5.1. A tissue analysis showed that the plants on the right had much less stress from aluminum toxicity with less than half the accumulated Al than the plants with reduced stand on the left with ppm of Al of 40.8 and 98.0 respectively. Not only did this show on the tissue samples but also manifested with shorter stressed plants with smaller heads. With each passing year more N is added to the system further acidifying the soil. As pH drops, Al becomes more soluble in soil solution. To fix this we need to add tons of lime and potentially reevaluate our fertilizer management.

Table 1. HRSW variety across fertilizer treatments, Dickinson 2021 and 2022.

Variety	Yield	
	2021	2022
SY Soren (susceptible)	19.6b	47.5b
Lanning (tolerant)	22.3a	65.4a
LSD (0.05)	1.2	3.2

Table 2. Calcium fertilizer yields of HRSW across other treatments, Dickinson 2021 and 2022.

Treatment	Yield	
	2021	2022
Control	21.4	54.3
Lime in furrow	20.3	56.3
Gypsum in furrow	20.8	57.4
Calcium nitrate in furrow	N/A	57.8
LSD (0.05)	ns	ns

Table 3. P fertilizer across HRSW varieties, Dickinson 2021 and 2022.

Treatment	Yield	
	2021	2022
Control	20.1b	51.8b
60 lbs additional P	21.6a	61.1a
LSD (0.05)	1.2	3.2



Figure 1. Sunflower stand greatly reduced by soil acidity.