Managing areas of fields with high pH

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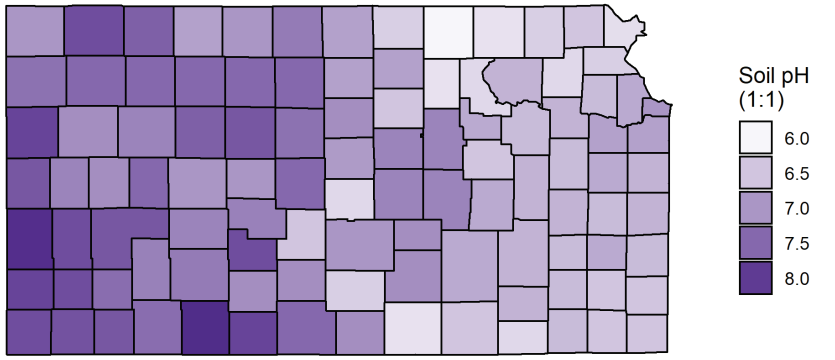
Overview

- Understanding high pH
- Options for management
- Effects on nutrient availability and soil test
- pH stratification in no-till

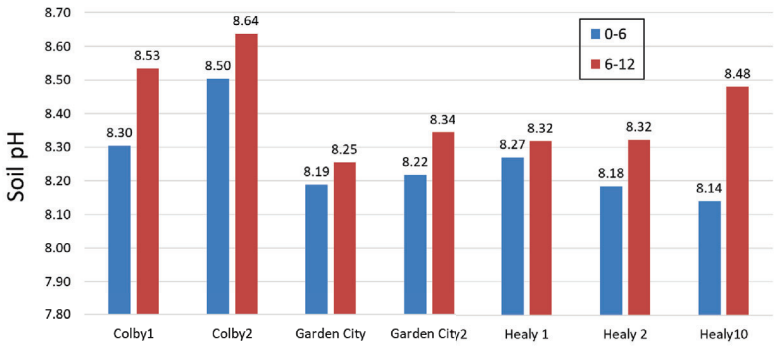
Soil pH and nutrient management

- pH is easy to measure in the lab and reliable
  - Concentration of H (Logarithmic scale)
- High pH- calcareous soils generally limit nutrient availability (particularly micros)
- Low pH and soluble aluminum can limit root growth and nutrient availability

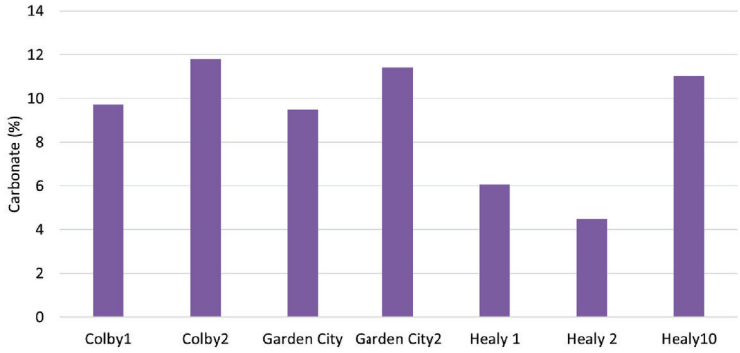
Soil pH trends vary substantially across KS



Selected high pH soil locations
Soil pH by depth: 0-6 in vs 6-12 in



Selected high pH soil locations
carbonate content (%) at 0-6 in depth



Can we neutralize calcium carbonate?

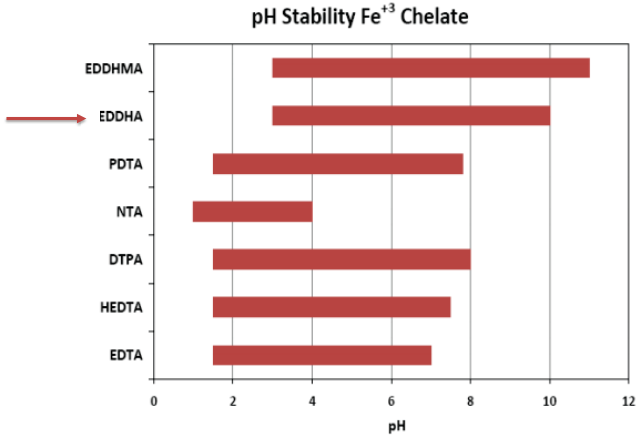
- S (oxidation) => H_2SO_4
- H_2SO_4 + $CaCO_3$ => $CaSO_4$ + H_2O + CO_2
- 1 lb of elemental S neutralize 3.1 lbs of $CaCO_3$
- 0-6” soil at 8% $CaCO_3$= 160,000 lbs $CaCO_3$/acre (80 tons)
- Will need about 26 tons/acre of elemental S

High pH, calcareous soils and driving factors for Fe chlorosis

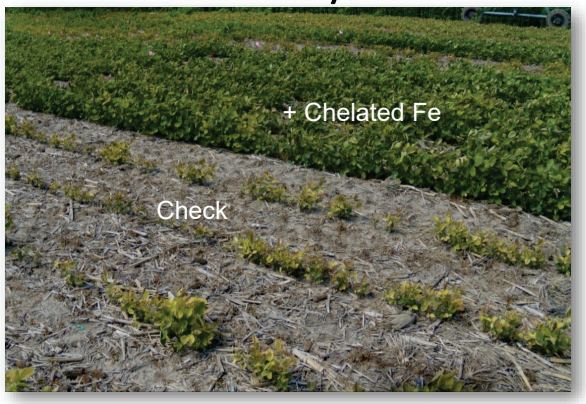
- High soil pH and the presence of calcium carbonate
- Other soil factors: salt accumulation, high nitrates
- Biotic and abiotic stress: wet soils, pest/disease damage etc.

Iron deficiency chlorosis in high pH calcareous soils

Stability of chelates with different pH

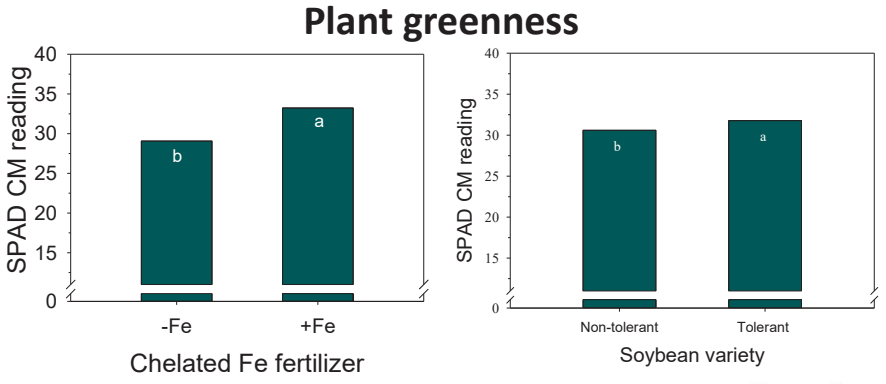


In-furrow application of EDDHA chelated Fe to soybean



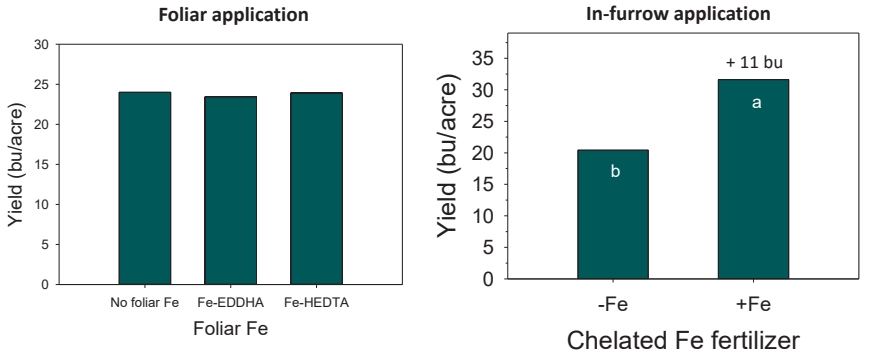
Chelated Fe fertilizer: ortho-ortho EDDHA Fe (6.0%)

Soybean response to EDDHA chelated fertilizer and variety



Average of 8 location

Soybean yield response



Average of 8 location

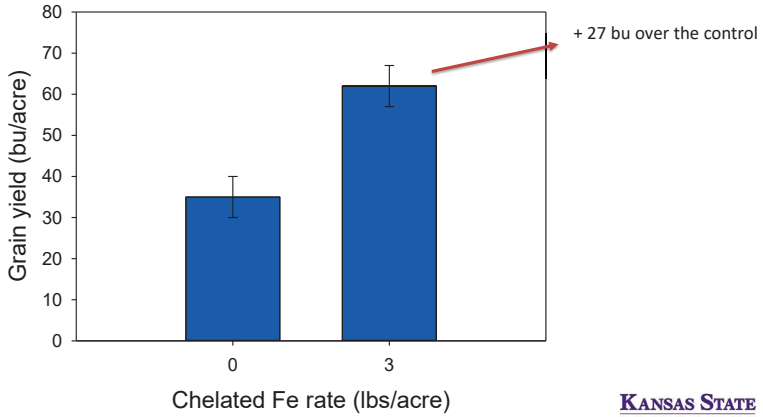
Chelated Fe application for grain sorghum

Check

3 lbs in-furrow EDDHA Fe (6.0%)

A. Obour, 2015

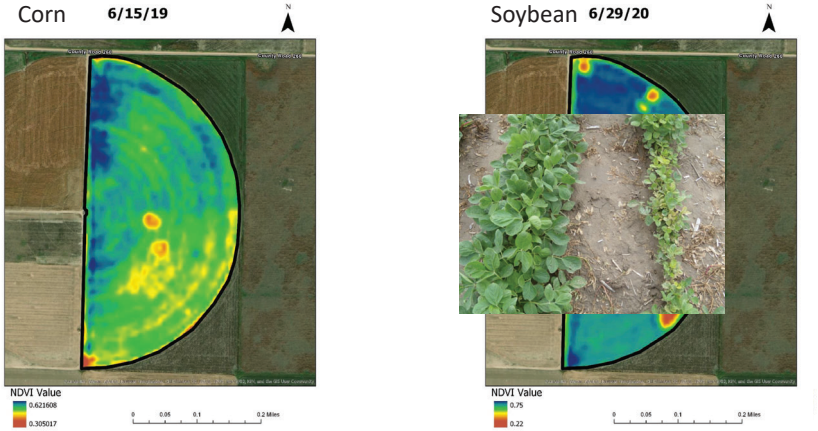
Sorghum yield as affected by chelated Fe application



Average of two locations, A. Obour, 2015

Fe fertilizer sources and the need of targeted applications

Effective Fe fertilizer sources, need targeted applications

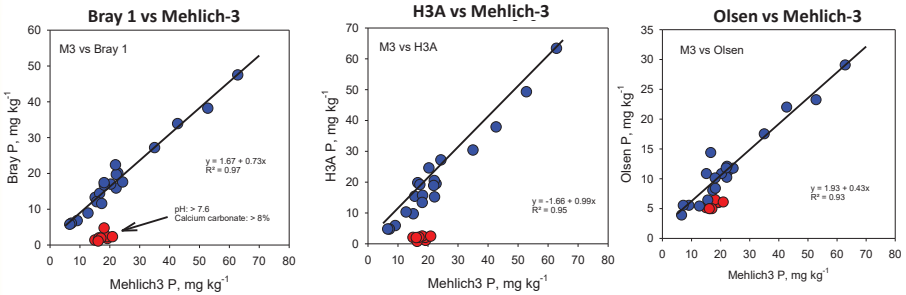


High pH calcareous soils and chlorosis

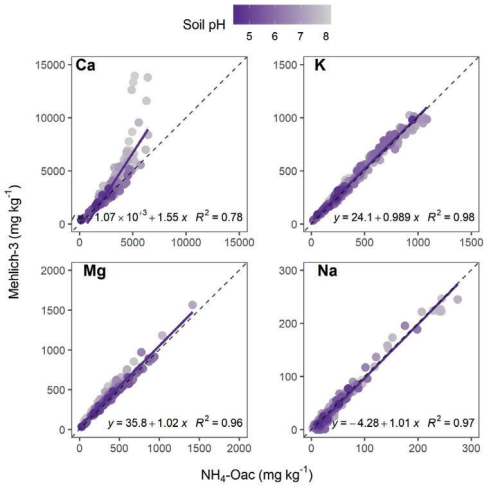
- Iron fertilizer sources are not the same. Type of chelate is important, particularly on “extreme” high pH soils.
  - Plant availability and cost
- Opportunities for high return to investment
  - But “blanket” applications are ineffective and waste expensive fertilizer in areas with no crop response.
- Combination of management options should include variety selection

Soil pH and other fertility considerations?

Phosphorus: effect of calcium carbonate on soil test P extraction methods

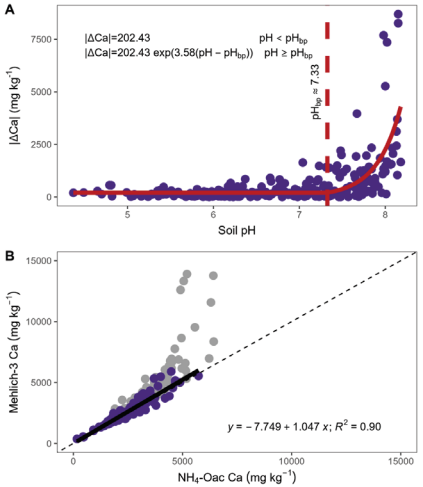


Mehlich-3 exchangeable cations



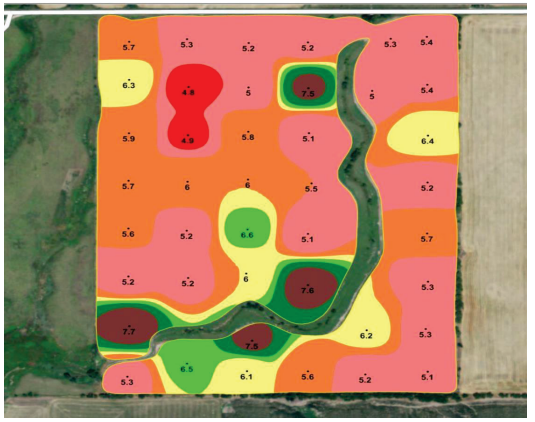
- K, Mg, Na highly correlated between methods
- Strong pH dependence for Ca
- M3 over-estimated exchangeable Ca in high pH soils

Calcium test with Mehlich-3



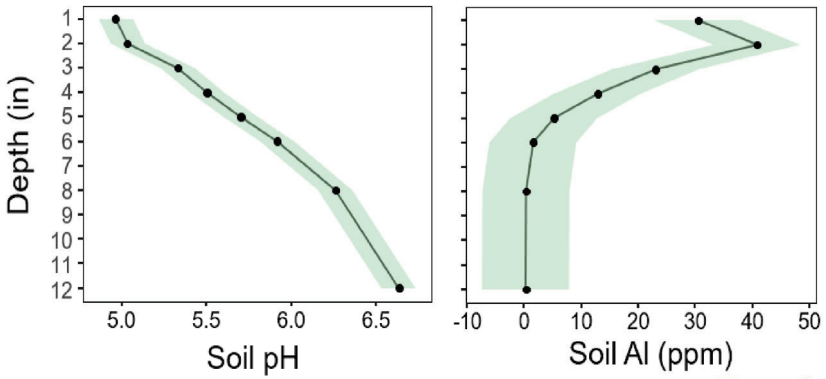
- M3 Ca >> Ammonium Acetate Ca in high pH soils
- Soil pH of 7.3 identified as break point
- Should not interpret M3 Ca as “exchangeable” if pH >7.3
- Ca extracted from carbonates

Variability of soil pH in the field



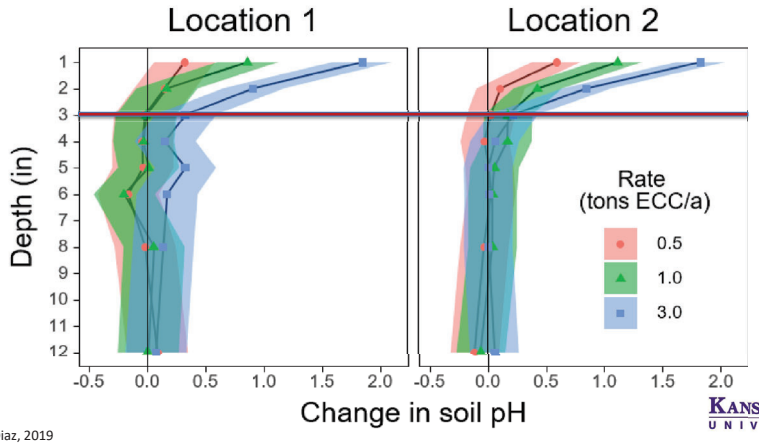
* 0-6 in sampling depth, NW Kansas

Soil pH stratification in no-till, and soil aluminum



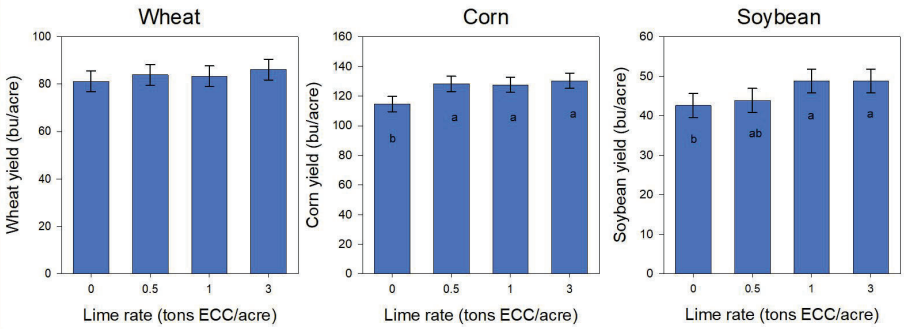
Average of two locations Mitchell and Jewell Co

Changes in soil pH with surface lime application



Ruiz Diaz, 2019

Average crop response to lime rates



Ruiz Diaz, 2019

Crop response and lime application in no-till

- Small yield increase, but shows across crops-years: the need to assess economic return multi-year.
- Surface lime increase soil pH only in the upper 3 in.
- For soils with neutral to alkaline subsoils, surface lime applications in no-till contributed to response for corn and soybean, and restored soil pH near the surface.
- Optimum soil pH near the soil surface can also improve other factors such as herbicide efficacy under no-till.

Summary

- Soil pH can be highly variable in some fields
- Stratification can be significant for long term no-till: may require different sampling depth
- pH can also affect soil test methods (particularly high pH)
  - Need to consider the most appropriate soil test method

Thank you!

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