Remediation of stratified soil acidity through surface application of lime in-nom-cropping systems

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Introduction:
Accelerated soil acidification resulting from application of ammonia-based fertilizers has been an issue of increasing concern in the Palouse region of Eastern Washington and Northern Idaho (6).
Low soil pH reduces crop yield as acidic conditions release phytotoxic levels of aluminum (Al) and manganese (Mn).
Soils that developed under native prairie have greater base saturation, organic matter and increased buffering capacity to resist pH changes as compared to soils that developed under native forest.
In no-till systems acidification is often concentrated in a stratified band where fertilizer has been placed.
Traditional incorporation of lime materials is not possible for producers wanting to maintain no-till management systems.
Surface application of lime has been shown to remediate stratified acidic conditions (3).
Recent availability of an ultra-fine (1-2 micron) fluid lime may help growers address stratified soil acidity issues.

Objectives:
Assess surface application of fluid lime and sugar lime on crop and soil properties in no-till cropping systems with stratified soil pH

Methods:
- Two sites representative of soils that were historically forested (Rockford) or in native prairie (PCFS) prior to agricultural cultivation
- November 2013 application of two calcium carbonate sources to experimental field plots in a Complete Randomized Block Design
  - Ultra-fine (1-2 micron) particle size fluid lime (NuCal), applied with a spray at rates: 200 lbs/acre, 400 lbs/acre, 1000 lbs/acre and 2000 lbs/acre calcium carbonate equivalent
  - Sugar lime - byproduct of sugar beet processing, shaken onto the soil surface at rates: 400 lbs/acre and 2000 lbs/acre calcium carbonate equivalent
- Spring soil sampling from 0-10 cm divided into 2-cm strata
- Above-ground biomass was taken at anthesis stage from each plot by hand with a 1 m² quadrat
- Chickpea yield was harvested using a plot combine in 15' x 30' strips

Results:
There was no significant difference between the lime treatments with chickpea or canola above-ground biomass, or chickpea yield (data not shown)

Discussion:
- Soil pH is important for maintaining soil quality, optimizing nutrient availability and avoiding problems with Al and Mn toxicity. Lime application is known to raise pH.
- In this study, surface-applied lime at the highest rates increased soil pH at the 0-2 cm depth, within 6 months of application regardless of lime source and location.
- There was no significant difference between the lime treatments with chickpea or canola above-ground biomass, or chickpea yield (data not shown)

Concentration of Mn at the surface depth (0-2 cm) was reduced under the 2000 lbs/acre rate of fluid lime at both sites as well as sugar lime at PCFS

Concentration of soil exchangeable Al at the 0-2 cm depth was reduced significantly between the 2000 lbs/acre and control treatments at both sites

References:

As pH decreased Mn increased at PCFS and at both sites Al increased exponentially

Soil pH stratification 0-30 cm at two sites

Soil pH at the surface depth of 0-2 cm, increased significantly between the 2000 lbs/ac rate application of both lime sources and the controls

Concentration of soil exchangeable Al at the 0-2 cm depth was reduced significantly between the 2000 lbs/ac and control treatments at both sites

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Lime treatments at Rockford

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Plant tissue concentrations of aluminum (Al) and manganese (Mn) showed no significant difference between treatments

Differences in Al concentrations in above ground biomass with lime treatments

Mn concentrations in above ground biomass with lime treatments

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