Sand County Foundation
Conservation Brief

2019 Issue 2 • No. 1

Can an Industrial Byproduct Improve Soil Health and Water Quality?

Used commercially to make wall board, gypsum is also spread on farmland to improve soil productivity.

How does a byproduct of the power generation process fit into agriculture?

Sand County Foundation's work to find ways to limit agriculture's impact on water quality involves an unlikely product: gypsum. We evaluated gypsum extracted from the exhaust of electric power plants and applied it to cropland as a way to reduce phosphorus draining into waterways after intense rainstorms.

Flue Gas Desulfurization (FGD) is a technology that was integrated into the coal fire power generation process to reduce sulfur dioxide emissions, a chemical contributor to acid rain. The chemical reaction used in FGD technology can remove sulfur dioxide by mixing it with limestone, resulting in a synthetically made gypsum product, nearly identical to naturally mined gypsum.

What are the uses of gypsum?

Gypsum is commonly applied to farm fields as a soil calcium or sulfur amendment for crop nutrition. By weight, synthetic gypsum can be 20-25% calcium and 15-20% sulfur. Calcium stimulates root growth and leaf development and strengthens plant structure. Sulfur promotes nodulation for nitrogen (N) fixation by legumes and aids in seed production. Since passing the 1970 Clean Air Act, emissions of sulfur dioxide have decreased, resulting in reduced deposition onto our soils and observed sulfur deficiencies in some crops.

From a soil health and environmental perspective, gypsum can improve soil aggregation (the capacity for soil particles to strongly bind to each other). The calcium induces the ability of soil particles to come together and form aggregates. In sodic soils (compact with poor water infiltration) the calcium can displace sodium held onto clay-binding sites, allowing the sodium to be leached from the soil. This improved soil structure and stability increases water infiltration and percolation, decreases surface runoff, improves the soil's trafficability, and reduces the potential loss of soil particles.

When synthetic gypsum is applied as a soil amendment to farm fields, it could potentially reduce phosphorus (P) loss through several processes. First, through less erosion and runoff as a result of the improved soil structure, but also through an increased ionic strength of the soil solution which will increase the mineral adsorption of phosphate. Also, the dissolved P can react with the calcium to form calcium phosphate, which is less soluble but still plant available. The dissolved P is an ion with a negative charge (anion) while the calcium is an ion with a positive charge (cation); therefore, the two react to form a compound. This transformation can reduce surface runoff and leachate loss of dissolved P, which is a contributor to increased eutrophication rates in rivers and lakes.

Sulfur promotes nodulation for nitrogen fixation by legumes and aids in seed production.

Q & A:

How did Sand County Foundation get involved in synthetic gypsum?

To evaluate the agronomic and environmental benefits of applying synthetic gypsum onto farm fields, Sand County Foundation collaborated with the Electric Power Research Institute, University of Wisconsin and We Energies on a demonstration project.

Edge-of-field runoff monitoring devices were installed on actively farmed ground to monitor three control fields (no gypsum applied) and three treatment fields (gypsum applied). FGD gypsum from a We Energies coal-fired power plant was spread across the treatment fields – the first application was in the spring and the second during the winter when soils were frozen. Both applications were at 1 ton of gypsum per acre. Rain occurred within the day following the summer application, which resulted in measurements of elevated sulfur concentrations in the runoff from the treatment fields, indicating that the water soluble FGD gypsum had been washed off the soil surface. The winter application occurred on a cold morning onto frozen soil. As the temperature increased throughout the day, the FGD gypsum adsorbed well to the soil.

What did we learn?

The field data collected did not show statistically significant crop yield or water quality improvements from the gypsum treatment due to the short time frame of the study. However, laboratory observations suggest that as soil P concentrations increase, the application of gypsum may have a greater impact on reducing potential runoff losses.

Considering applying gypsum as a soil amendment?

Please first review *NRCS Practice Code 333 - Amending Soil Properties with Gypsum Products.*

To learn more please contact:

Greg Olson, 989.430.5483
golson@sandcountyfoundation.org

Heidi Peterson, 612.504.7186
hpeterson@sandcountyfoundation.org

For more information visit:

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