Using Calcium Sulfate
To Amend
Poorly Drained Soils, Gumbo Soils, High pH Soils, and Alkali Soils

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Using Calcium Sulfate To Amend Poorly Drained Soils & Gumbo Soils

Calcium sulfate has been used for decades to improve soil drainage. Until recent years explanation of how this is accomplished has been uncertain. Now we at least have some theories.

Figure 1. Soil with a high capacity to shrink and swell with drying and wetting.

Soils high in clay content, particularly montmorillonite clays, have a high shrink-swell capacity. When these clays become wet, they swell and the percolation and infiltration is greatly reduced.

Applying a neutral salt such as calcium sulfate increases the salt concentration of these soils. This will reduce the swelling of these clay particles. This enhances the infiltration and percolation of water downward through these soils.

Calcium in calcium sulfate is also quite soluble and will react with clay particles to enhance the aggregation (clumping together). This will improve soil structure and allow for greater pore space.

Soils that are considered gumbo usually have a high magnesium level. Research has shown that the magnesium ion has a larger hydrated radius. This causes a more dispersed clay soil structure causing infiltration to be less. By adding calcium through calcium sulfate this slightly dispersed state is reversed.

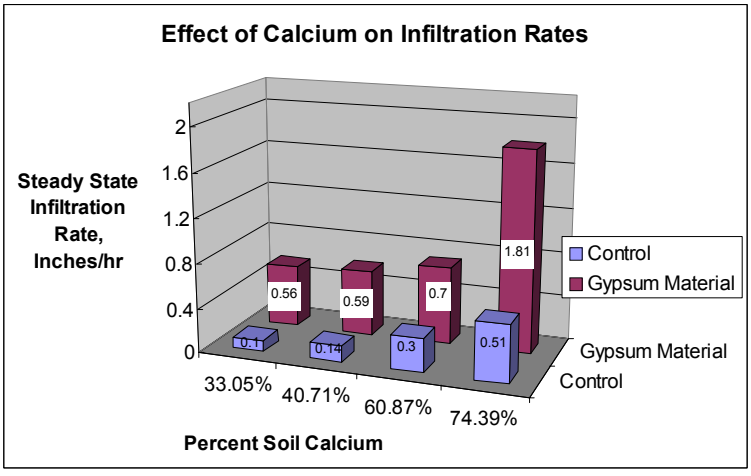

Figure 2. These soils all had higher infiltration rates with the addition of gypsum. (Source: Purdue University; Dontsova & Norton)

Visual Observations: Where calcium sulfate is applied to these soils, less water ponding will be noticed and crusting will be greatly reduced. Tillage of these soils will require less horsepower.

Using Calcium Sulfate to Amend High pH Soils

Soils with a pH above 7.5 often yield less. This can be due to several factors. Availability of many nutrients is less as the pH increases above 7.2. Bicarbonates form in these soils more easily which also reduces nutrient availability, but will also cause a toxicity to roots of many plants.

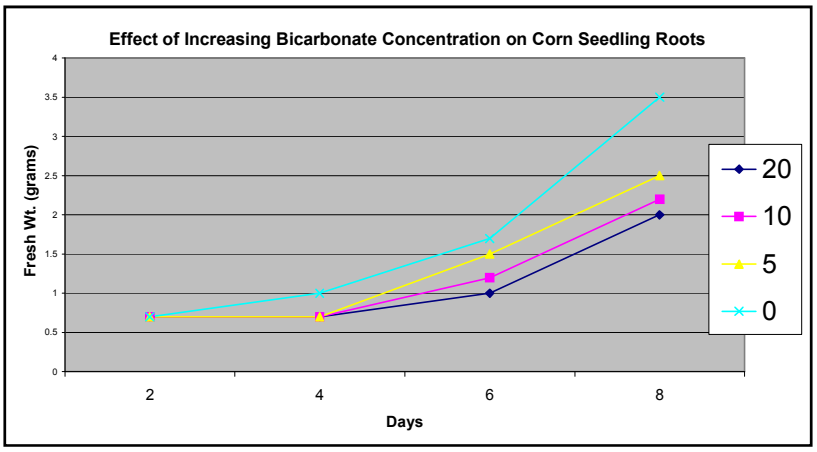

Figure 3. Root growth is diminished as the bicarbonate level increased.

High pH soils also may have calcium carbonate present which will tend to cement soil particles together causing a surface sealing. This will reduce water infiltration as well as air exchange into the soil as it dries.

Calcium Sulfate applied at rates of 1 to 2 tons/A increases availability of many nutrients in high pH soils. One means that this is accomplished is that the sulfur applied at these rates causes a reaction with many of the nutrients that enhances their availability.

Calcium sulfate also dissociates in soils and the calcium will react with the bicarbonates to tie them up. This will reduce the toxic affect to roots. The addition of calcium sulfate to soils with free lime also reduces the hard-setting or surface sealing. This is the same reason that a small amount of calcium sulfate is added to cement. It reduces how quickly the concrete will harden, thus reducing cracking.

Using Calcium Sulfate to Amend Alkali Soils

Soils that contain sodium at high levels are referred to as alkali soils. Sodium will cause soil structure to deteriorate. This is due to sodium having a greater hydrated radius than calcium. This keeps soil particles farther apart. Also sodium has a single positive charge compared to calcium which has two positive charges. With two charges calcium will bind soil particles together improving soil structure.

Calcium sulfate contains 22% calcium that will react readily with soils to replace sodium on the soil particle. The sodium will then react with the sulfate sulfur and be leached below the root zone. This will improve the soil structure and crop growth from the previous alkali condition.

Results

Figure 4. Untreated check remained yellow after a heavy rainfall event. Where gypsum was applied, water drained away and corn remained green.

The picture to the left shows a field where calcium sulfate was applied (1 T/A) to the area on the right of the picture. The yellow corn on the left was an untreated area.

The yield response to calcium sulfate applied to this field exceeded 100 bushels/acre. This was due to improved soil structure which increased the infiltration and allowed air back into the soil.

The picture of soybeans to the right is from a field in the Missouri River valley where calcium sulfate was applied at a rate of 2 to/acre to a high pH (8.1) soil. The soybeans were taller where the calcium sulfate was applied and they yielded over 10 bushels/A more in the treated area.

Figure 5. Farmer shows the difference in height of the soybeans. The treated soybeans were about six inches taller.

The producer reported that this part of this field has had performance problems in the past. This application of calcium sulfate should give many years of improved performance.

The picture to the left is from a field in the Missouri River valley where calcium sulfate was applied at a rate of 1.5 ton/A. The corn plants are from the treated area.

Figure 6. This corn plant was fromt the area that received 1.5 tons of PRO CAL 40 two years previous.

This picture to the right is taken from plants in the untreated area just a few feet away from the picture above. The farmer reported a 30 bushel yield difference between the treated and untreated areas.

Figure 7. These corn plants were a few feet from the other green plants in the untreated area of the field.

PRO CAL 40

Pro Cal 40 is a premium grade calcium sulfate produced from the processing of corn sugars at Blair, NE. Due to its very fine crystalline physical properties, it is faster acting than many other calcium sulfate sources. It is marketed by Soil Solutions, LLC of Holstein, Iowa.

Economics

The beneficial affects of calcium sulfate applied at the rates of 1 ton/A or greater can be expected to last for 3-6 years.

If 1 ton is applied for a price of $30/A and average yield increases of 12 bushel/A corn and 6 bushel/A soybeans are realized then returns of greater than $200 per acre can be expected over a four year period. In some soils $ returns may exceed $80 per year.

In addition, less expense will be realized in energy costs as the treated soil does till with less horsepower. Many soils will be able to be no tilled that would otherwise be impossible to no till due to poor soil structure. This will also mean less cost.

References

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