*Have questions? Send them to Dave at: ISU, Hort. Dept., Ames, IA 50011.*

# What's the Scoop on Gypsum?

***I have always been told that gypsum can improve soil structure in heavy clay soils. Is this true?***

*by Dr. Dave Minner*

Gypsum ($CaSO_4$) is often applied, but seldom needed on sports fields. The classic misunderstanding with gypsum arises from its association with improving water movement and soil structure on sodic (high sodium) soils that are typically found only in semi-arid climates.

Gypsum is correctly used on sodic soils that have undergone a process of deflocculation. In this case, gypsum will likely improve soil structure and water infiltration. A brief review of soil cation exchange capacity (CEC) and soil aggregation may help you understand the process.

## Aggregation and deflocculation

There are many negatively (-) charged sites on the surface of clay particles. Some of the more important nutrients are positively charged (calcium: $Ca^{++}$, magnesium: $Mg^{++}$, iron: $Fe^{++}$, and potassium: $K^{+}$). These nutrients attach themselves to the negatively charged soil particles.

Positively charged nutrients are called cations. The CEC is simply a measure of how many negative sites are available to attract these positively charged cations.

Small individual soil particles are clumped together to form aggregates, or "soil crumbs." Calcium can initiate this granulation in a process called flocculation, and gypsum is a source of calcium. However, flocculation alone does not make aggregates stable.

Organic matter and other viscous microbial products stabilize soil aggregates. In a well aggregated soil, there are large voids between the soil crumbs. The large voids, or macropores, improve water infiltration.

Now back to gypsum. The CEC sites in sodic soils are dominated by sodium (Na). Cations that help soil aggregation, such as $Ca^{++}$ and $Mg^{++}$, are displaced by $Na^{+}$. Excessive levels of sodium reverse the process of aggregation and cause soil crumbs to disperse into individual soil partcles.

The deflocculation that occurs in sodic soils results in a very tight arrangement of individually dispersed soil particles saturated with $Na^{+}$. Macroporosity is greatly reduced, and water infiltration slows to near zero.

Wet sodic soils are slick, sticky and have poor drainage. When dry, they become quite hard. Gypsum is correctly used to remedy these problems caused by excessive sodium in the soil.

## Gypsum application

The $Ca^{++}$ in gypsum ($CaSO_4$) displaces $Na^{+}$ on the exchange site. The freed $Na^{++}$ reacts with sulfate ($SO4^{-}$) to form sodium sulfate ($Na_2SO_4$), a highly water soluble material that is leached from the soil. Removing $Na^{+}$ and replacing it with $Ca^{++}$ on the exchange site reduces deflocculation and allows natural aggregation of particles. This eventually restores soil structure.

Gypsum is very useful, but *only* when soil structure deteriorates because of high $Na^{+}$. This applies to a very small percentage of sports turf soils. The belief that gypsum can improve structure and drainage in *any* heavy clay soil is a misconception.

Unfortunately, the symptoms that indicate problems in sodic soils are very similar to those of heavily trafficked clay soils that are not affected by $Na^{+}$. Both situations create hard turf with poor structure and drainage. To add confusion, gypsum is often advertised as a "soil softener." Only a soil test will determine if there is a true need for gypsum application.

Most soil scientists agree that gypsum will not improve poor permeability due to problems of soil texture, compaction, hardpans, claypans, or high water tables. Though gypsum offers other benefits to sports turf, sports turf managers should not rely on it to reduce compaction and improve drainage in their fields. ❑

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