APPLYING GYPSUM – when is it really needed?

by Dr. David D. Minner

Gypsum ($CaSO_4$) is often applied but seldom needed on Iowa [*or New Jersey*] 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 not typically found in Iowa [*or New Jersey*].

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 how this is actually accomplished by gypsum. 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^{+}) and attach themselves to the negatively charged soil particles. These positively charged nutrients are called cations. The CEC is simply a measure of how many negative sites are available to attract the positively charged nutrients or cations.

Soil aggregation is another term you will need to understand to follow this discussion. Small individual soil particles are clumped together to form aggregates or "soil crumbs." Calcium - gypsum is a source of calcium - can cause this granulation to initiate in a process called flocculation, 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 larger voids between the "soil crumbs." The larger voids or macropores improve water infiltration.

Now, back to gypsum. The CEC sites in sodic soils are dominated by Na. Other cations that help soil aggregation, such as Ca^{++} and Mg^{++}, are displaced by Na^{+}. The excessive sodium reverses the process of aggregation and causes the "soil crumbs" to disperse into individual soil particles. 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. When wet, sodic soils are slick, sticky, and have poor drainage. When dry they become quite hard. Gypsum is correctly used to remedy this situation caused by excessive sodium in the soil. The Ca^{++} in gypsum ($CaSO_4$) displaces Na^{+} on the exchange site. The Na^{++} reacts with sulfate (SO_4^{-}) to form sodium sulfate (Na_2SO_4); a highly water soluble material that is ∞leached from the soil.

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Removing Na$^+$ and replacing Ca^{++} on the exchange site reduces deflocculation and allows natural aggregation of particles that eventually restores soil structure. Gypsum is very useful when soil structure deteriorates because of high Na$^+$.

The **misconception** arises when there is a belief that gypsum can improve structure and drainage in any heavy clay soil, even those not necessarily affected by Na$^+$. A Na$^+$ impact on soil structure that requires the application of gypsum only occurs on a small percentage of sports field soils. A soil test will determine the need for gypsum application. The problematic symptoms of sodic soils are very similar to those of heavily trafficked clay soils that are not affected by Na$^+$; both are hard and have poor structure and drainage. To add confusion, gypsum is often advertised as a "soil softener" material. Most soil scientists agree that gypsum will not be useful for improving poor permeability due to problems of soil texture, compaction, hardpans, claypans, or high water tables. Most sports field managers should not anticipate a reduction in compaction and improved drainage by using gypsum. Even with this misconception, there are situations where gypsum is useful in sports fields.

Gypsum ($CaSO_4$) can be used to supply Ca. When pH is above 6.7 and Ca is deficient, gypsum instead of lime ($CaCO_3$), should be used to supply Ca. Lime applied to an already high pH would further increase pH and may lead to iron deficiency. Gypsum supplies Ca without increasing pH. A suggested target range for Ca in the plant is 0.4 to 1.2%.

Many water supplies are often high in Na$^+$. Sand based systems irrigated with high Na$^+$ water may have excessive Na$^+$ on the exchange complex. Since sands do not deflocculate, the high Na$^+$ in this case will not result in reduced drainage. Sands retain their macroporosity through particle size arrangement rather than by aggregation of particles. The high Na$^+$ irrigation water can easily displace Ca^{++} and make it deficient in sandy soils with low CEC. Gypsum can be used in this case as a source of Ca^{++}. Testing both soil and plants associated with sand based sports turf has revealed that apparently adequate levels of Ca^{++} in the rootzone have produced apparently deficient levels of Ca^{++} in the plant. Application of gypsum in these situations increased plant calcium and improved turf growth (Dr. David York, personal communication 1998). Calcium availability, uptake, and effect on turfgrass performance in athletic fields continues to be evaluated.

Sodium Chloride (NaCl) is commonly used as a deicer for roadways and sidewalks. Soil Na levels may be elevated in grass areas adjacent to paved surfaces treated with NaCl for deicing. Gypsum may be helpful to remove excessive Na from the soil is this situation.

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