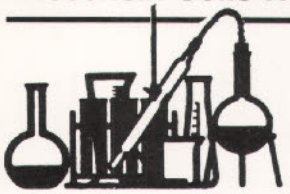

USE OF GYPSUM ON TURF

By Dr. Wayne R. Kussow

Turf managers in the state are occasionally being advised to apply gypsum ($CaSO_4 \cdot 2H_2O$). Reactions to this recommendation have fallen into one of three categories: (1) recommendation followed; (2) recommendation questioned; and (3) recommendation ignored. Obviously, this is a recommendation that needs examination.

There are three reasons one could cite to justify application of gypsum on turf:

1. To improve soil structure.
2. To supply the turfgrass with additional sulfur
3. To achieve the proper balance among exchangeable calcium, magnesium and potassium in soil.

The third reason is what is prompting soil testing laboratories to recommend use of gypsum on turf in Wisconsin. But let's include the other two reasons in this discussion as well, since these are potential selling points for gypsum.

Gypsum has long been used in the process of reclaiming for agricultural use those soils suffering from excessive amounts of sodium. Such soils are essentially structure-less because the sodium prevents aggregation of the clay particles. The function of gypsum is to provide a low-cost source of calcium ions that displace sodium ions from the soil's cation exchange sites. The sodium ions are then leached out of the soil during the long period of intensive irrigation. Replacing sodium with calcium on the exchange sites permits aggregation of clay particles and eventual formation of soil structure.

But, do we have high sodium soils in Wisconsin? NO. These soils reside only in arid to semi-arid regions of the country. Applying gypsum to our soils has no measurable effect on soil structure and, we must never perceive gypsum as being a substitute for lime.

When soil supplies of sulfur are inadequate for normal plant growth, gypsum is an excellent, slow-release source of the nutrient. Some crops grown in Wisconsin have high sulfur requirements and occasionally the soil supply is inadequate. However, turfgrass is a low sulfur requiring crop and we have to remember that potassium sulfate rather than potassium chloride is used almost exclusively in turf fertilizers. For every pound of K_2O applied as potassium sulfate, approximately 0.3 lb. sulfur is being applied as well. Considering that turfgrass requires approximately eight times as much potassium as sulfur, we can readily see that use of potassium sulfate on turf will very effectively avoid having to apply gypsum as a sulfur source.

Having dispelled the notion that gypsum will resolve soil compaction problems or is needed to prevent sulfur deficiency on turf in Wisconsin, let's examine the principal reason why some of you are being advised to apply gypsum. Believe it or not, this reason has its roots in some research reported on in 1901. This work presented evidence that soil Ca:Mg ratios affect plant growth. By the 1940s, researchers had accumulated enough evidence to formulate what is known as the basic cation saturation ratio (BCSR) theory.

According to the BCSR theory, soil is not an optimum environment for plants unless 65 to 85% of the cation exchange sites are occupied by calcium ions, six to 12 percent by magnesium ions and two to five percent by potassium ions. In short, what this theory suggests is that plant accumulation of sufficient quantities of these nutrients depends more on their ratios in soil than the amounts actually present. When this theory is applied in the interpretation of soil analyses, it is possible to conclude that even soils with a pH of 6.5 or more require additional calcium or magnesium to ensure their presence in the proper ratios.

How can Wisconsin soils with near neutral pH not contain what the BCSR theory perceives to be the "proper" Ca:Mg ratio? Actually, this is not an uncommon occurrence. The reason is dolomitic limestone. All lime produced in Wisconsin is dolomitic and contains Ca and Mg in a ratio of approximately 1.1:1. This is considerably below the minimally acceptable Ca:Mg ratio of 5:1 put forth by the BCSR theory. But one need not apply dolomitic lime to get their soil Ca:Mg ratio down to less than 5:1. Irrigating with well water that has seeped down through dolomitic limestone has the same effect.

It is when the Ca:Mg ratio falls below 5:1 in soils with satisfactory pH for turfgrass that the BCSR theory leads to the recommendation to apply gypsum. Is this a valid recommendation? The

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answer to this question lies in the answer to the question of what controls plant accumulation of Ca, Mg and K — the ratios at which they are present in soil or the actual amounts present? To summarize a lot of research conducted in the Midwest, the evidence strongly favors the notion that plant growth and accumulation of Ca, Mg and K is much more dependent on the amounts present in soil than their ratios. Ratios become the prime factor only in extreme conditions deliberately created in experiments. It is in light of this convincing body of research data that most soil testing laboratories do not apply the BCSR theory when interpreting soil analyses. Thus, they do not recommend adding additional Ca or Mg to soils whose pH values are already satisfactory for plant growth.

To carry this discussion one step further let's review the results of field trials that Dr. Don Waddington and his graduate students carried out on turf at eight different sites in Pennsylvania in the 1970s. They applied calcitic lime (Ca:Mg=14:1), P and K prior to establishment of several turfgrass species and on turf ranging from two to ten years in age. Soil pH on the eight sites ranged from 5.1 to 6.5 and the soil Ca saturation percentage was less than 65% on seven of the eight sites and averaged 45% over all eight sites. Hence, according to the BCSR theory, the turfgrass should have responded to lime application, if not because of increased soil pH, because of an increase in Ca saturation percentage. What actually happened was that liming had no significant influence on turfgrass clipping weights, turf quality or turfgrass tissue Ca content at any of the research sites.

A major manufacturer/distributor of turf products in the U.S. utilizes the services of a soil testing laboratory that continues to employ the BCSR theory to interpret soil analyses. Utilization of this service will occasionally result in the recommendation that gypsum be applied to turf in Wisconsin even though the soil contains many-fold more than the 15 to 25 pounds/A of Ca that turfgrass annually requires. In my opinion, the evidence is overwhelming that this recommendation merits a "category 3" response.