University of Kentucky
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Magnesium for Kentucky Turfgrasses

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Magnesium is an essential element for all plants. Soluble magnesium (Mg) exists in soils primarily as Mg^{2+}, a positively charged divalent cation. Kentucky soils are naturally high in Mg and, thus, Mg applications to turfgrass are normally unnecessary. However, turfgrasses grown in sand-based rootzones, such as golf course putting greens and sand-based sports fields, are prone to Mg deficiency. When Mg is necessary, it is essential to understand the function of Mg in the plant, the dynamics of Mg in the soil, and the forms of Mg fertilizers.

Function in Turfgrasses

The primary function of Mg in turfgrass is to serve as the central atom in the chlorophyll molecule. As much as 25% of plant Mg is used for this purpose. Other functions of Mg in turfgrasses include: enzyme activation, stabilization of ribosomes during protein synthesis, and maximization of energy during phosphate transfer. Chlorophyll provides the green color in leaves, so a lack of Mg leads to a lack of green color ("chlorosis"), and turf can look pale even if other nutrients such as nitrogen (N) and phosphorus (P) are adequate. Mg will not cure chlorosis caused by N deficiency. Magnesium is mobile within the plant, thus deficiency symptoms typically appear as a chlorosis on older leaves first.

Soil Magnesium

The earth's crust consists of 1.93% Mg, but the majority of this Mg is bound in primary and secondary minerals and is not available for plant uptake. To assess the soil's ability to supply plant-available Mg, soil testing labs remove a portion of soil Mg using an extractant. Many different types of extractants may be used, but the extractant preferred by most turfgrass scientists is the Mehlich (mā lik) III. Although the exact quantity of Mehlich III Mg required to sustain acceptable turfgrass on Kentucky soils has not been fully investigated, a generally accepted minimum soil Mehlich III Mg concentration for turfgrasses is 20 parts per million (ppm). Kentucky soils average 200 ppm Mehlich III Mg, which implies that the application of Mg to turfgrasses will not normally result in a turfgrass response (Figure 1).

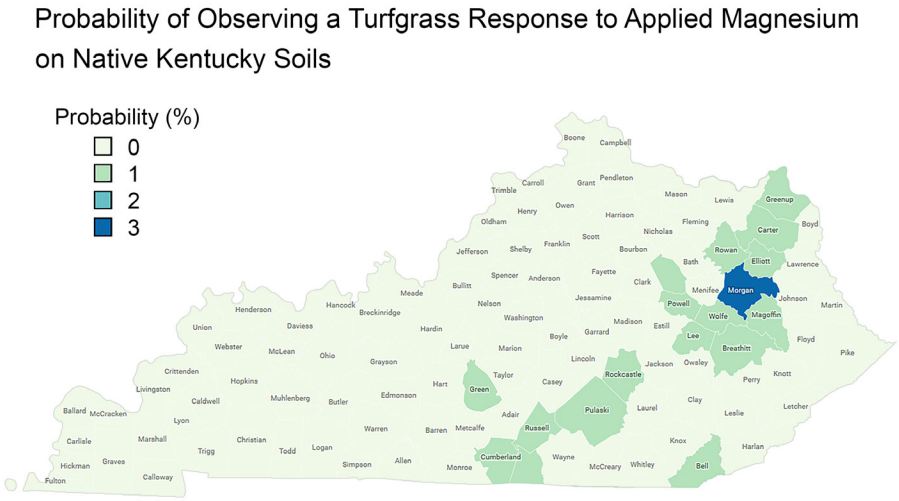

Figure 1. Probability of turfgrass responding to applied magnesium

Soil Testing

Soil tests for turfgrasses can determine if Mg should be applied, but a soil test cannot determine with any reasonable confidence how much Mg should be applied. When soil contains > 20 ppm Mehlich III Mg, a turfgrass response to applied Mg is unlikely. Inversely, when Mehlich III Mg concentrations are ≤ 20 ppm, Mg applications may be warranted.

Turfgrass grown in sand-based root zones are prone to Mg deficiency. This is because sand does not retain nutrients as well as native Kentucky soils, so Mg is more easily leached. Mg leaching is not known to cause environmental harm, but Mg leaching does reduce the amount of Mg available for plant uptake. In addition, other cations, such as calcium (Ca) and potassium (K) in fertilizers or sodium (Na) in reclaimed water, can replace Mg on exchange sites, which can exacerbate Mg leaching and lead to Mg deficiency. For this reason, the application of Ca and K should occur only when a soil test confirms they are necessary.

Tissue Testing

Tissue testing is common on highly maintained turfgrasses such as golf course putting greens or sport turf. Tissue testing provides a measurement of the nutritional status of the plant at the time the sample was taken. However, turfgrass tissue test results can be difficult to interpret. Current research indicates that minimum nutrient levels for healthy turfgrass fluctuate drastically depending upon the species, location, and season. In addition, the process of tissue analysis has been shown to contaminate turfgrass tissue leading to erroneous results. Lastly, to recommend the correct amount of Mg fertilizer to apply, the tissue test must be properly calibrated to each Mg source and, unfortunately, Mg calibration data do not exist for Kentucky turfgrasses. For these reasons, applying Mg based upon a turfgrass tissue test is not a best management practice in Kentucky.

So, are turfgrass tissue tests useful? If tissue tests are collected from the same location at the same time of year for several years, then turf managers may be able

to use historical data to establish a baseline Mg concentration. Deviations from this baseline may be helpful in diagnosing issues. Be mindful that historical Mg data may provide only a partial answer and a Mg deficiency may or may not be the underlying cause.

Applying Magnesium

If your turfgrass appears acceptable to you, then additional Mg is normally not necessary regardless of soil test Mg values. However, if your turfgrass is not acceptable and a soil test confirms that the soil concentration is ≤ 20 ppm Mehlich III Mg, then additional Mg may be warranted.

As is the case with nearly all fertilizers, Mg should be applied at a time when the turfgrass has the greatest opportunity to use it. For cool-season grasses such as tall fescue and bentgrass, the best time to apply Mg is during late spring and again in the autumn months when cool-season grasses are growing at their peak. If you have warm-season turfgrasses such as bermudagrass or zoysiagrass, the suggested time to apply Mg is during their peak growth period from June through August.

Magnesium can be applied to turfgrasses in granular and foliar forms. A foliar application using Mg sulfate at 0.1 lb. of Mg per 1,000 sq. ft. in 1 gallon of water (or 4 lbs. of Mg per acre using 40 gallons of water per acre) may be sufficient to induce a response *if* the turfgrass was initially Mg deficient. When granular Mg is used, rates between 0.5 and 1 lb. of Mg per 1,000 sq. ft. may be necessary to induce a turfgrass response. It is recommended that a small, impermeable surface be placed on top of a section of turf prior to application to serve as an untreated check. A small piece of plywood or a floor mat works well. After application, remove the mat and wait a day or two. If the turfgrass surrounding the untreated area is noticeably greener, then the turfgrass was likely Mg deficient.

Forms of Magnesium Fertilizers

In the rare case that a soil test results in Mehlich III Mg concentrations ≤ 20 ppm, Mg may be warranted. In these cases, several Mg fertilizers are available. Most Mg fertilizers are salts and supply Mg in a soluble form, whereas other Mg sources contain insoluble Mg and have little to no agronomic value. To make a more informed decision, the following provides information on Mg sources available in turfgrass management.

Magnesium Sulfate

Also known as Epsom salts, Mg sulfate has an analysis of 10% Mg, appears as a white, angular particle or prill, and is 100% water soluble. It is a common Mg fertilizer because it can be spread or sprayed, and it is normally less expensive than other Mg fertilizers.

Sulfate of Potash Magnesia

Sulfate of potash magnesia (often referred to as SPM, SulPoMag, or potassium magnesium sulfate) provides both K and Mg in a single fertilizer. SPM can be more expensive than Mg sulfate per pound of Mg but, because it also contains K, the cost of the fertilizer may be offset because the applicator does not need to pay for additional K. SPM is manufactured in numerous forms including brown prills and pink crystals, and the variety of particle sizes allows SPM to be applied to nearly any turfgrass, including putting greens, fairways, and home lawns. Typical analysis is 22% K and 10% Mg.

Dolomite

Dolomite is Ca-Mg carbonate and is usually used as a lime source rather than a Mg source. Dolomite analyses can vary but a typical analysis is 18% Ca and 10% Mg. The use of dolomite as a Mg source on soils with a pH > 6.5 is not recommended for turfgrass due to the associated increase in pH. In contrast, turfgrass grown on low pH soils that are documented as Mg deficient may respond more favorably to dolomite than to other lime sources such as calcium carbonate.

Keiserite

Keiserite ($MgSO_4$ H_2O) is a natural occurring mineral containing 17% Mg and is obtained during the mining of potash ore. Few, if any, turfgrass fertilizers contain kieserite, but kieserite is included in some landscape fertilizers that may be inadvertently applied to home lawns. As with most minerals, kieserite must weather in order to release Mg. To this end, kieserite has been documented to provide extended release of Mg compared to soluble Mg sources. The influence of kieserite on Kentucky turfgrasses has not been investigated; therefore, its value relative to other Mg sources is unknown.

Magnesium Oxide

Mg oxide (MgO) contains 56% Mg and is applied to turfgrasses directly or in the form of frits (homogenous granules of metal oxides). Because Mg is in the oxide form, the solubility of Mg in MgO is extremely low. Studies have shown that MgO does not increase Mehlich III Mg levels in soils and thus using any form of MgO (hydroxides, frits, sucrates, etc.) is an inefficient and often futile method of supplying Mg to Kentucky turfgrasses.

Magnesium Sucrate

Magnesium sucrate is manufactured by pellitizing MgO powder into a black or dark-red granule. The term "sucrate" comes from the molasses used to pelletize the MgO powder. Although Mg sucrate granules rapidly disperse in water, this dispersion only forms a suspension of undissolved particles and, thus, Mg remains mostly insoluble. Mg sucrate has been studied on turfgrass and has not been documented to increase turfgrass quality or color relative to untreated turfgrass.

Magnesium Chelates

Mg may be chelated for use on soils or as a foliar spray. Limited information exists on chelated Mg for turfgrasses, however, evidence indicates that chelated Mg may result in the same turf response and soil solubility as non-chelated Mg. Under normal Kentucky conditions, unchelated Mg will remain soluble in the soil for several weeks after application (Figure 2), which implies the addition of a chelating agent is unnecessary.

Organic Magnesium

Some natural organic fertilizers such as municipal biosolids may contain small amounts of Mg. The value of this Mg in turfgrass management is difficult to determine because most organic Mg sources also contain nitrogen and/or phosphorus, which also increases turf-

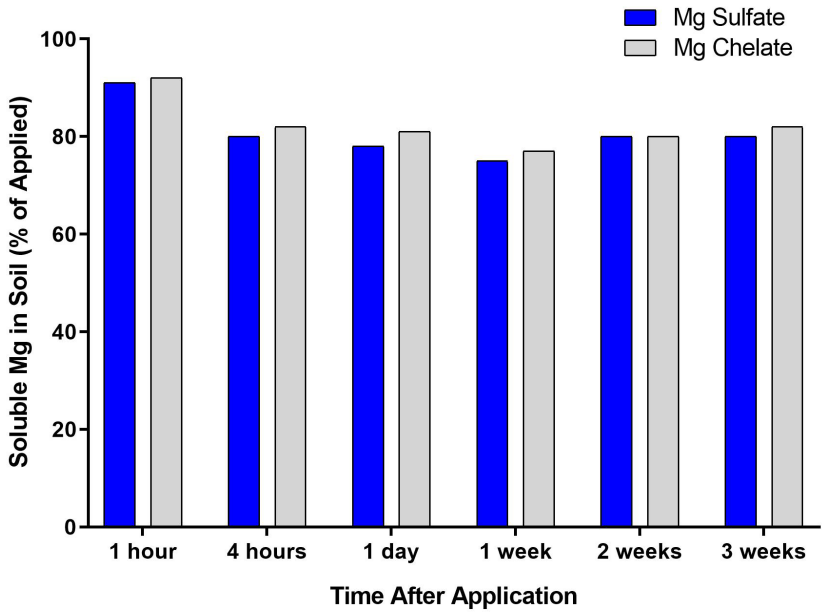

Figure 2. Magnesium remains soluble in soils after application without the need for chelation.

grass greening and can obscure the influence of Mg. Organic Mg may become plant available through mineralization and be taken up by the turfgrass. However, this dynamic has not been adequately investigated in turfgrasses, and the value of using organic Mg remains unknown.

Summary

Turfgrass response to Mg is rare because Kentucky soils contain large quantities of Mg available for turfgrass uptake. However, under unique growing conditions such as those found on golf course putting greens or sand-based sports fields, Mg may be required to achieve a desired color. When Mehlich III soil test values are ≤ 20 ppm Mg, a Mg application may be warranted. Otherwise, Mg can be omitted from nutrient programs to reduce cost. If a Mg deficiency is confirmed, granular and/or foliar Mg sources may be applied so long as the source contains soluble Mg.

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