A2524

Understanding Plant Nutrients

Soil and Applied Magnesium

E.E. Schulte

Magnesium (Mg) is abundant in most Wisconsin soils. It makes up about 2.7% of the earth's crust. Many common soil minerals contain magnesium, including amphibole, biotite, chlorite, dolomite, montmorillonite, olivine, pyroxene, serpentine, and vermiculite. Soils developed from coarse-grained rocks low in these minerals tend to be low in magnesium. Most fine-textured soils and soils developed from rocks high in magnesium minerals contain adequate amounts.

Animals grazed on grass pastures low in magnesium sometimes develop hypomagnesemia, or grass tetany. This problem occurs primarily where calcitic limestone ($CaCO_3$) is used as a liming material. Grass tetany is rare in Wisconsin because dolomitic limestone ($CaCO_3 + MgCO_3$) has been used on most of our soils and because forage legumes, which contain higher levels of magnesium than do grasses, make up a substantial part of livestock rations.

MAGNESIUM REACTIONS IN SOILS

Magnesium ions are held on the surface of clay and organic matter particles. While this exchangeable form of magnesium is available to plants, it will not leach easily from the soil.

Acid soils, especially sands, often contain relatively low levels of magnesium. Neutral soils or those with a high pH usually contain more than 500 parts per million (ppm) of exchangeable magnesium. Use of dolomitic lime has prevented magnesium deficiency in most of Wisconsin. However, a few soils may be deficient:

- soils limed with materials low in magnesium, such as paper-mill waste, marl, or calcitic limestone;
- acid sandy soils (usually in central and north-central Wisconsin);
- organic soils containing free calcium carbonate or marl.

In sandy soils, application of high rates of potassium or ammonium fertilizer often heightens magnesium deficiency. High concentrations of these cations in the soil solution interfere with magnesium uptake by plants. This interference, called antagonism, usually does not occur when the soil contains more exchangeable magnesium than exchangeable potassium.

Calcium/Magnesium Ratios

Wisconsin research does not support claims that calcium/magnesium ratios in Wisconsin soils need adjusting to increase calcium levels and/or decrease magnesium levels. This research shows that a wide range of calcium/magnesium ratios has no effect on plant growth as long as calcium and magnesium levels are not deficient. However, carefully monitor magnesium levels when using liming materials low in magnesium, particularly in acidic soils originally low in magnesium. Consult Extension publication G2986, *Soil Calcium to Magnesium Ratios—Should You Be Concerned?*, for more information.

SOURCES OF MAGNESIUM

The most economical way of correcting magnesium deficiency in an acid soil is to apply dolomitic limestone. If the pH is already high, however, or if the crop requires an acid soil (as do potato and small fruits), then you must use other carriers of magnesium such as Epsom salts ($MgSO_4 \cdot 7H_2O$) or potassium magnesium sulfate ($K_2SO_4 \cdot 2MgSO_4$). If excessive potassium fertilization has induced magnesium deficiency, Epsom salts are the best source. Correction of magnesium deficiency with Epsom salts or potassium-magnesium sulfate requires 50–100 lb/a of magnesium when broadcast or 10–20 lb/a when applied in a band alongside the row. Table 1 provides the magnesium content of common magnesium sources.

Table 1. Sources of magnesium.

MATERIAL	CHEMICAL FORMULA	PERCENT MAGNESIUM
Dolomitic lime	$CaCO_3 + MgCO_3$	8–20
Epsom salts	$MgSO_4 \cdot 7H_2O$	10
Kieserite	$MgSO_4 \cdot H_2O$	18
Potassium magnesium sulfate	$K_2SO_4 \cdot 2MgSO_4$	11

DIAGNOSTIC TECHNIQUES

Deficiency Symptoms

Magnesium is a component of chlorophyll in plants. A deficiency of this element results in a yellowing (chlorosis) of the plant leaves. Because magnesium moves readily from lower to upper parts of the plant, the deficiency appears first on the lower leaves. In corn, the lower leaves become yellow between the veins (interveinal chlorosis). As the deficiency becomes more severe, the leaves may turn somewhat rosy colored or reddish purple. Deficiency symptoms are not definitive, and it is sometimes difficult to distinguish between magnesium deficiency and deficiency or toxicity of manganese, although the latter cases are usually confined to newer plant growth.

Soil Analysis

Available magnesium is determined by measuring the quantity of magnesium on the surface of soil particles (exchangeable magnesium). Optimum soil test levels for exchangeable magnesium are 51–250 ppm for sandy soils and 101–500 ppm for all other soils. See Extension publication A3030, *Optimum Soil Test Levels for Wisconsin*, for additional information.

Plant Analysis

Table 2 lists the critical plant-tissue concentrations of magnesium for the major Wisconsin field crops. Because magnesium is a mobile element in the plant, the concentration of magnesium usually decreases from the top to the bottom of the plant. Also, the magnesium concentration usually decreases as the plant approaches maturity. It is therefore important to indicate the age of the plant and the portion of the plant sampled when providing material for magnesium analysis. For more information, see Extension publication A2289, *Sampling for Plant Analysis: A Diagnostic Tool*.

ADDITIONAL INFORMATION

These publications in the *Understanding Plant Nutrients* series are available from your county Extension office:

Soil and Applied Boron	(A2522)
Soil and Applied Calcium	(A2523)
Soil and Applied Chlorine	(A3556)
Soil and Applied Copper	(A2527)
Soil and Applied Iron	(A3554)
Soil and Applied Magnesium	(A2524)
Soil and Applied Manganese	(A2526)
Soil and Applied Molybdenum	(A3555)
Soil and Applied Nitrogen	(A2519)
Soil and Applied Phosphorus	(A2520)
Soil and Applied Potassium	(A2521)
Soil and Applied Sulfur	(A2525)
Soil and Applied Zinc	(A2528)

Table 2. Magnesium plant-analysis interpretations for common Wisconsin field crops.

			INTERPRETATION			
CROP	PLANT PART SAMPLED	TIME OF SAMPLING	DEFICIENT	LOW	SUFFICIENT	HIGH
			%			
Alfalfa	Top 6 inches	Bud	<0.20	0.20–0.30	0.31–1.00	>1.00
Corn	Earleaf	Silking	<0.10	0.10–0.20	0.21–0.40	>0.40
Oat	Top leaves	Boot stage	<0.10	0.10–0.15	0.16–0.30	>0.30
Soybean	First trifoliate	Early flower	<0.15	0.15–0.30	0.31–1.50	>1.50

Author: E.E. Schulte is professor emeritus of soil science, College of Agricultural and Life Sciences, University of Wisconsin-Madison and University of Wisconsin-Extension, Cooperative Extension. The author wishes to thank L.M. Walsh, professor of soil science, University of Wisconsin-Madison and University of Wisconsin-Extension, Cooperative Extension, for contributions from an earlier edition of this publication and P.P. Motavalli for editorial assistance. Produced by Cooperative Extension Publications, University of Wisconsin-Extension.

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