Magnesium for Field Crops

Introduction

Magnesium (Mg) is one of 18 nutrients essential for plant growth. It is actively involved in photosynthesis as a component of chlorophyll and also plays an important role in plant respiration and energy metabolism. This factsheet describes the Mg cycle and deficiency symptoms, and provides guidance for Mg management for field crops commonly grown in New York State (NYS).

Magnesium Cycle

Plants take up Mg in the ionic form (as Mg^{2+} dissolved in soil solution). The rocks and clay particles in soils contain Mg but it is not plant available. As rock and clay particles weather over time (break down over time), minerals like Mg are released but this process is very slow. Magnesium can be applied as dolomitic lime, Mg-containing fertilizers and/or manure. Magnesium levels in soil decline over time as a result of crop removal, soil erosion, and leaching. Low soil pH, and/or high levels of potassium (K) and calcium (Ca), low temperatures, and dry soil conditions can all contribute to Mg deficiency.

Magnesium Deficiency Symptoms

Soil test results from across NYS indicate that most agricultural soils are high or very high in Mg. Deficiencies, if present, are most likely to occur in acid soils (pH below 5.4) and especially on sandy/gravelly soils. This is due to a low Mg availability instead of low Mg content in the soil.

Deficiency symptoms are most severe on the older leaves of the plants because plants will mobilize Mg from the older parts of the plant to areas with new growth. The classic deficiency symptom for soybeans and alfalfa is interveinal chlorosis (yellowing between the veins) of the lower/older leaves (Figure 1). Full season symptoms include pre-harvest leaf drop, weakened stalks, and long, branched roots. In corn and wheat, the deficiency appears as yellow or white stripes in lower leaves, running the full length of the leaves parallel to the veins. As the deficiency progresses, the striping may turn into dead, round spots appearing as beaded streaks. Tips and margins of lower leaves may also turn purple, brown and die. The plants may be stunted and have an overall yellow appearance (Figure 1).



Figure 1. Magnesium deficiencies in corn, soybean and alfalfa. Photo credits: International Plant Nutrition Institute (IPNI).

Grass Tetany in Cattle

Grass tetany or hypomagnesemia is a cattle metabolic disorder caused by a low level of Mg in the blood serum. It is most likely to occur in the spring when older lactating ruminants graze cool-season grasses with a milliequivalent ratio of less than 2.2 for K/(Ca+Mg). High soil K negatively affects Mg uptake. Agronomic practices to reduce the risk include splitting applications of N and K fertilizers, and liming with dolomitic rather than calcitic limestone. Providing a Mg supplement to animals that are exposed to high K and N forages can also reduce the risk. While grass tetany may be the most important nutritional disease of ruminants in the

southern two thirds of the USA, it is extremely rare in NYS possibly due to the general high availability of Mg in NYS soils.

Magnesium Toxicity

Magnesium toxicity is rare and will not occur in soils that have a Ca/Mg ratio of 1.0 or higher. Since the Ca/Mg ratio of limestone is always equal to or higher than 1.0, soil Mg can only exceed soil Ca in NYS soils when large quantities of Mg-containing fertilizers have been used. In other words, the use of dolomitic lime cannot increase the Ca/Mg ratio.

Magnesium Soil and Tissue Testing

A Mg deficiency is easily confused with zinc (Zn) or chloride (Cl) deficiencies, viruses, or natural aging because they all have similar symptoms. The first steps to determine if additional Mg is needed are to take an on-site soil pH test followed by a complete soil test. It is also recommended to sample healthy and unhealthy growth areas to compare for identification of a deficiency.

The Cornell Morgan soil test (0-8 inch sample depth) is the basis for guidelines for Mg management in NYS. Table 1 shows the interpretations for common field crops.

Although soil testing is the first step, plant analyses can be used as an additional diagnostic tool if a deficiency is shown. When sampling tissue, it is important to sample the specific plant part at the recommended sampling time (Table 2).

Table 1: Determination of magnesium status from Cornell Morgan soil test results.

	Very low	Low	Medium	High	Very high
	----------lbs Mg/acre----------				
Soil test Mg	<20	20-65	66-100	101-199	>200

Table 2: Magnesium sufficiency levels in selected tissue of field crops.

Crop	Plant part	Time of sampling	Sufficiency level
			%Mg
Alfalfa	Upper 1/3	1/10 bloom	0.3-1.0
Corn	Ear leaf	Silking	0.2-0.4
Soybean	First trifoliate	Early flower	0.3-1.5
Small grain	Whole tops	Heading	0.2-0.5

Magnesium Management

For soils where the pH is below the desired range for the rotation, the easiest and most economical way to correct a Mg deficiency is to apply dolomitic limestone. It is best to make this application while the field is in corn, the year before seeding of more pH and Mg sensitive crops such as alfalfa or soybeans.

If the pH is near 7 and soil test Mg levels are low, smaller quantities of dolomitic lime can be used to correct low Mg levels, but it will require some time for the lime to react with the soil. Therefore, in high pH conditions, it is better to use Mg-containing fertilizers such as magnesium sulfate (Epsom salts or Kieserite), or potassium-magnesium sulfate (KMag or Trio), rather than dolomitic limestone. Table 3 provides the Mg content of the common Mg fertilizer sources.

Table 3: Common magnesium-containing fertilizers.

Material name	Chemical formula	Mg content
		-----%----
Dolomitic limestone	$CaCO_3$ + $MgCO_3$	8-20
Epsom salts	$MgSO_4 \cdot 7H_20$	10
Kieserite	$MgSO_4 \cdot H_2O$	18
Langbeinite (KMag; Trio)	$K_2SO_4 \cdot 2MgSO_4$	11

Banded rates of 2-10 pounds of Mg per acre will correct most Mg problems for corn and other row crops. Broadcast rates of 20-40 pounds of Mg per acre are sufficient for alfalfa.

In Summary

Magnesium deficiency can occur in acidic and sandy soils, or soils with high levels of Ca and K. Soil tests can help detect a Mg deficiency. Dolomitic lime and Mg-containing fertilizers can be used to correct a Mg deficiency.

Additional Resources

- Plant Nutrition Manual by J. Benton Jones, Jr. CRC Press LLC. http://www.crcpress.com.

Disclaimer

This fact sheet reflects the current (and past) authors' best effort to interpret a complex body of scientific research, and to translate this into practical management options. Following the guidance provided in this fact sheet does not assure compliance with any applicable law, rule, regulation or standard, or the achievement of particular discharge levels from agricultural land.

For more information

Cornell University Cooperative Extension

Nutrient Management Spear Program
http://nmsp.cals.cornell.edu

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