

# Calcium and Magnesium in Mississippi Crop Production



Calcium (Ca) and magnesium (Mg) are essential plant nutrients. They are considered secondary nutrients because plants require them in smaller quantities than nitrogen, phosphorus, and potassium. However, secondary nutrients are required in larger quantities than micronutrients such as boron and molybdenum. Sulfur, also a secondary nutrient, is more thoroughly outlined in [\*P3669 Sulfur Nutrition for Mississippi Crops and Soils\*](#).

Calcium and magnesium are generally adequate in Mississippi soils with favorable pH and organic matter levels. Limes containing Ca and/or Mg increase pH when soil-applied, but some Ca or Mg containing products have minimal or no effect on soil acidity; these products should be considered soil amendments rather than fertilizers.

## Calcium

Plants use Ca to support cell walls. Calcium also serves as a secondary internal messenger when plants are physically or biochemically stressed.

Calcium deficiencies are rare in Mississippi soils. Most soils with non-acidic pH levels are not deficient in calcium. Acid soils with calcium contents of 500 pounds per acre or less are considered deficient for legumes, especially peanuts, alfalfa, clovers, and soybeans. Crops with limited root systems such as tomatoes, peppers, and cucurbits will need additional calcium in these low Ca soils. Peanuts at pegging time require plant available calcium in the Ca<sup>2+</sup> ion form. An adequate supply of Ca is necessary to prevent blossom end rot in peppers and tomatoes.

### *Potential pathways for Ca loss from soils include:*

- dissolution and removal in drainage water
- plant uptake and removal
- absorption by soil organisms
- loss via leaching from the soil with water infiltration
- absorption by clay particles

Calcium deficiency symptoms include death at the growing point, abnormally dark green foliage, weakened stems, shedding flowers, or any combination of these (McCauley et al., 2009).

The lime materials calcite (calcium carbonate) rock,

dolomite (calcium and magnesium carbonates), or marl (largely calcium carbonates) are the primary sources of calcium in Mississippi.

Other sources such as basic slag, gypsum, hydrated lime, and burned lime may be available. Gypsum may be used to improve soil stability in some situations. It does not affect soil pH (acts as lime) even though it contains calcium. Gypsum may be recommended to alleviate salt-impacted soils. The Ca component of gypsum replaces sodium (Na<sup>+</sup>) ions on the soil exchange complex. The displaced Na is leached (moved down the soil profile and out of the rooting zone) with rainfall or irrigation.

**Table 1. The average percentage of the chemical content of major sources of calcium.**

Material	Calcium	Magnesium	Sulfur	Other
calcitic lime	31.7	3.4	0.1	0
dolomitic lime	21.5	11.4	0.3	0
gypsum	22.5	0.4	16.8	0
basic slag	29.0	3.4	0.3	No longer a P source

## Magnesium

Magnesium is adequate for crop production in most Mississippi soils, except in the coarse sandy soils of the Coastal Plains and the heavy dark clays of the Blackbelt Prairie. Magnesium is absorbed as the Mg<sup>2+</sup> ion and is mobile in plants, moving from the older to the younger leaves. It leaches from the soil like calcium and potassium.

Magnesium is the central atom amid four nitrogen atoms in the chlorophyll molecule, so it is involved in photosynthesis. It serves as an activator for many enzymes required in plant growth processes and stabilizes the nucleic acids.

Interveinal chlorosis is a deficiency symptom in legumes, corn, sorghum, cotton, and certain leafy vegetable crops. Interveinal chlorosis is a yellowing of the tissue between the veins of a plant while the veins remain green. The leaves may become pink to light red and may curl upward along the margins.

Dolomitic lime can address magnesium deficiency in soil when lime is required. Soluble sources of magnesium should be used when lime is not needed. The most

common soluble sources of magnesium to use as fertilizer are magnesium sulfate (containing 10% Mg and 14% S, also known as Epsom salt), sulphate of potash magnesia (containing 11.2% Mg, 22% S, and 22% K<sub>2</sub>O, commercially sold as K-Mag), and magnesium oxide (containing 55% Mg, also known as magnesia).

Attaining “ideal” ratios of Ca to Mg in soils through fertilization is recommended by some private consultants and private laboratories to optimize crop yields. University research has not verified this concept as yields were maximized across a wide spectrum of Ca to Mg ratios in many studies (Chaganti and Culman, 2017; Kopittke and Menzies, 2007; Stevens et al., 2005).

**Table 2. The average percentage of the chemical content of major sources of magnesium.**

Material	Calcium	Magnesium	Sulfur	Other
magnesium sulfate	2.2	10.5	14.0	0
sulfate of potash magnesium	0	11.2	22.7	22 K <sub>2</sub> O
magnesium oxide	0	55	0	0

## Calcium and Magnesium influence on soil physical characteristics

Stable aggregates, favorable structure, and good tilth are characteristics of healthy soils. Calcium and magnesium promote aggregation. The Ca<sup>2+</sup> ion is smaller than Mg<sup>2+</sup> hence it is more efficient in binding soil particles, and has more flocculating power (the ability to clump and form small masses) than magnesium. Conversely, Mg could lower soil structural stability.

Calcium, in the form of gypsum (calcium sulfate) may be used to amend soils with structural problems due to sodium (Na). The Ca component of gypsum replaces Na in the soil. The Na is subsequently removed from the rooting zone with either natural rainfall or irrigation (Chaganti and Culman, 2017).

## Grass Tetany

Cattle grazing annual ryegrass, small grains, or cool-season perennial grasses are often affected by grass tetany when Ca or Mg is low in soil. Grass tetany is a metabolic disorder associated with grazing lush, rapidly growing pastures, resulting in low concentrations of blood magnesium in animals, which results in nerve impulse failure.

Other factors include nitrogen, calcium, and potassium levels, stage of growth (particularly February through April in Mississippi), whether cattle are lactating, and seasonal conditions. Dolomitic limestone is recommended to lime soils where grass tetany has been a problem. Grazing animals should be provided supplemental magnesium and calcium when grass tetany is an issue. Detailed information on grass tetany issues is available in *P2484 Mineral and Vitamin Nutrition for Beef Cattle*.

## References

- Chaganti V.N., Culman S.W. (2017). *Historical Perspective of Soil Balancing Theory and Identifying Knowledge Gaps: A Review*. Crop, Forage & Turfgrass Management 3:cftm2016.10.0072. DOI: 10.2134/cftm2016.10.0072.
- Kopittke P.M., Menzies N.W. (2007). *A Review of the Use of the Basic Cation Saturation Ratio and the “Ideal” Soil*. Soil Science Society of America Journal 71:259-265. DOI: 10.2136/sssaj2006.0186.
- Maathuis F.J.M. (2009). *Physiological functions of mineral macronutrients*. Current Opinion in Plant Biology 12:250-258. DOI: 10.1016/j.pbi.2009.04.003.
- McCauley A., Jones C., Jacobsen J. (2009). *Plant nutrient functions and deficiency and toxicity symptoms*. Montana State University Extension, Bozeman, MT. pp. 16.
- Stevens G., Gladbach T., Motavalli P., Dunn D. (2005). *Soil Calcium: Magnesium Ratios and Lime Recommendations for Cotton*. Journal of Cotton Science 9:65-7.

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By **Larry Oldham**, PhD, Extension Professor, Plant and Soil Sciences, and **Keri D. Jones**, PhD, Lab Coordinator, Soil Testing Laboratory.

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