Soybean Nutrient Profile

Magnesium

This nutrient profile is a part of a weekly series dedicated to the function of the 16 essential nutrients in soybean. After excluding carbon, hydrogen, and oxygen, we are left with a thirteen part series in which we will explore how nutrients are used throughout the plant as well as how to identify deficiency symptoms and develop nutrient management decisions.

In the Plant

Although magnesium (Mg) is considered a secondary nutrient, the roles it plays in plant structure and metabolism are anything but. Fifteen to 20% of the Mg in plants can be found in chlorophyll as a vital, structural component of the chlorophyll molecule, without which photosynthesis would not occur. Magnesium is also needed for the energy transfer reactions of phosphate transfer from ATP as discussed in the previously released phosphorus profile. These reactions are required to supply the energy for many plant processes including photosynthesis, respiration, and many other metabolic processes in the plant.

In the Soil

Similar to calcium (Ca) in our soils, Mg occurs as a cation (Mg^{+2}) in the soil and in the plant and occupies the negatively charged sites found on the surface of clay particles that makeup a soil's cation exchange capacity (CEC). In many Louisiana soils with a neutral or alkaline pH, Mg can be very high and occupy a lot of these exchangeable sites. As with any cations that occupy these sites, soil Mg will exist in equilibrium between solution and exchangeable Mg. As Mg is removed from the

Figure 1. *Soybean magnesium deficiency appears as interveinal chlorosis. (IPNI, E.A.B. Fransisco, 2018)*

solution due to plant uptake or leaching, exchangeable Mg will desorb from these sites into the soil solution to maintain this equilibrium. Plant roots often encounter Mg through the mass flow or diffusion of solution Mg. There is the rare potential, in the presence of very high Ca, for Mg deficiencies to be induced due to a high Ca:Mg ratio of 10:1 to 15:1. Magnesium uptake can also be reduced by high levels of aluminum (Al^{+3}), ammonium (NH_4^+), or potassium although all three cases will be rare in Louisiana.

Deficiency Symptoms

Though very rare in Louisiana, magnesium deficiency symptoms are similar to both iron and manganese symptomology including interveinal chlorosis, or the yellowing of leaves between the veins of the leaf (figure 1). Because of the mobility of Mg in the plant however, symptoms will begin to occur in older leaves in the lower part of the canopy instead of new growth like iron and manganese (figure 2). Under severe deficiencies, the symptomology will progress to a uniform chlorosis and necrosis of the leaves.

Figure 2. *Soybean magnesium deficiency appears first on the older growth of the lower part of the canopy. (IPNI, L.Prochnow, 2018)*

Deficiency Corrections

Magnesium fertility should only be necessary in some of our more coarse soils with low inherent fertility. Magnesium fertility in soils with accompanying acid pH levels can be treated with $CaMg(CO_3)_2$ (dolomitic lime) to correct both low Mg levels and low pH. In soils with a more neutral pH, $K_2SO_4 \cdot MgSO_4$ (K-mag) can be utilized. Magnesium levels are reported in most routine soil test results and any deficient levels should be corrected prior to the growing season.

Takeaways

- Magnesium (Mg) is a secondary plant nutrient that is an essential structural component of chlorophyll and necessary for the energy transfer reactions that occur during photosynthesis, respiration, and many other metabolic processes.
- Magnesium occurs as a cation in the soil (Mg^{+2}) both in solution and adsorbed to the negatively charged exchangeable sites on clay particles that makeup the majority of a soils CEC. Although calcium will often take up the majority of these exchangeable sites in our soils, Mg will occupy a significant portion.
- Magnesium deficiency symptoms include the interveinal chlorosis of older leaves in the lower part of the canopy. Progressing deficiency symptoms will appear as a total chlorosis or necrosis of older leaves.
- To correct both low soil pH levels and the potential for Mg deficiencies in soybean, soils should be limed with $CaMg(CO_3)_2$ (dolomitic lime). If producers need to correct low soil Mg without the need to increase soil pH, then $K_2SO_4 \cdot MgSO_4$ (K-mag) can be applied.

References

- *Figure 1*: IPNI, E.A.B Fransisco. 2018. IPNI Crop Nutrient Deficiency Image Collection. Version 2018-05-07.
- *Figure 2*: IPNI, L. Prochnow. 2018. IPNI Crop Nutrient Deficiency Image Collection. Version 2018-05-07.
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