MANGANESE SUFFICIENCY/DEFICIENCY IN SOYB EANS

Manganese (Mn) deficiency in soybeans is an oft-discussed topic. Mn is one of the 16 elements essential for plant growth and development. Since it is needed in relatively small amounts by plants compared to the macronutrients nitrogen, phosphorus, and potassium, it is considered a micronutrient. Thus, it is not likely that this deficiency and its effects are given much consideration or attention in soybean production. That is probably because there is little evidence from research conducted in the US soybean-producing areas that Mn deficiencies occur except in isolated cases with unique soil conditions that will promote such a deficiency.

There is much known about Mn as a plant nutrient–e.g. its function in plants, its deficiency symptoms, where and when deficiencies might occur, and remediation measures to correct deficiencies. The following points are noteworthy with regard to this knowledge and are a composite of the information found in the sources listed at the end of this article.

Soybeans are more often deficient in Mn than in other micronutrients. Mn deficiency symptoms are exhibited as interveinal chlorosis or yellowing between the veins of the leaf blade on younger leaves (see photos here and here) since Mn is immobile in the plant. Deficiency symptoms will appear when the soybean plant can no longer extract sufficient amounts of Mn from the soil. Mn deficiency is sometimes referred to as "yellow flash" (thus named because the symptoms can disappear following rain or irrigation).

Mn is sufficient in most soils, but may be deficient in soils that are sandy and/or dry, or that have high organic matter (OM) or high pH levels. Dry soil conditions (increased soil oxygen levels) will result in less Mn being available to plants from the soil solution. OM and Mn ions will combine to form insoluble compounds, and this is exacerbated by high pH. Experts surmise that the worst combination of soil factors to create a potential Mn deficiency is low soil Mn coupled with a high soil pH, and this is exacerbated by dry soil.

Since the availability of Mn is related to the soil factors listed above, fields with Mn deficiency will seldom be affected uniformly because soil conditions in any given field will vary. Thus, knowledge of a field's soil attributes and history, along with periodic soil nutrient analysis for Mn, will be invaluable in predicting and/or diagnosing Mn deficiencies.

The most accurate way to determine a Mn deficiency is to look for deficiency symptoms through visual scouting and then conduct tissue tests (click here for sufficiency levels) on leaves of plants that exhibit those symptoms. The newest opened trifoliate leaves (leaf blades only; e.g. petioles should be removed) will be the ones that show deficiency and therefore should be the ones that are sampled since Mn is not mobile in the plant. Plant tissue typically contains 20-100 ppm of Mn; a level of 20 or fewer ppm is generally considered deficient and will assuredly result in visual Mn deficiency symptoms. A safe bet is to suspect Mn deficiency if a tissue test reveals less than 40 ppm. Soil testing tends to be less predictive of such a deficiency.

Foliar applications of a Mn compound are the preferred method of supplying Mn to a deficient crop since they will increase leaf Mn concentration immediately after application (however, this effect may be short-lived). Synthetic Mn chelates (e.g. Mn-EDTA and others) are the preferred foliar fertilizer source. Blanket applications are not recommended because application of Mn to a crop with Mn sufficiency can result in toxic concentrations that will result in yield loss. Thus, applications of Mn should only be made to the portion of a soybean crop that exhibits verified Mn deficiency symptoms. Also, recommended maintenance or reduced rates should not be applied because they will not correct a verified deficiency. Soil applications of Mn at planting tend to be ineffective compared to the foliar treatments.

Mn is most soluble and therefore most available in soils with a pH range of 5 to about 6.5. Plants growing in soil with a pH above about 6.5-6.8 can potentially suffer from Mn deficiency. Variable rate application of lime should be used to prevent raising soil pH above

the critical level for Mn availability in portions of a field that have an acceptable pH. A general rule of thumb is that as pH increases by one unit, Mn availability in the soil solution decreases 100-fold.

Take Home Message

Mn deficiency symptoms are documented and easily recognized with visual scouting.

Document the soil texture and OM content/variability in a field to better predict where Mn deficiency might occur.

Know the soil pH history of a field–both pH level/range and in-field variability–to predict where Mn deficiency might occur in a field.

Periodically have soil tested for micronutrient levels so that Mn level in the soil is known.

Use tissue testing to verify Mn deficiency in plants that exhibit deficiency symptoms.

Remedy Mn deficiencies with foliar applications of chelated Mn fertilizers.

Use variable rate lime application to prevent over-liming portions of a field that need little or no pH correction.

Information gleaned from referenced sources indicates that Mn sufficiency/deficiency in soybean plants is related to soil properties of a given field rather than to the amount of Mn in soil.

Resources

Manganese Fertility in Soybean Production. Keith Diedrick, Pioneer.

Manganese deficiency in soybeans? Experts advise foliar application. Douglas and Vyn, Purdue Univ.

Yellow soybean leaves may be due to manganese (Mn) deficiency. David Holshouser, Virginia Tech Univ.

Soybean nutrient profile: Manganese. Todd Spivey, LSU.

Manganese deficiencies in Indiana soils. Brouder et al., Purdue Univ.

Composed by Larry G. Heatherly, Updated Apr. 2020, larryh91746@gmail.com