Nutri-Facts

Agronomic information on nutrients for crops

Nutri-Facts #9

It's Mandatory —
Manganese Is Required by Plants

MANGANESE (Mn), one of the 16 essential elements, is mandatory for plant growth and reproduction. Manganese is considered a micronutrient because plants require only small amounts. This designation, however, is unrelated to its relative abundance in soils or its importance as a plant nutrient. Relatively large quantities of Mn can occur in soils, but only a small fraction is normally available at any one time.

Manganese Function in Plants

Manganese functions primarily as part of plant enzyme systems. It has a role in several important metabolic reactions, including the conversion of nitrate-nitrogen to a form the plant can use. Manganese plays a direct role in photosynthesis by aiding chlorophyll synthesis. Because of this role, Mn deficiency symptoms usually involve leaf yellowing or chlorosis.

Deficiency Symptoms and Sufficiency Levels

Manganese is not translocated in the plant, so deficiency symptoms appear first on younger leaves. Deficiencies occur most often on high organic matter soils, on soils with neutral to alkaline pH, and on those soils that are naturally low in Mn content. Deficiency symptoms vary somewhat among crops.

> Manganese deficiency occurs most often on high organic matter soils, on soils with neutral to alkaline pH, and on soils that are naturally low in Mn content.

Soybeans and Potatoes. Upper leaves first become chlorotic between the veins while veins remain green. Newer leaves become pale green first and then pale yellow. As the deficiency becomes more severe, brown, dead areas appear.

Cotton. The upper (younger) leaves are affected first. They become yellowish-grey or reddish-grey in color with green veins.

Corn and Sorghum. Plants are slightly stunted and young leaves show slight loss of color between the veins. Symptoms are often not dramatic and can be easily confused with other problems.

Small Grains. Oats are the most sensitive of the small grains. Leaves show marginal gray-brown necrotic spots and streaks on the third highest leaf. In advanced stages, the upper half of the leaf droops with a distinct kink, while the remaining portion of the leaf stays green and upright. Field symptoms should always be supported with plant tissue analysis. **Table 1** gives the Mn sufficiency ranges for several crops and relative crop responsiveness to applied Mn.

Table 1. Manganese sufficiency ranges for some crops and crop responsiveness to applied Mn.

	Mn sufficiency range, ppm	Responsiveness
Corn	30-150	Medium
Soybeans	20-100	High
Alfalfa	30-100	Medium
Wheat	20-200	High
Sugar beets	30-150	High
Sorghum	18-190	High
Cotton	25-350	Low
Potatoes	30-200	Medium

Possible causes for high and low plant tissue Mn concentrations include:

Concentrations above sufficiency level

- Low soil pH
- High application rates of nitrogen (N), phosphorus (P) and potassium (K) on acid, low organic matter soils
- Soil or dust contamination of sample
- Fungicide residues on leaves

Concentrations below sufficiency level

- Low natural soil Mn levels
- Low availability due to high soil pH (7.0 and higher)
- High soil organic matter content
- High soil moisture
- Very low soil organic matter levels.

Factors that Affect Soil Availability

Soil pH. Manganese deficiencies are often associated with high soil pH. **Figure 1** illustrates the influence of soil pH on Mn availability. Activity of soil microorganisms which convert Mn to unavailable forms reaches a maximum near pH 7. Extremely acid soils can produce Mn toxicity in plants.

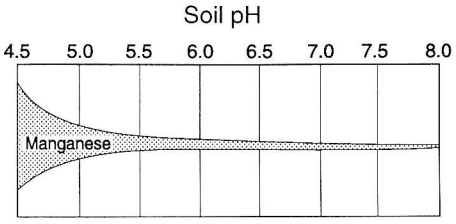

Figure 1. Manganese availability is higher at low soil pH levels.

Crop response to applications of Mn on low testing soils or where pH is high can be very profitable, especially for responsive crops as soybeans, sugar beets and small grains (**Table 2**).

Soil Organic Matter. Manganese deficiencies frequently occur on cool, wet, high organic matter soils. Symptoms disappear as soils dry and temperatures increase. This condition may be related to lower microbiological activity in cool, wet soils.

Table 2. Soybean response to Mn on high pH soils.

Applied as $MnSO_4$	Yield, bu/A
None	56
15 lb/A Mn broadcast	63
5 lb/A Mn row	65
0.5 lb/A Mn foliar	65

Leaf Mn, control plot = 18 ppm. Wisconsin

Low availability of Mn in high pH, high organic matter soil may be due to the formation of unavailable chelated Mn compounds.

Nutrient Balance. High soil levels of available copper (Cu), iron (Fe) or zinc (Zn) will reduce Mn uptake by plants. High availability of calcium (Ca) or magnesium (Mg) may also decrease Mn uptake.

Rapidly growing crops, well fertilized with N, P and K but growing on soils that are marginal in Mn availability, often show Mn leaf concentrations below the critical level. This condition might be a yield-limiting factor.

Other Fertilizers. Nitrogen sources can influence Mn availability. Ammoniacal N sources that produce soil acidity such as ammonium sulfate, urea, ammonium nitrate and ammonia will enhance plant uptake of Mn. Potash (KCl), a neutral salt, can increase the availability of Mn, especially in acidic soils.

Correcting Manganese Deficiencies

Manganese can be applied broadcast preplant, in starter fertilizers, or as a foliar spray. Recommended Mn rates range from 10 to 25 lb/A broadcast, 3 to 5 lb/A with starter fertilizer, and 0.5 to 2 lb/A foliar. Starter band applications of Mn with NPK fertilizers is a common, effective application method. Choice of Mn application method is largely a factor of equipment availability, crop grown, and management preference.

Summary

Soil testing, plant analysis, crop yield level, soil conditions, climatic factors and crop rotation can all affect a crop's need for Mn.

For high quality, profitable yields, crops needs Mn — it's mandatory. ■

For further information contact:

FRIT INDUSTRIES
Ozark, Alabama
Phone: 334/774-2515
FAX: 334/774-9306

The Micronutrient People

Technical information prepared by FAR

DP.3/96.5M

Reference #96092