Midwest Laboratories®

AGRICULTURE • ENVIRONMENTAL • ANIMAL FEED • FUEL
PET FOOD • FOOD & BEVERAGE • HOME/SMALL BUSINESS

Micronutrients

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RELATIONSHIP OF NUTRIENT ELEMENTS TO PLANT FUNCTIONS

PLANT FUNCTION	MINERAL ELEMENTS INVOLVED
Photosynthesis	N,P,K,Mn,Mg,S,Fe,Cl
Enzyme Regulation	N,P,K,Ca,Mg,S,Fe,Mn,Zn,Cu,Mo
Protein Synthesis	N,P,S,Mn,Mo,Zn,Cu
Carbohydrate Metabolism	P,Ca,Cu,Mg,Fe,Mn,B,Mo
Nitrogen Metabolism	N,P,K,Mn,Zn,Mo
Hormone Synthesis	Mn,Zn,Cu
Osmotic Pressure	K,Cl,Ca,Na
Translocation	K,B,Cl
Grain Production	All essential elements

Huber and Tsai-Purdue University

SOIL FACTORS LEADING TO DEFICIENCIES

ZINC: low zinc test, low OM, high pH, excessively high P, cold, wet or poorly drained soil, compacted soil.

MANGANESE: Insoluble at high pH, excessive P, Ca, Zn, Fe or Cu can reduce availability. High OM soils, compacted soils.

IRON: Insoluble at high pH, soluble in acid soils. Calcareous soils. Compacted soils and soils with poor drainage.

COPPER: Very high OM soils (peats or mucks), high soil pH, very sandy soils.

BORON: Low soil B test, sandy, low OM, high soil pH, drought and soils developed under high rainfall conditions.

CHLORIDE: Parent materials low in Cl, lack of KCl use in crop rotation, leached by water passing through soil.

Micronutrients

Zinc, manganese, iron, copper and boron are the five micronutrients of concern in crop production. Boron is the only negatively charged element and is fairly mobile. The others are considered immobile in the soil. Although these elements are required in small amounts, their deficiency or toxicity can have as much effect on crop production as any of the major nutrients. All micronutrients are taken up through the plant root in their elemental forms.

Midwest Laboratories, Inc. uses the DPTA test to analyze zinc, manganese, iron, copper and boron. The table below explains the ratings that are used for each micronutrient on our soil test.

Ratings	Zinc	Manganese	Iron	Copper	Boron
VL	0 – 0.5	0.4	0.5	0.03	0 – 0.3
L	0.6 – 1.0	5 – 8	6 – 10	0.4 – 0.8	0.4 – 0.7
M	1.1 – 3.0	9 – 12	11 – 16	0.9 – 1.2	0.8 – 1.2
H	3.0 – 6.0	13 – 30	17 – 25	1.3 – 2.5	1.3 – 2.0
VH	> 6	> 30	> 25	> 2.5	> 2.0

Micronutrients

	Preferred Soil Test Range
Zinc	3 - 6 ppm
Manganese	13 - 30 ppm
Iron	17 - 25 ppm
Copper	1.3 - 2.5 ppm
Boron	1.3 - 2.0 ppm

Zinc

- Has some of the best correlation and calibration data to support soil test based recommendations.
- When soil test P is high, you will see a greater response to Zinc applications.
- Too much N and P can limit Zinc.
- Build soil test levels to 3 -6 ppm.
- Can supplement with plant tissue testing.

Manganese

- Has limited correlation and calibration data to support soil test based recommendations.
- Manganese is very insoluble in higher pH soils.
- Plant tissue testing may be used to supplement soil test data when making long-term Mn decisions. (foliar applications)
- Some herbicides (Glyphosates) temporarily immobilize Mn in the plant.
- Wet (flooded) and poorly aerated soils can show higher soil test level Mn.

Iron

- Very insoluble in high pH soils.
- Lack of Fe in the soil is seldom the problem, as it is the compound that Fe forms in high pH soils that limit the plants ability to take up the nutrient.
- Plants can exhibit Iron Deficiency Chlorosis (IDC).
- Plant tissue test can help confirm IDC
- Applying sulfur can help with iron availability.
- Wet or poorly drained soils will actually increase Fe availability similar to Mn due to the lack of oxygen that leads to a larger amount of Fe in its reduced form, which is more available.
- Excess Mn can limit Fe, so we ppm of Fe higher than Mn.

Copper

- The soil test correlation to yield is limited outside of organic soils.
- Copper deficiencies are fairly rare in field crops.
- Deficiencies can sometimes be observed in small grains in high OM soils.
- Leaf tissue testing is a good tool to determine if Cu is a limiting factor.

Boron

- Boron has negative charge so it can leach easily in lighter soils.
- Careful consideration when applying Boron from soil test results due to potential of toxicity.
- High response when applied on alfalfa.
- Potassium ties up Boron when K base saturation is above 8%.
- High Ca/high pH soil test levels can inhibit Boron uptake.
- Excess N levels can limit the availability of Boron.

MICRONUTRIENT APPLICATION RATES

- BORON: .5-2 #/A. Broadcast at V-6 (Corn) 1-3#/A depending on soil test level and soil type.
- COPPER: 3-10#/A as CuSO4. Use soil and plant tests to monitor levels after application.
- IRON: Soil applications not as effective. Spray applications of a 3-4% spray solution in 30-40 gal/A.
- MANGANESE: 2-20#/A as MnSO4. Band applications with acid-forming fertilizers more efficient.
- MOLYBDENUM: Low requirement. Soluble sources sprayed on soil surface or as a coating on the seed.
- ZINC: 1-10#/A as ZnSO4 Band or broadcast. Foliar applications of a 0.5% ZnSO4 solution in 20-30 gal/ also effective. There are residual effects of applied zinc. Monitor with soil testing.

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