Soil Micronutrients: From B to Z

Wisconsin Crop Management Conf.

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Essential Plant Nutrients

- Macronutrients
  - C, H, O – *supplied by air and water*
  - N, P, K
- Secondary Nutrients
  - Ca, Mg, S
- Micronutrients

Micronutrients

- ★ Boron (B) $H_2BO_3^-$
- Chlorine (Cl) Cl^-
- Copper (Cu) Cu^{++}
- Iron (Fe) Fe^{++} or Fe^{+3}
- ★ Manganese (Mn) Mn^{++}
- Molybdenum (Mo) MoO_4^{-}
- Nickel (Ni) Ni^{++}
- ★ Zinc (Zn) Zn^{++}

Micronutrients

- Plants require very small amounts of micronutrients for optimal growth.
- Excessive soil concentrations of micronutrients can harm plants.

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- Ease & convenience of adding micros to multiple input tank mixes, nutrient "paks", etc.?
- Potential for increased revenue with the sale of micros?
- Increased awareness of nutrient deficiency occurrences?

Conditions (i.e. Red Flags) than could lead to a Micro Deficiency

- Unique nutrient demand levels of specific crops

Relative Micronutrient Needs of Crops

Crop	Micronutrient				
	Boron	Manganese	Zinc	Molybdenum	Copper
Alfalfa	High	Medium	Low	Medium	Medium
Corn	Low	Medium	High	Low	Medium
Soybean	Low	High	Medium	Medium	Low
Wheat	Low	High	Low	Low	Medium
Oat	Low	High	Low	Low	Medium
Potato	Low	Medium	Medium	Low	Low
Pasture (legume-grass)	High	Low	Low	High	Medium
Small grain silage	Low	High	Low	Low	Medium
Sorghun-sudan forage	Low	High	Medium	Low	Medium
Beet	High	Medium	Medium	High	High
Onion	Low	High	Low	High	High
Lettuce	Medium	High	Medium	High	High

Source: Laboski et al., 2006. UW-Extn pub A2809. Table 8.3.

Conditions (i.e. Red Flags) than could lead to a Micro Deficiency

- Unique nutrient demand levels of specific crops
- Extremes in soil conditions
  - pH (low, high)
  - Soil texture (sands, heavy clays)
  - Organic matter (low, high)
  - Eroded, compacted, abused soils

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- Extremes in weather conditions
- No previous manure applications

Diagnosing Micronutrients

- Soil Test:
  - Boron
  - Manganese [1]
  - Zinc
- Plant Analysis:
  - Copper
  - Iron
  - Molybdenum
  - Chlorine & Nickel *(rarely done)*

When to Apply Micros -Preferred-

- Crop requirement is high
- Soil test is low
- Deficiency symptoms on plant
  - Confirmed by plant analysis

When to Apply Micros
- Practical -

- Fertilizer additions recommended when:
  - Crop requirement is high

  - Soil test is low

Soil Micronutrient Deficiency Symptoms, Susceptible Crops & Soils

BORON (B)

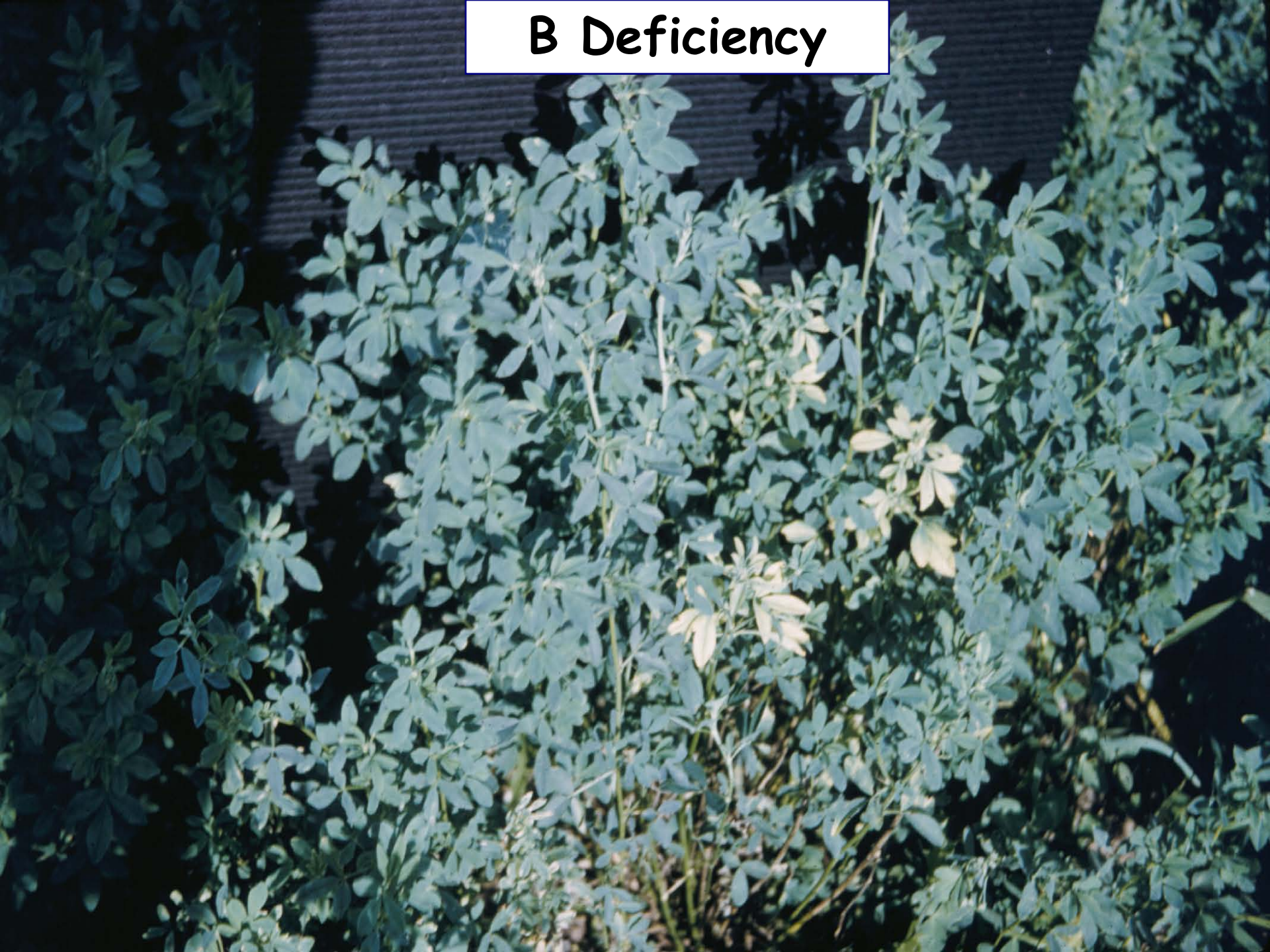
- Common micro deficiency for alfalfa and other forages
  - Most widespread micro def. in Wis.
- Susceptible soils:
  - Sands and low OM soils
  - Dry soils
- Diagnose with soil test
  - Optimum levels: 0.5-1.0 ppm B (sands);
    0.9-1.5 ppm B (other soils)

B Deficiency Symptoms

- Yellowing (chlorosis) or reddening of top (newest) leaves
- Shortened new growth; bushy look
  - Due to shortened internode growth
- With forages, often seen after 1st cut
  - Esp. with dry weather
- Can be mistaken for leafhopper injury

B DEFICIENCY

B Deficiency



B Deficiency

B Deficiency

Iowa State Univ.

B Deficiency Corrections

- For soils testing optimum or higher:
  - No need for B

- For soils testing low or very low:
  - Broadcast 2-3 lb B/acre, respectively, if crop has high B requirement
  - Broadcast 1-2 lb B/acre, respectively, if crop has medium B requirement

MANGANESE (Mn)

- Common micro deficiency for soybean, small grains, and snapbean
- Susceptible soils:
  - High pH (alkaline) soils (>6.8)
  - High organic matter soils (>6%)
  - Red clays of eastern Wis. & wet, cold soils in general
- Diagnose with soil test if OM is ≤ 6%
  - Optimum levels: 11-20 ppm Mn (all soils)
  - Optimum for high OM: pH of 6.0–6.9

Mn Deficiency Symptoms

- Interveinal chlorosis of top (newest) leaves in soybean
- Stunted growth, leaf drop

S.P. Conley, Univ. Wis.

- "Gray speck disease" in oats, barley

Alberta ARD

Mn Deficiency

Mn Deficiency

Mn & Glyphosate-Resistant Soy

- Spike in Mn def. of Wis. soybean in 2007
  - Commonalities: High pH and/or high OM soils, GR soybean varieties
- Researchers from multiple states report linkage between Mn def. & GR soybean
  - See proceedings of 2008 conference
  - GR soy root uptake and/or metabolism of Mn may be reduced by GR gene, glyphosate apps. or both
- Potential for Mn def. on susceptible soils increases with GR soybean varieties

Mn Deficiency Corrections

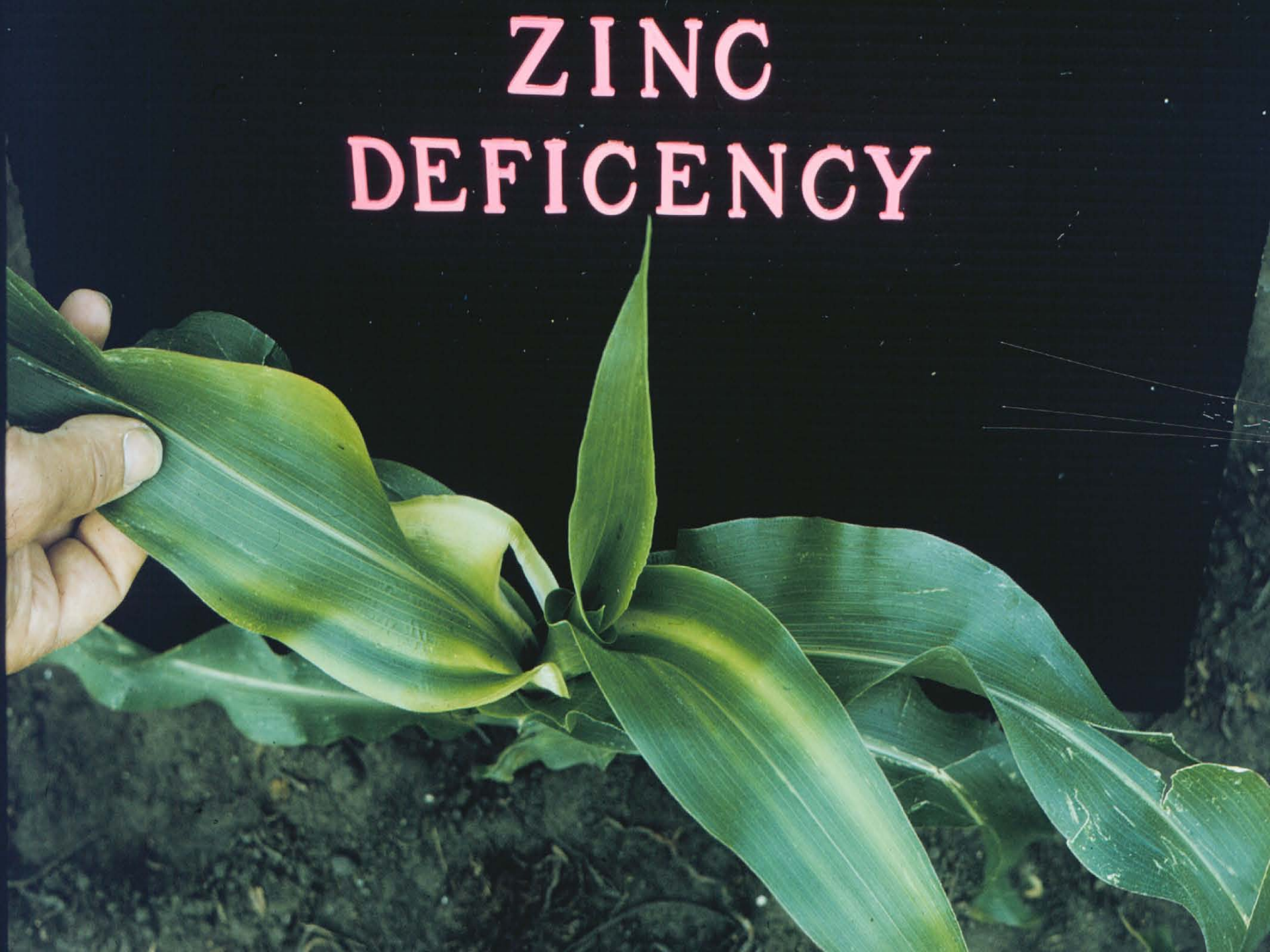
- For soils testing optimum or high:
  - No need for Mn
- For soils testing low:
  - Apply 3-5 lb Mn/a, if crop has high or medium need
  - In-row or band. Do not broadcast!
  - Chelated Mn not effective for soil apps
- Foliar applications at 1-1.25 lb Mn/a
  - 0.15-0.2 lb Mn/a in chelate form
- Need for supplemental Mn on GR beans?

ZINC (Zn)

- Most common micro deficiency for corn
  - Occasionally snapbean, onion, fruit, ornamentals
- Susceptible soils:
  - High pH soils (>6.5)
  - Eroded, scalped or compacted soils
  - Sands & organic soils
  - Cold soils
- Diagnose with soil test
  - Optimum levels: 3.1-20 ppm Zn (all soils)*

Zn Deficiency Symptoms

- Broad band of bleached tissue along midrib on top (newest) corn leaves
  - Begins at base of leaf
- Stunted growth
  - Due to shortened internodes
- Rosetting in broadleaf crops
  - Small leaf size
  - Interveinal chlorosis in snaps


ZINC
DEFICENCY

Zn Deficiency

J.E. Sawyer, Iowa St. Univ.

Zn Deficiency

Univ. Minn.

Zn Deficiency Corrections

- For soils testing optimum or higher:
  - Response to Zn is unlikely
- For soils testing low or very low **and** crop has a high Zn need:
  - Band apply 2-4 lb Zn/a (0.5–1.0 lb/a Zn chelate)
  - Broadcast apply 4-8 lb Zn/a (1–2 lb/a Zn chelate)
- Foliar applications at 1 lb Zn/a
  - 0.15 lb/a Zn chelate
  - Repeat applications may be needed

Other Micronutrients
-- Cu, Cl, Fe, Mo, Ni --

- Deficiencies are rarely seen in Wisconsin's major agronomic crops.

- **Cl, Ni:** Deficiencies not seen in Wis.
- **Cu:** Beet, lettuce, onion = high need
  small grains on acid/organic soils
- **Mo:** Beet, brassica, broccoli, cauli-
  flower, lettuce, onion = high need

Other Micronutrients
- Cu, Cl, Fe, Mo, Ni -

- **Fe:** Occasionally seen on soybean grown on alkaline (pH > 7.0) soils

Micronutrient Summary

- Micro deficiencies are rare in Wis.
- Be aware of the high demand levels of specific crops that you grow or manage
- Be wary on susceptible soils
  - Sands, heavy clays, very high/low pH, very high/low OM, eroded, compacted soils
- Be wary with unusual weather
- Confirm need
  - Soil test, visual signs, plant analysis/tissue test