SULFUR

SULFUR (S)

- Role of S in plants
  - Component of amino acids
  - Essential for nitrate reductase enzyme
    - Nitrate $\longrightarrow$ organic-N
- Deficiency symptoms not localized

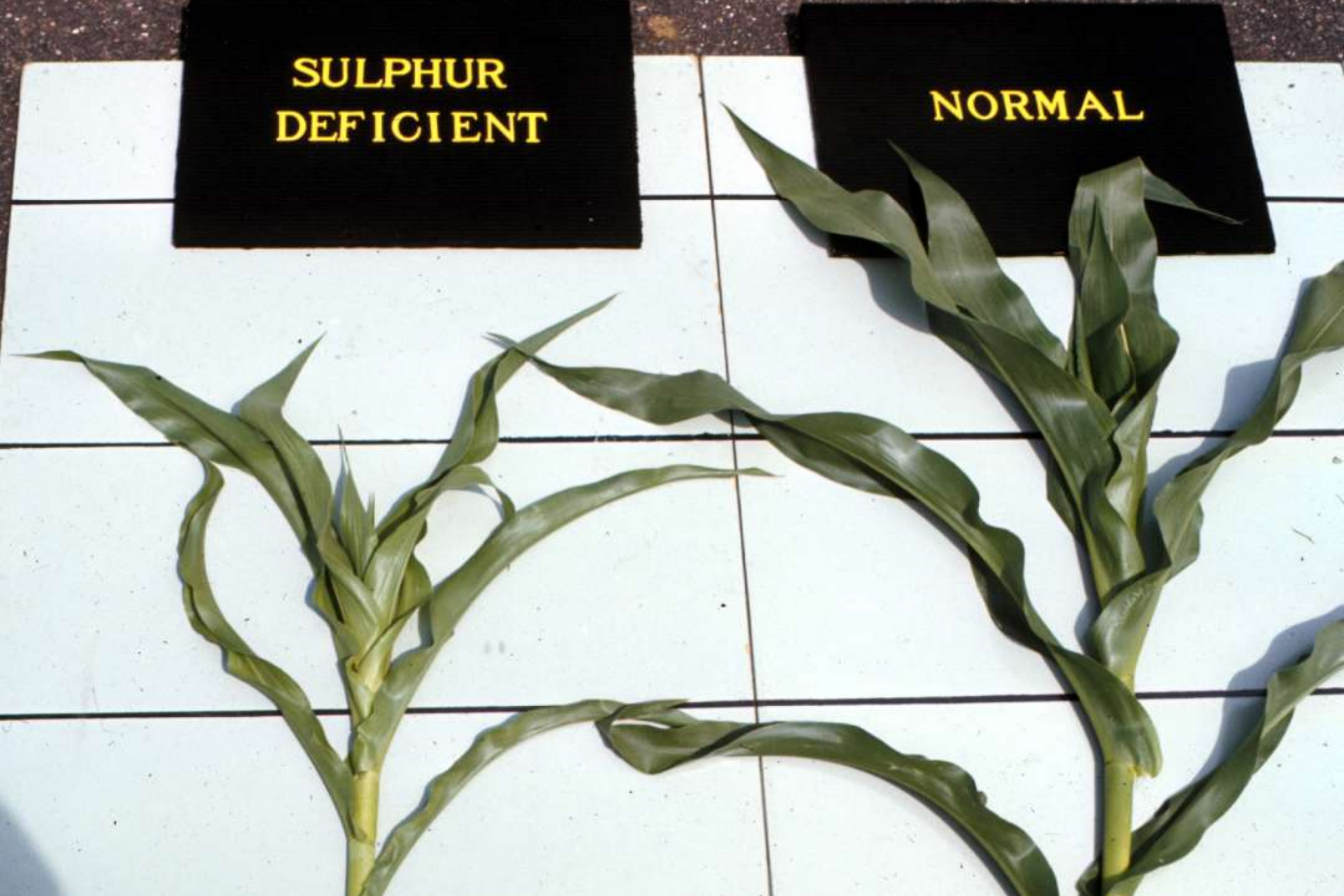
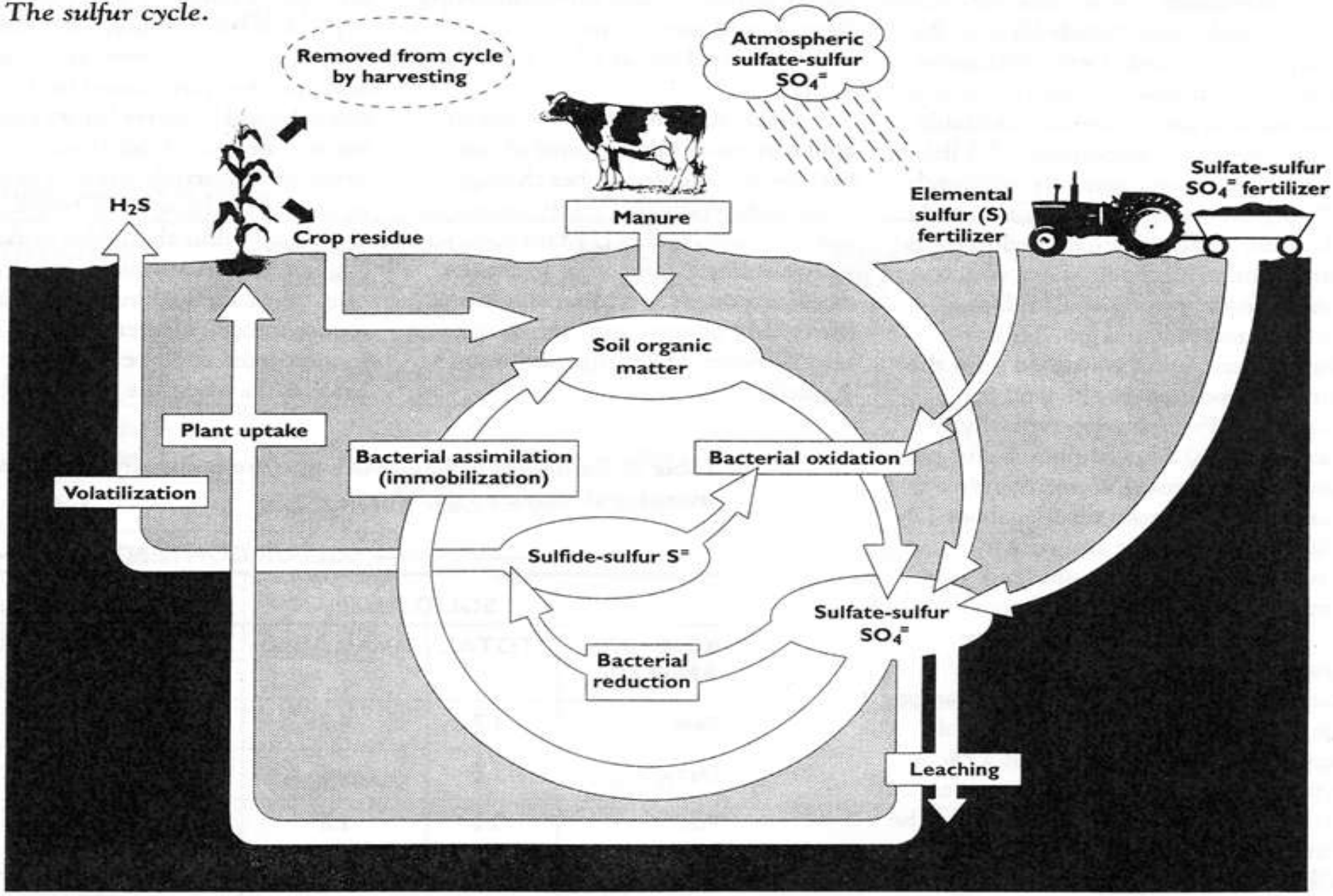

SULPHUR
DEFICIENT
NORMAL

Figure 1. The sulfur cycle.



POTENTIAL SULFUR DEFICIENCIES

- Low organic matter soils
- No recent manure history
- Low sulfur in precipitation
- Low subsoil sulfur

Sulfur Removed by Crops

Crop	Portion harvested	Yield/acre	Sulfur removed
			-- lb/acre --
Alfalfa	hay	4 tons	23
Corn	grain	150 bu	10
	silage	15 tons	25
Oat	Grain	80 bu	5
	straw	2 tons	9
Potato	tubers	400 cwt.	10

SULFUR AVAILABILITY INDEX (SAI)

= Sum of available S inputs:

- Organic matter – 2.8 lb S/a for 1% OM
- S in rain & snow – 10 or 20 lb S/a
- S in subsoil 5, 10, or 20 lb S/a
- S in manure – depends on rate, kind
- Soil sulfate-S test

SAI Interpretation:

- < 30 = Apply S to S-demanding crops
- 30-40 = Confirm S need by plant analysis
- > 40 = No additional S needed

Suggested treatments for sulfur deficiencies

Crop	Sulfur needed
	-- lb S/acre --
Forage legumes:	
Incorporated at seeding	25 - 50
Topdressed on established stand	15 - 25
Corn, small grains, vegetables & fruits	10 - 25

Sources of sulfur fertilizer

Name of fertilizer	Chemical formula	Fertilizer analysis (%) N-P_2O_5-K_2O	Sulfur Content (%)
Very soluble:			
Ammonium sulfate	$(NH_4)_2SO_4$	21-0-0	24
Potassium sulfate	K_2SO_4	0-0-50	18
Potassium-magnesium sulfate	K_2SO_4 •$2MgSO_4$	0-0-22	23
Ammonium thiosulfate	$(NH_4)_2S_2O_3$	12-0-0	26
Magnesium sulfate	$MgSO_4$ •$7\ H_2O$	0-0-0	14

Sources of sulfur fertilizer

Name of fertilizer	Chemical formula	Fertilizer analysis (%) $N\text{-}P_2O_5\text{-}K_2O$	Sulfur Content (%)
Slightly soluble:			
Calcium sulfate (gypsum)	$CaSO_4 \cdot 2H_2O$	0-0-0	17
Insoluble:			
Elemental sulfur	S	0-0-0	88-98

MICRONUTRIENTS

Essential Plant Nutrients

- Micronutrients:
  - Zinc (Zn) Zn^{++}
  - Manganese (Mn) Mn^{++}
  - Iron (Fe) Fe^{++} or Fe^{+3}
  - Copper (Cu) Cu^{++}

Essential Plant Nutrients

- Micronutrients:
  - Boron (B) $H_2BO_3^-$
  - Molybdenum (Mo) MoO_4^{--}
  - Chlorine (Cl) Cl^-
  - Nickel (Ni) Ni^{++}

Relative micronutrient requirements of crops

	Micronutrient		
Crop	Boron	Manganese	Zinc
Alfalfa	High	Medium	Low
Corn	Low	Medium	High
Soybean	Low	High	Medium
Cabbage	Medium	Medium	Low
Beets	High	Medium	Medium
Potato	Low	Medium	Medium

MICRONUTRIENT FERTILIZERS

- Apply only when:
  - ✓ Soil test is low
  - ✓ Deficiency symptoms on plant
  - ✓ Plant analysis indicates deficiency
  - ✓ High crop requirement

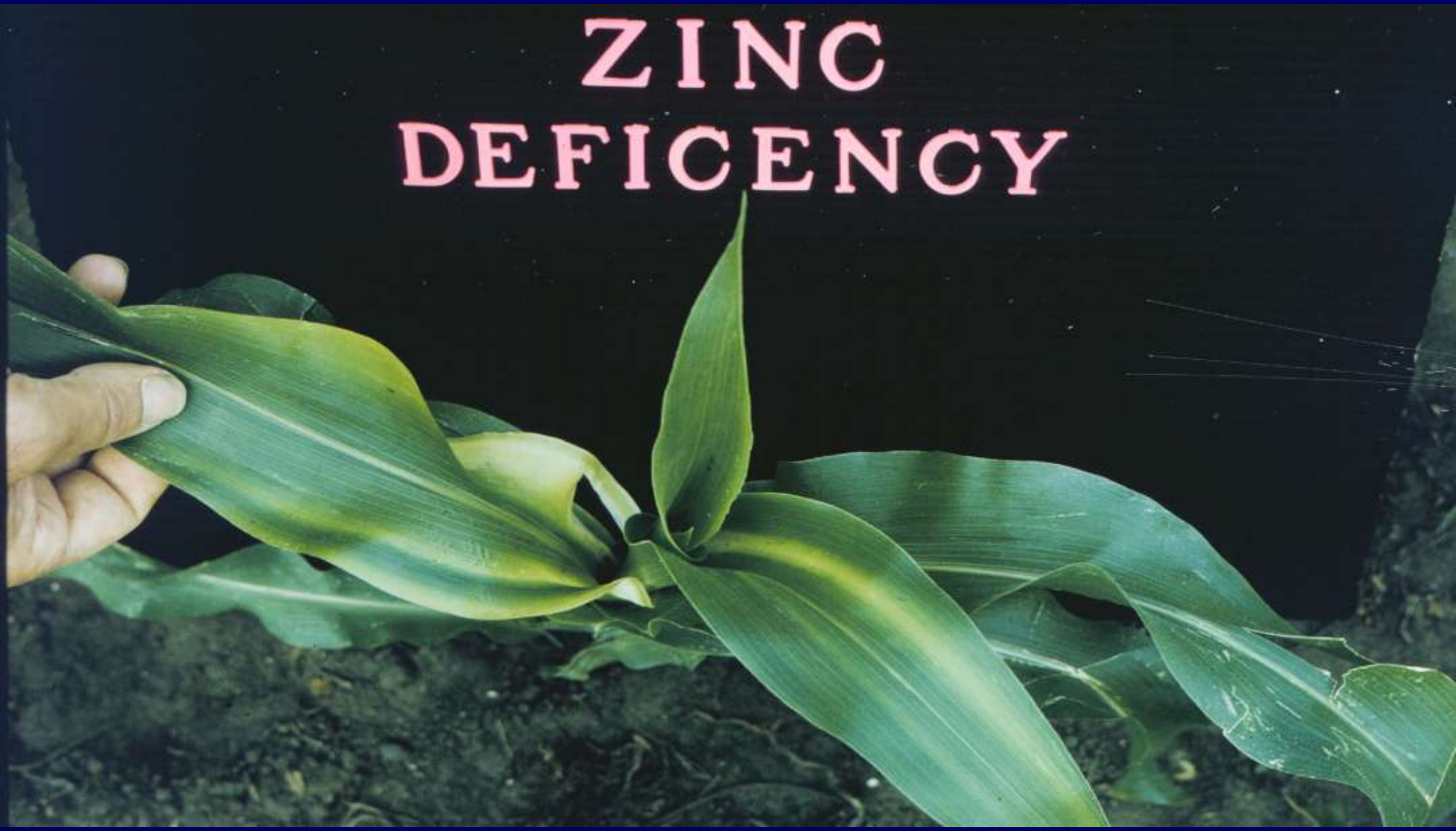
MICRONUTRIENT FERTILIZERS

- Fertilizer addition recommended only when:
  - ✓ Soil test is low

  AND
  - ✓ Crop requirement is high or medium

POTENTIAL MICRONUTRIENT DEFICIENCIES

- Zinc
  - High pH soils
  - Eroded or scalped soils
  - Lower organic matter soils
  - Corn


ZINC
DEFICENCY

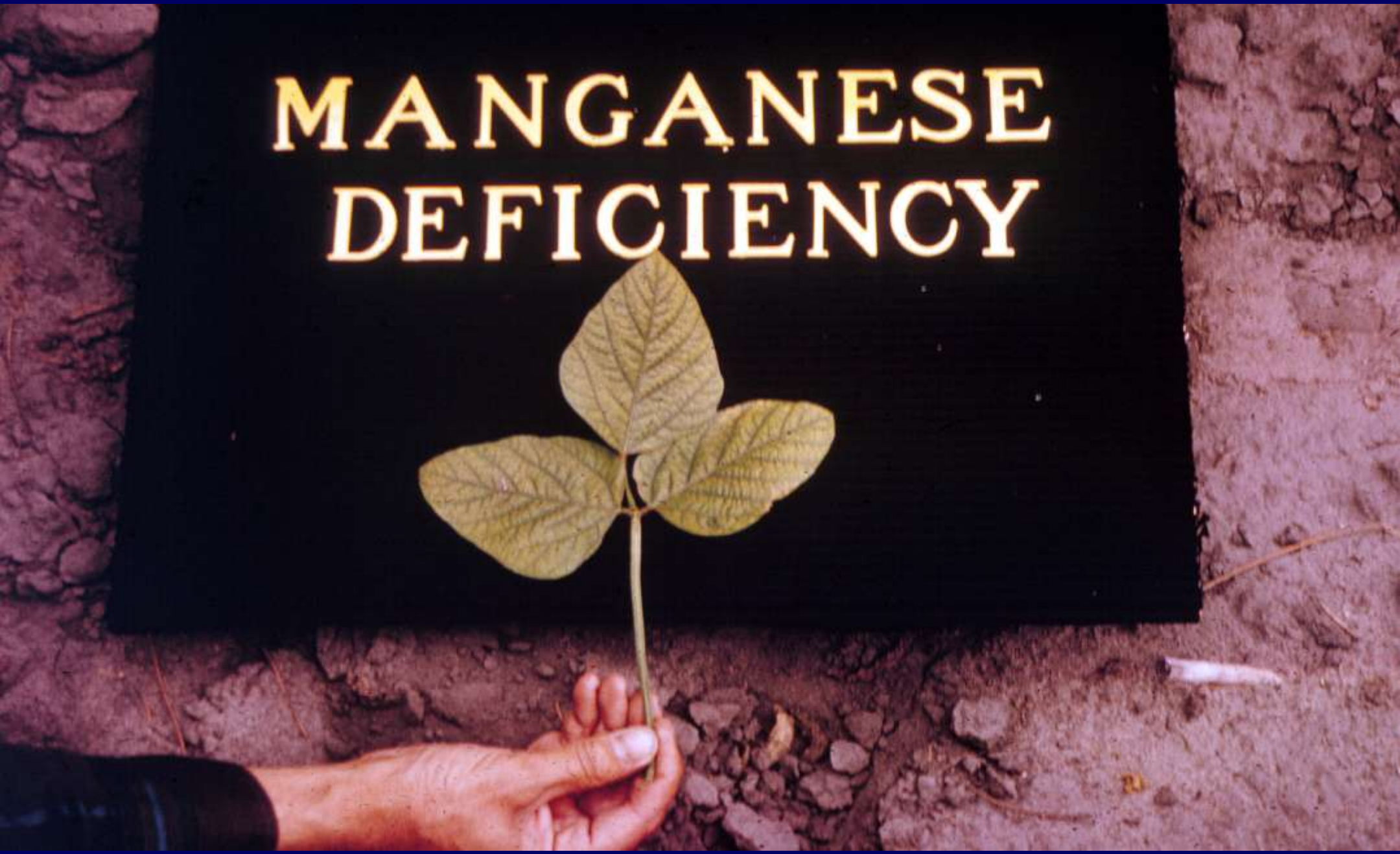
MICRONUTRIENT FERTILIZER RECOMMENDATIONS

- Zinc
  - ✓ Apply 2-4 lb Zn/acre (banded) if crop has high requirement
  - ✓ Apply 4-8 lb Zn/acre (broadcast)
  - ✓ Foliar applications = 1lb Zn/acre, repeat treatments may be needed

POTENTIAL MICRONUTRIENT DEFICIENCIES

- Manganese
  - High pH soils
  - Dark colored soils in Southern & Southeastern Wisconsin
  - Red soils in Eastern Wisconsin
  - Soybean & small grains


20 LBS MN /ACRE
MNSO4
ROW
NO
FERTILIZER

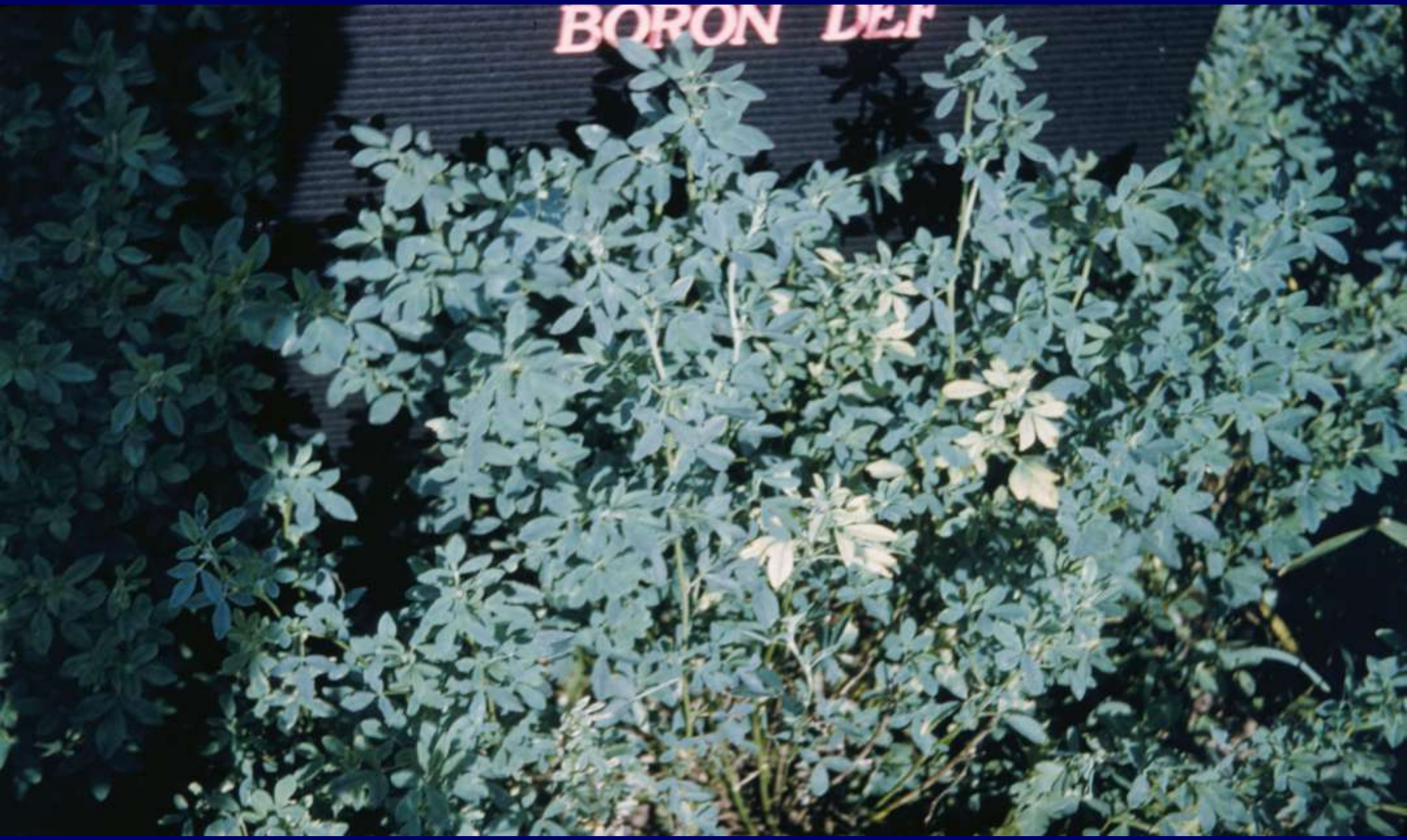

MANGANESE
DEFICIENCY

MICRONUTRIENT FERTILIZER RECOMMENDATIONS

- Manganese
  - ✓ Apply 5 lb Mn/acre (banded) if crop has high requirement
  - ✓ Foliar applications = 1lb Mn/acre, repeat treatments may be needed
  - ✓ Broadcast applications not recommended

POTENTIAL MICRONUTRIENT DEFICIENCIES

- Boron
  - Low pH soils
  - Periods of dry weather
  - Alfalfa


BORON DEP

MICRONUTRIENT FERTILIZER RECOMMENDATIONS

- Boron
  - ✓ Apply 2-3 lb B/acre (broadcast) if crop has high requirement
  - ✓ Apply 1-2 lb B/acre (broadcast) if crop has medium requirement