DEFICIENCY SYMPTOMS AND TISSUE TESTING
Extension Agent Agronomy College
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Objectives

- Learn to identify plant nutrient deficiency symptoms
- Understand conditions that decrease nutrient availability
- Present tissue testing

How to evaluate soil nutrient status

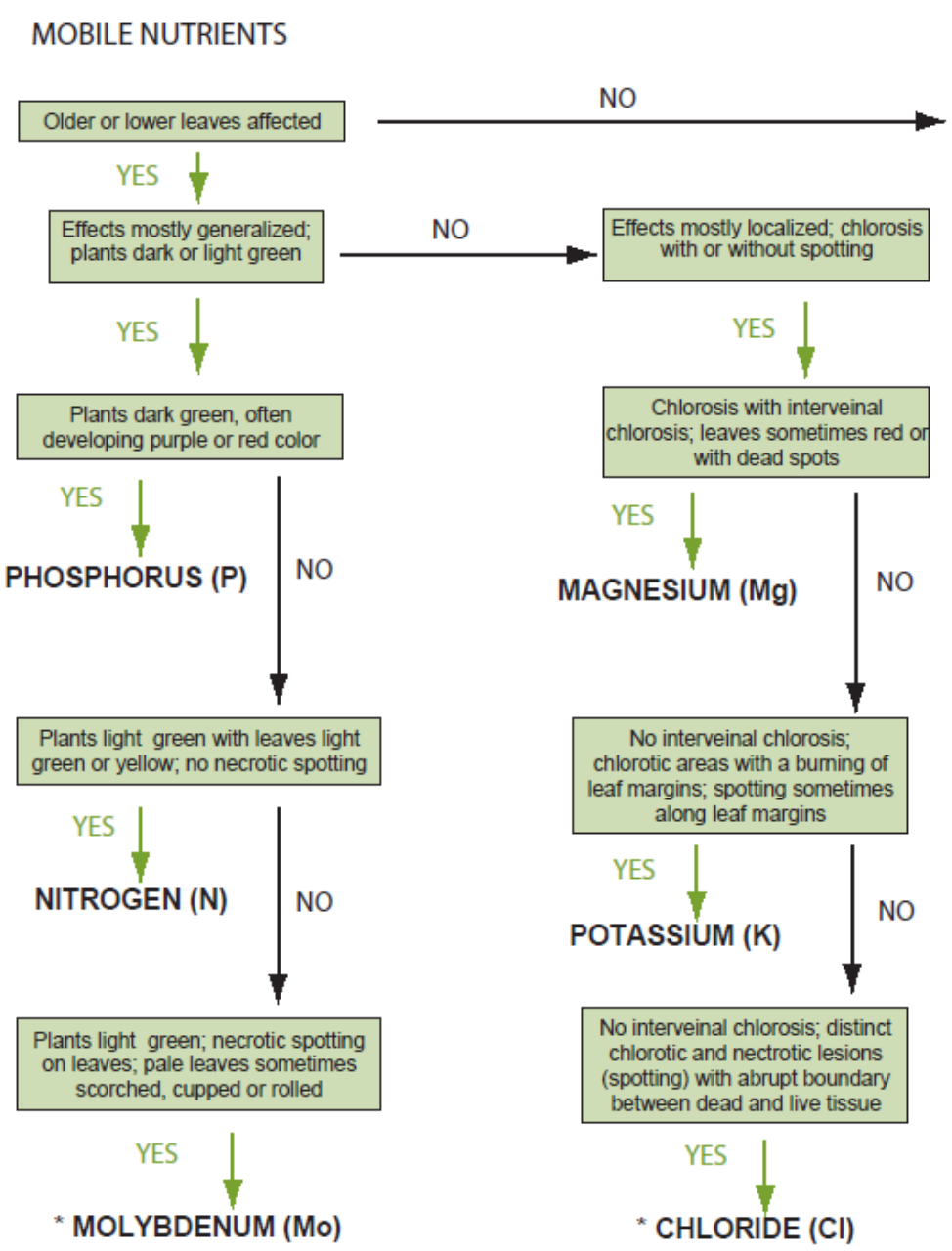
- Visual assessment of tissue and tissue testing: May identify what has been lacking to this point – topic of this session. If identified early enough may be able to correct within growing season
- Apply fertilizer test strips
- Soil test: Tells you what is currently available in the soil, useful to calculate nutrient addition rates, estimate of what will be available for that growing season – comes later

Visual tissue assessment

Nutrients that are *mobile in the plant* will affect *lower* leaves first.

These include:

- Nitrogen (N)
- Phosphorus (P)
- Potassium (K)
- Chloride (Cl)



IMMOBILE NUTRIENTS

Boron
Calcium
Copper
Iron
Manganese
Sulfur
Zinc

http://landresources.montana.edu/NM/Modules/NM9.pdf

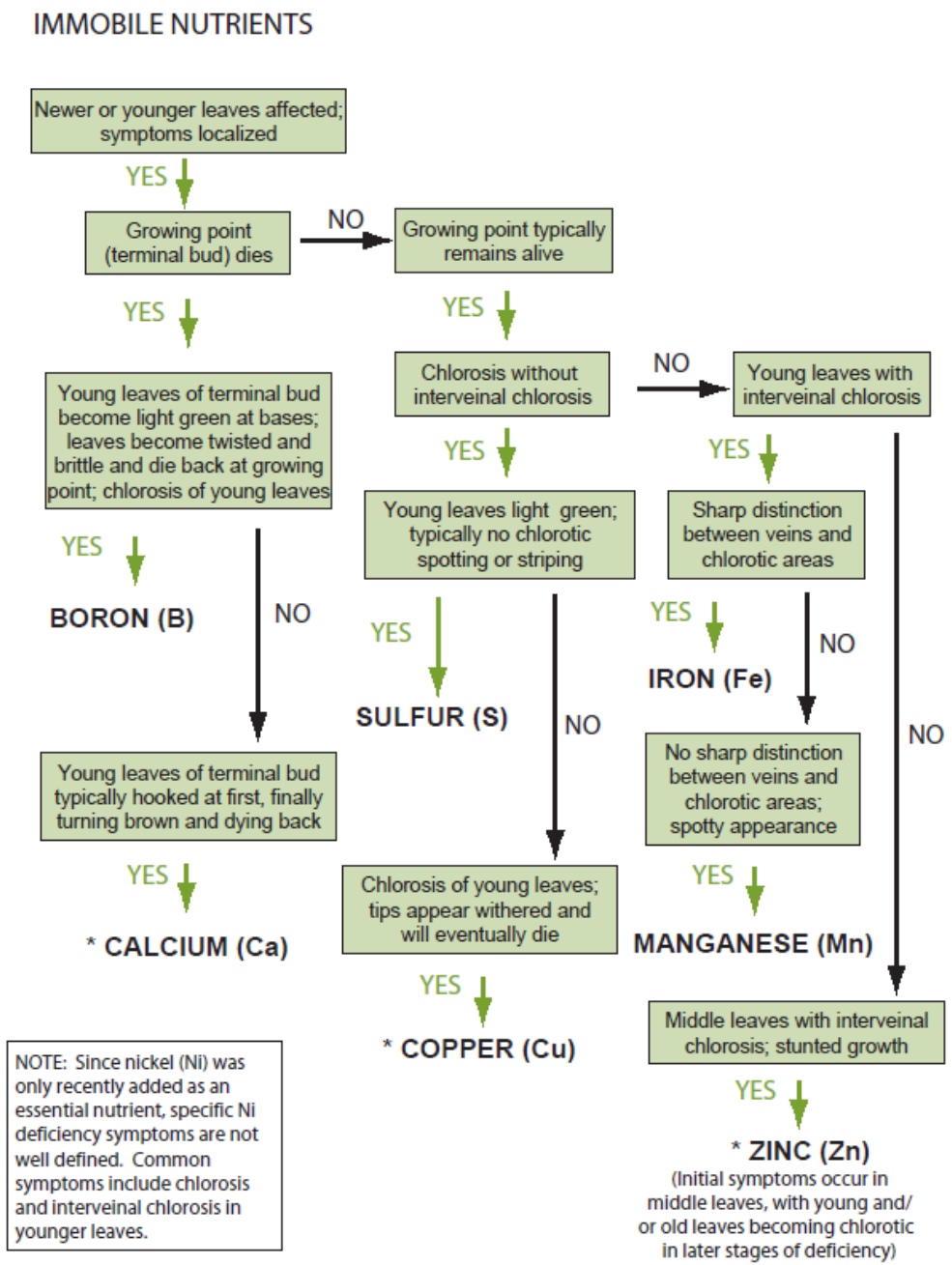
Visual tissue assessment

Immobile nutrients will affect young leaves first

These include:

- Boron
- Calcium
- Copper
- Iron
- Manganese
- Sulfur
- Zinc

http://landresources.montana.edu/NM/Modules/NM9.pdf



What is deficient?

- Only upper leaves chlorotic, consistently, no interveinal?

Sulfur

Factors decreasing N availability

- Low soil organic matter
- Poor nodulation of legumes (e.g. alfalfa)
- Excessive leaching
- Cool temperatures, dry

The main form of available N (nitrate) is very mobile in soil.

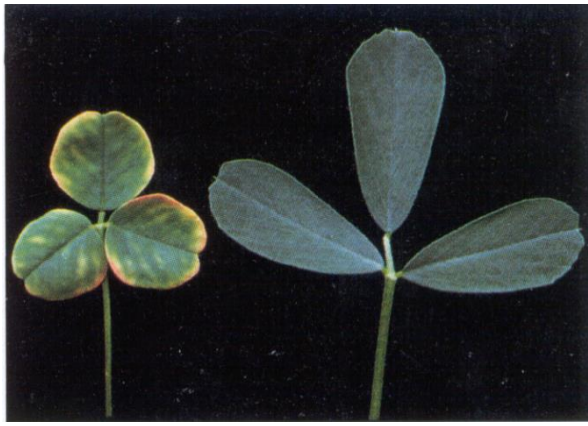
N Deficiency Symptoms

- Pale green to yellow lower (older) leaves. Why lower leaves?

  N is MOBILE in plant

- Stunted, slow growth
- Yellow edges on alfalfa

Alfalfa



Spring Wheat

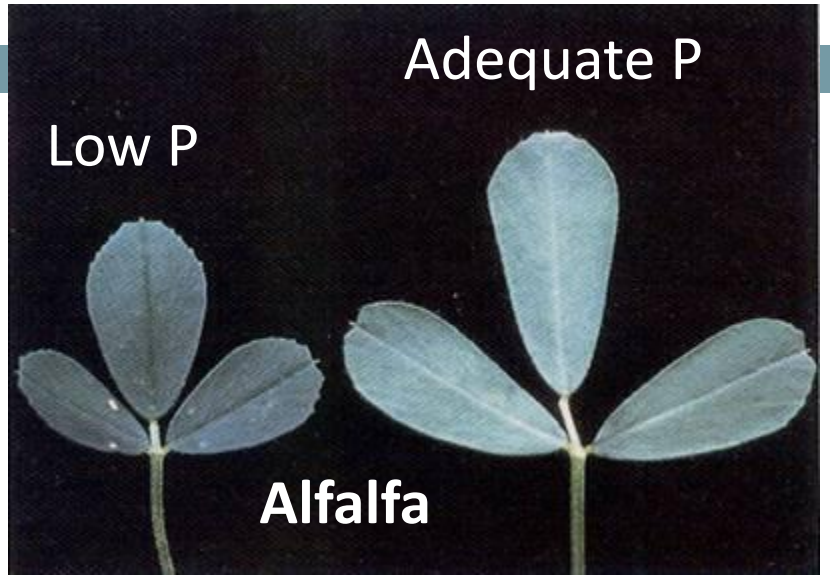
Corn

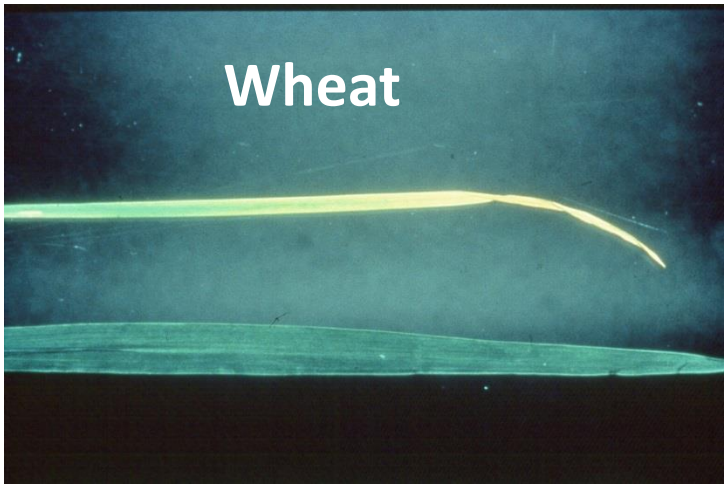
Factors decreasing P availability

- Soil pH below 6.0 or above 7.5
- Cold, wet weather
- Calcareous soils
- Leveled soils
- Highly weathered, sandy soils

P Deficiency Symptoms

- Dark green, often purple
- Lower leaves sometimes yellow
- Upward tilting of leaves may occur in alfalfa
- Often seen on ridges of fields
- In fruiting crops, healthy vigorous plants that don't flower to produce fruit





Factors decreasing K availability

- Cold, dry weather
- Calcareous or sandy soils
- Saturated soils
- High N or magnesium
- Low soil organic matter

K deficiency symptoms

- Alfalfa – white spots on leaf edges.
- Corn and grasses – chlorosis and necrosis on lower leaves first. Why?

K is MOBILE in plant

- Weakening of straw-lodging in small grains, breakage in corn.
- Wilting, stunted, shortened internodes

Factors decreasing S availability

- Irrigated with low S in irrigation water
- Sandy, acidic, or low organic matter soils
- Cold soils
- Soils formed from minerals low in S or far from industrial sources

S deficiency symptoms

- Upper leaves light green to yellow. Why?

  S is immobile in plant
- Small, thin stems
- Low protein
- Delayed maturity
- No characteristic spots or stripes

What nutrient is lacking?

1. N
2. P
3. K
4. Sunshine
5. Fe

U of Idaho Extension

What nutrient is lacking?

1. N
2. P
3. K
4. S
5. vinegar and oil

Photos courtesy IPNI

Pseudo-deficiencies

What else can cause symptoms that look like nutrient deficiency symptoms?

1. Insects
2. Salinity
3. Moisture stress
4. Disease
5. Herbicides

Photo: Ontario Ministry of Ag., Food & Rural Affairs

What else would you look at other than shoot tissue?

1. Roots – healthy (white), distribution?
2. Soil – compacted, texture, moisture?
3. Distribution on field – near edges, patchy, in strips…?
4. ?

Questions?

For more information see:

- *Plant nutrient functions and deficiency and toxicity symptoms* (4449-9) http://landresources.montana.edu/nm/
- On-line deficiency images at http://landresources.montana.edu/soilfertility/nutrientdeficiencies.html
- Yara CheckIT a mobile app with photo library of crops for identification of possible nutrient deficiencies http://www.yara.com/media/apps/checkit/index.aspx

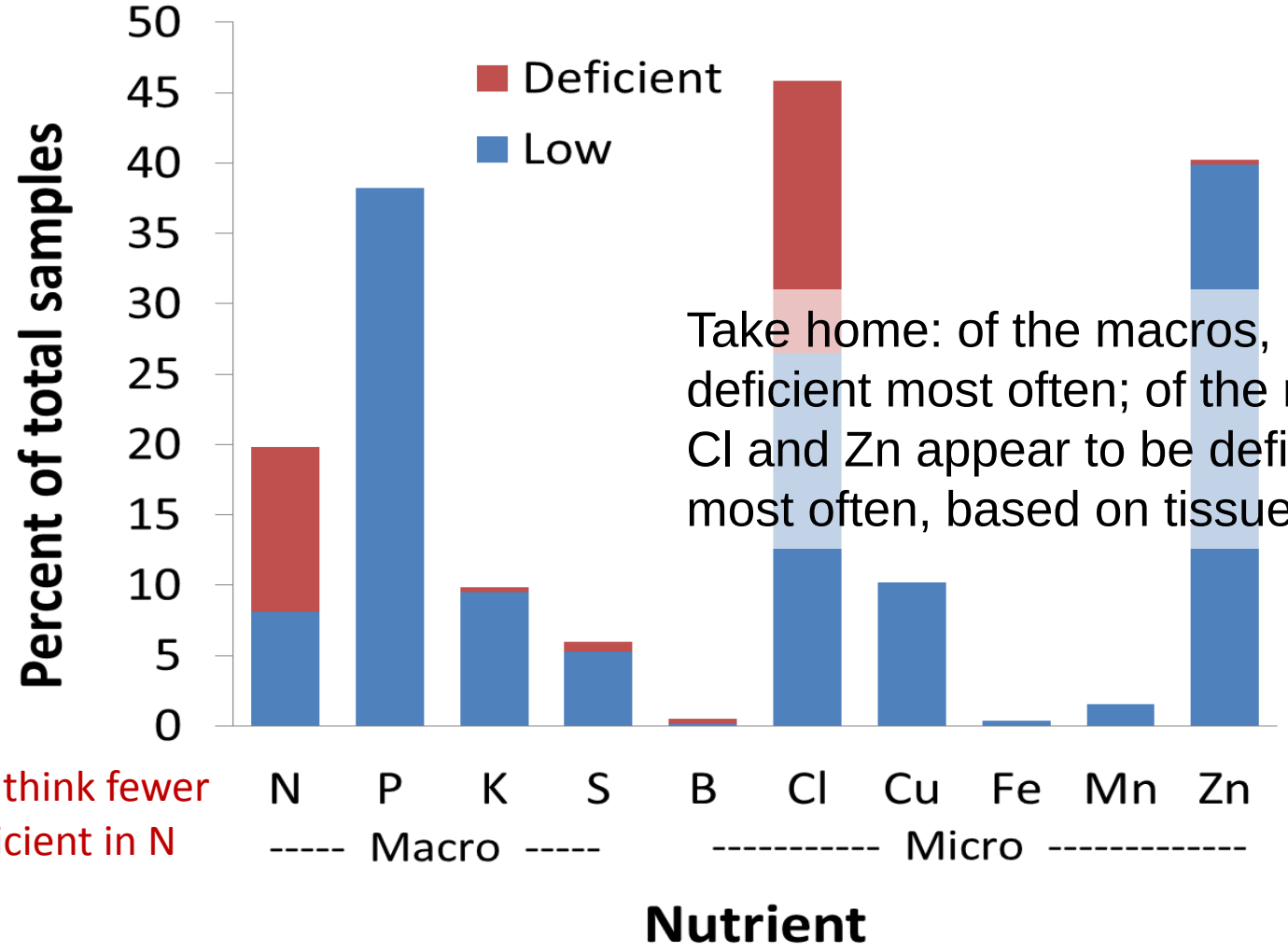
Tissue testing for N, P, and K

- Vegetation index sensors (NDVI) have potential for adjusting N by early tillering in SW for yield (Walsh unpub. data)
- Tissue sampling: (see references at end for more info)
  - Crop dependent sufficiency ranges
  - Correct time and tissue sampled
  - Correct handling of sample
  - Sufficiency ranges and fertilization recommendations not well established in MT, best to compare with healthy plants from same area
- Soil test better for P and K

Tissue testing for S and micronutrients

- Tissue sampling for S is useful if deficiency is suspected.
- See *Secondary Macronutrients: cycling, testing and fertilizer recommendations* for sufficiency ranges (4449-6)
  http://landresources.montana.edu/nm/
- There are tissue concentration sufficiency ranges, but other than for Cl there are no MT fertilizer guidelines for micronutrients based on tissue tests

Small grain tissue nutrient concentrations from Montana in 2013 (source: AgVise Labs, n=589)



Take home: of the macros, P is deficient most often; of the micros, Cl and Zn appear to be deficient most often, based on tissue testing

Why do you think fewer samples deficient in N than in P?

There may be error b/c many samples are not the correct plant part and there may be bias because more samples with deficiency symptoms are submitted than w/o symptoms

How know if Cl is deficient in wheat?

- Based on plant Cl level at boot stage:
- Cl < 0.12 ppm: large chance for a response
- 0.12 < Cl < 0.4 ppm: some chance for a response

See *Winter Wheat Response to Chloride Fertilizers* (Fertilizer Fact #3) for more details

http://landresources.montana.edu/fertilizerfacts

Summary

- Visual symptoms can identify what has been lacking to this point
- Use location of symptoms on plant and leaf part along with pattern and color to identify deficiency
- Consider growing conditions that might contribute to deficiency
- Be aware of pseudo-deficiencies
- Tissue sample interpretation is crop, plant part and plant growth dependent
- There are sufficiency ranges but no fertilizer guidelines based on tissue concentrations

Questions?

For more information on micronutrients and tissue sampling and concentrations see:

McKenzie, R. 2001. Alberta Ag and Rural Development. *Micronutrient Requirements of Crops.* www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex713

Beegle, D. 2002. *Soil Fertility Management for Forage Crops: maintenance.* Agronomy Facts 31-C. Penn State Extension. http://extension.psu.edu/plants/ crops/forages/soil-fertility/soil-fertility-management-for-forage-crops-maintenance