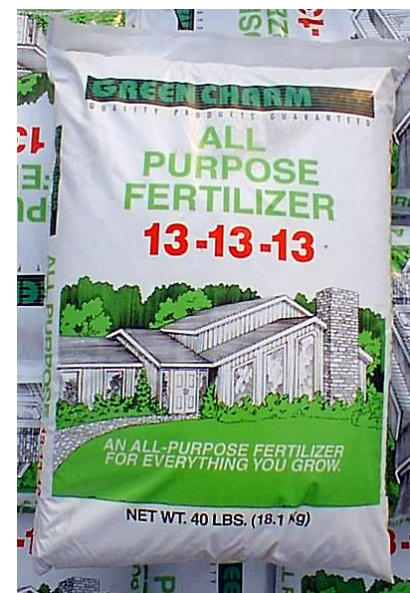


SOIL FERTILITY CONSIDERATIONS FOR HOME GARDENS

Ag Extension Agent Training
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Clain Jones clainj@montana.edu 994-6076

Today's objective

- Present you with a path to answer common garden soil questions

“My plants don’t look healthy. What’s wrong?”

- Ask for background information (list on next slide)
- Ask for photograph, see if you or someone at Schutter lab can diagnose quickly over phone or email (possibly using nutrient deficiency key – following 2 slides)
- If can’t diagnose, send sample to Schutter Diagnostic Lab
- If determined to be an ‘abiotic’ cause, help gardener collect a soil (or tissue) sample and get it sent to an analytical lab
- Interpret soil or tissue sample results, possibly w/ Clain’s help

Background information to help diagnose problem

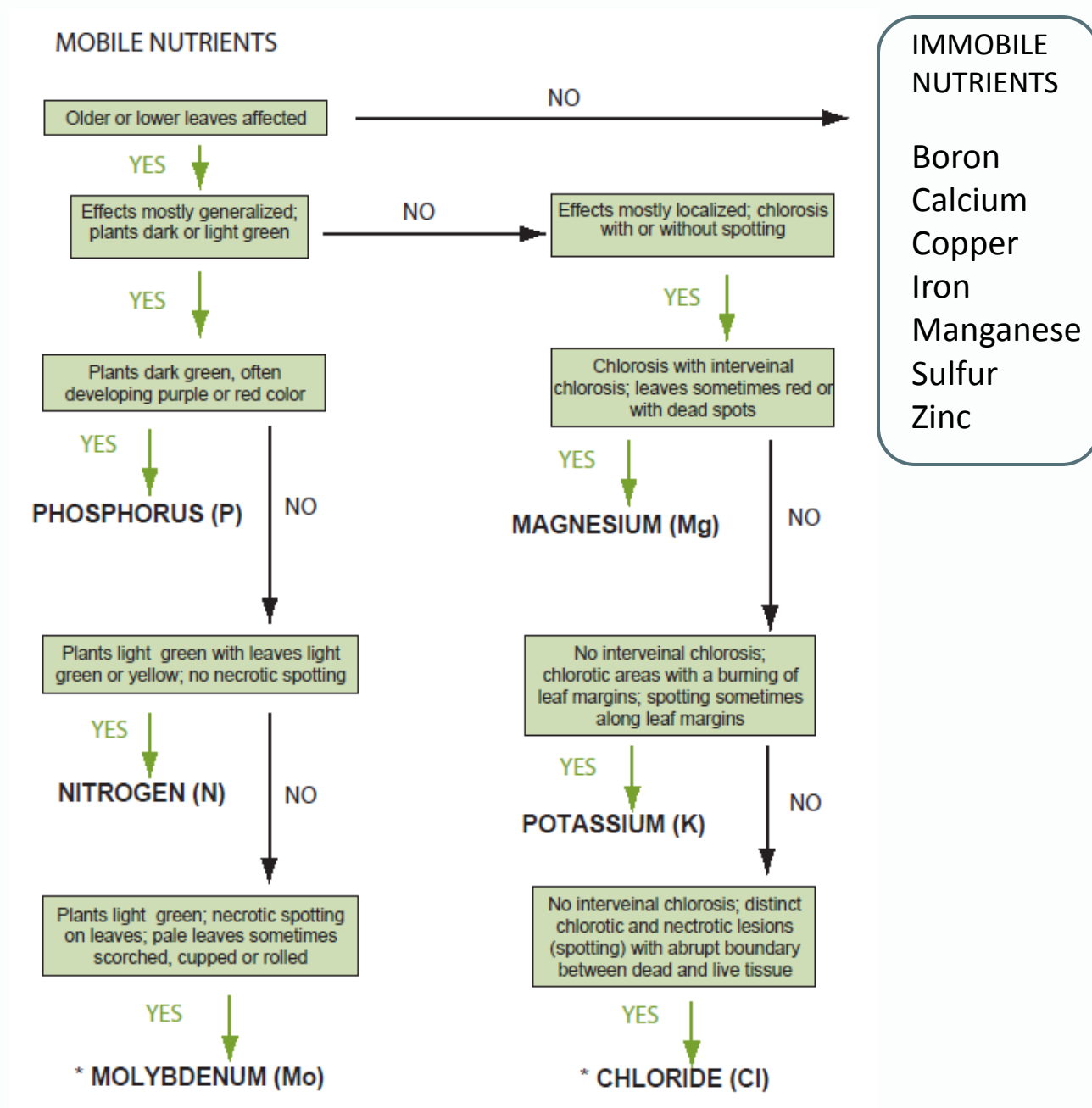
- Plant and variety
- Location (greenhouse, field, windbreak, home garden)
- Irrigation practices (type of system, frequency, amount applied)
- Plant history (age, size)
- Fertilizer/amendments source, rate, timing, placement
- Pesticides/herbicides used with names, rates, dates
- Weather conditions
- Pattern of symptoms on the plant and surrounding plants
- Previous problems in this location

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)



Visual tissue assessment

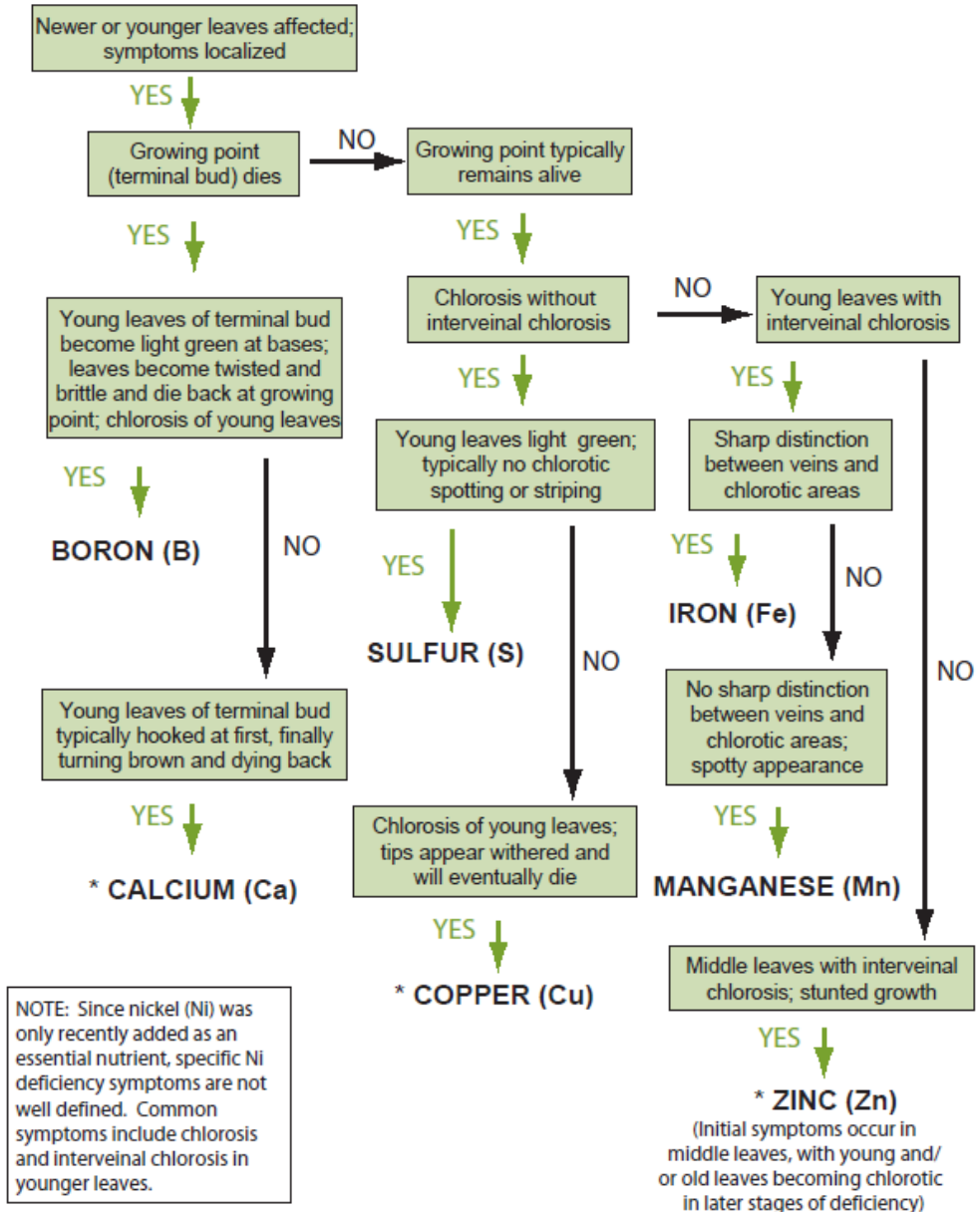
Immobile nutrients will affect young leaves first

These include:

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

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

IMMOBILE NUTRIENTS





N deficient basil.
Lower leaves are more yellow than upper leaves.

P deficient lettuce. Dark green foliage with purple stems or leaves, or plants don't flower.

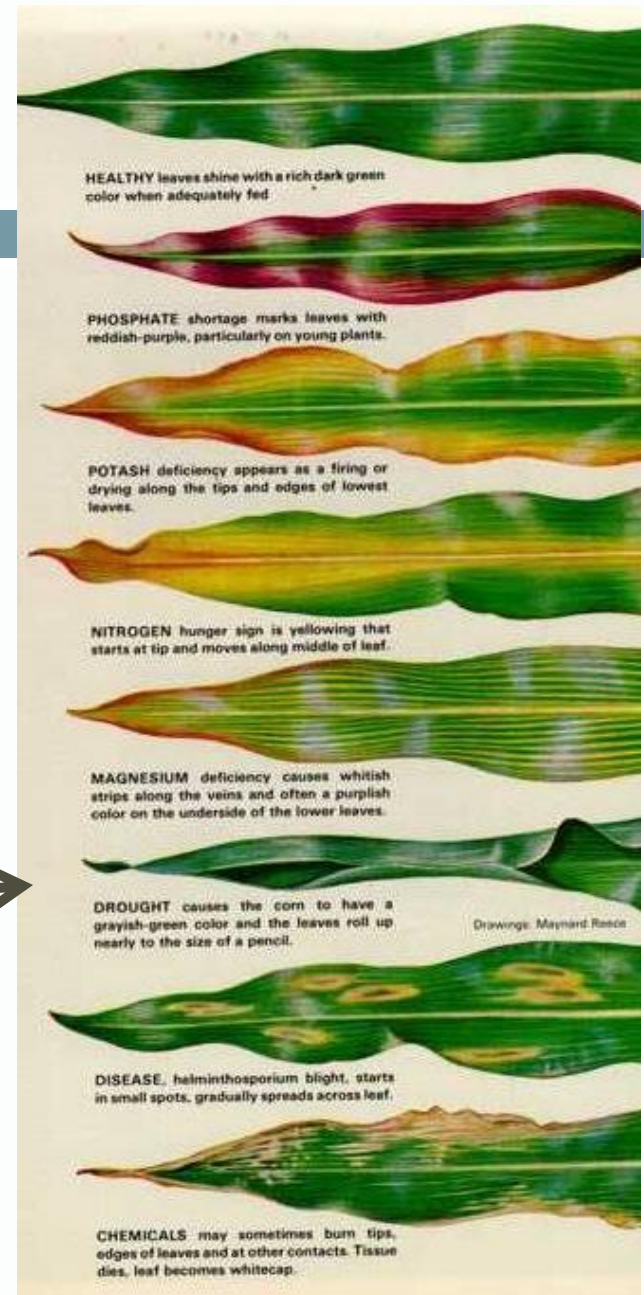


S deficient field pea.
New leaves are yellow.

Pseudo-deficiencies

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

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



“Why should I soil test?”

- To identify nutrient deficiency or imbalance hopefully BEFORE it affects plants
- To help calculate fertilizer rates
- Can increase yield and/or save on fertilizer costs, and decrease environmental risks
- See *Home Garden Soil Testing & Fertilizer Recommendations* (MT200705AG) for details

FIGURE 2. Sample soil test report and fertilizer recommendations.

Name: Homeowner		Sample Date: April 9, 2007	
Lab Number: 12345		Your Sample Number: 1	
Crop to be Grown: Garden		Sampling Depth: 0 to 6 inches	
Soil Test Results		Interpretation	Recommendation
Nitrate-N	12 lb/acre	Low	3 lb N/1000 sq ft
	6 ppm		
Olsen Phosphorus	15 ppm	Medium	2 lb P ₂ O ₅ /1000 sq ft
Potassium	192 ppm	Medium	1 lb K ₂ O/1000 sq ft
Sulfate-S	15 ppm	High	—————
Boron	0.5 ppm	Medium	0.02 lb B/1000 sq ft
Copper	1.7 ppm	Very High	—————
Iron	47 ppm	Very High	—————
Manganese	10 ppm	Very High	—————
Zinc	1.3 ppm	High	—————
Soluble Salts	0.3	Low	—————
Organic Matter	3.4%	Medium	—————
Soil pH	7.7	Medium/High	—————
CEC	17.8	Medium	
Soil Texture	Sandy Loam		

Limiting soil nutrient levels in top 6 inches

Nutrient	Limiting	High
N	Crop and soil organic matter dependent	
	<20 lb N/acre	>80 lb N/acre = adequate
P	< 8 ppm	> 30 ppm very high
K	< 150 ppm	> 500 ppm very high
S	Not available –tissue testing better	
B	< 0.5 ppm	> 5 ppm = toxic
Cl	Not available	
Cu	< 0.25 ppm	> 0.5 ppm
Fe	< 2.5 ppm	> 5.0 ppm
Mn	< 0.5 ppm	>1.0 ppm
Zn	< 0.25 ppm	> 60 ppm = toxic

What if lab doesn't provide a recommendation (or is from another state)?

- Use tables 3, 4, and 5 (for N, P, K respectively) in *Home Garden Soil Testing & Fertilizer Recommendations* (MT200705AG)
- Calculate fertilizer application rate following example calculation in MT200705AG

Considerations when fertilizing with manure



- Easy to over apply N, P, and K
- Rapid excess buildup of P and K if fertilizing to meet N needs

After just 1 - 6 years of 'uninformed' fertilization with composted dairy manure, what % of 67 gardens had excess P and K?

- <25
- 25 – 50
- 50 – 75
- >75

92% had excess P and 88% excess K

(Hansen unpub data, Ohio State Univ.)

Approximately how much total N, P, and K does 1" of manure compost supply?

	N	P ₂ O ₅	K ₂ O	N:P
	lbs/1000 sq. ft.			
Removed annually by vegetables	3.4	0.3	3.2	23:1
Added by 1" manure	40	15	40	5.5:1

Take home message: 1" of manure can supply vegetable nutrient needs for at least 10 years.

“How can I increase soil organic matter and N without adding too much P and K?”

- Add organic material high in C (dry leaves, wood shavings, straw, peat moss), but remember, “C ties up N”
- Add organic material based on plant’s P and K needs
- Supply N with chemical fertilizer, organic fertilizer such as blood meal, or plant legumes

Which is true about using legumes to supply N?

1. Legumes fix very little of their own N if soil N is sufficient
2. Legume seeds must be inoculated before planting
3. The rhizobia that help legumes fix N are not legume specific
4. Soil critters not used to legumes get digestive upset

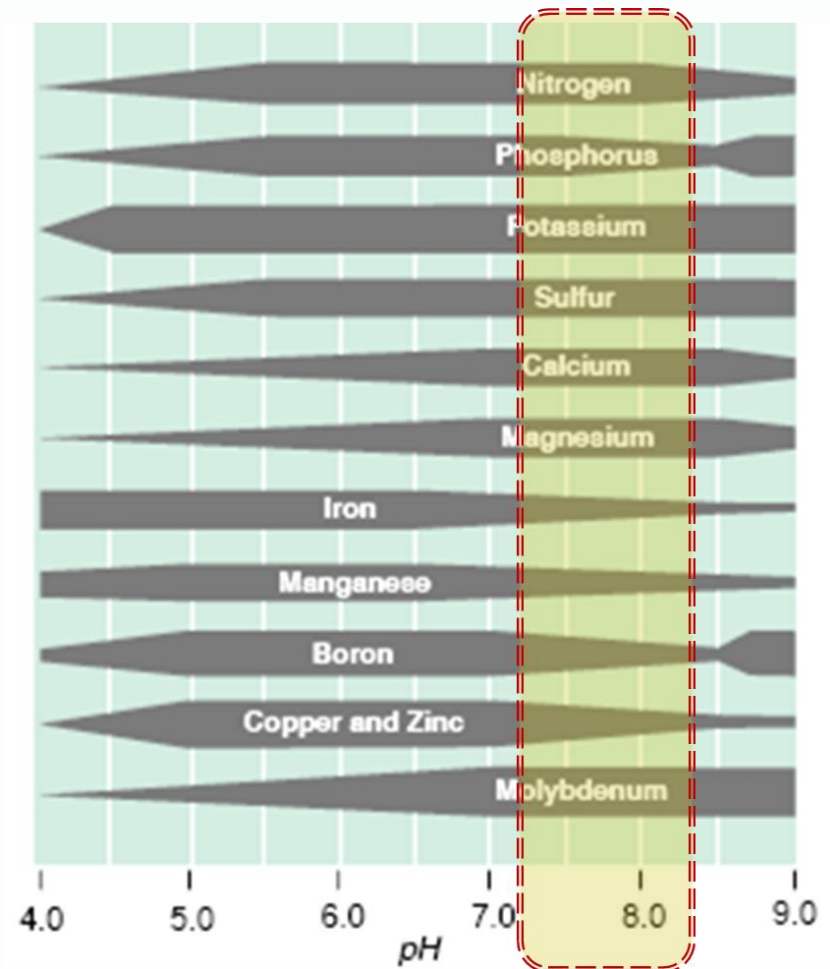


“How can I lower P and K if too high?”

- Dilution with sand is about only way. Or starting a new garden spot.
- Prevention. Stop adding manure.

“Why is high pH bad for nutrient availability?”

- Most MT soils are highly calcareous = alkaline
- This reduces soil P and metal micronutrient availability



“Can I lower pH if too high?”

- Plants can do well at pH 8, but make sure P and metal micronutrients are adequate
- If $\text{pH} > 7.8$, can lab test for CaCO_3
 - If $\text{CaCO}_3 > 0.5\%$ will take too much sulfur (S) or acid or time to lower pH
 - If $\text{CaCO}_3 < 0.5\%$, it might be possible
- If $\text{pH} < 7.8$, likely have low or no CaCO_3 and could try adding elemental S (3 to 10 lb/1000 sq ft). Mix in. Recheck pH.

Summary: things to look at in your client's soil

Item	Why	What to do
N	Lost to leaching or tied up by straw, sawdust, bark mulch	Add OM, blood/fish meal, legumes in rotation
P and K	Manure provides much more than needed	If high, dilute with sand; no more manure
Soil organic matter (SOM)	>8% may indicate too much manure, 5-8% is suitable	Add if low; add small amounts if high to maintain tilth/aggregation
pH	>8 may be too high, ideal is 5.8-7.5 (depending on crop) for nutrient availability	In calcareous soils not much can be done to change
Salts (Electrical conductivity; EC)	>4 mmhos/cm or dS/m may be damaging	sprinkler rather than drip irrigate to flush out, if irrigation water isn't source of high salts

Promote healthy soils



- Minimize rototilling, especially when soil is wet
- Keep planted or covered with plant residue/mulch all year
- Rotate crops and include legumes
- Add organic matter regularly but not too much at a time (1/4" every two years should be enough)
- Be careful with herbicides and pesticides

Questions?

For more information on soil fertility see
Clain's website:

<http://landresources.montana.edu/soilfertility/>