GALLATIN GARDENER CLUB
APRIL 6, 2015

Clain Jones

clainj@montana.edu 994-6076

Hands-on is the best way to learn, but we'll use clickers because….

1. I just had my nails done 33%
2. Clicker training isn't just for dogs 33%
3. There isn't enough dirt on the floor to get a good soil sample 33%

Response Counter

Why should home gardeners know something about soil nutrition?

- To grow healthy plants and tasty vegetables
- To protect the environment
- For efficient use of resources (water and $)

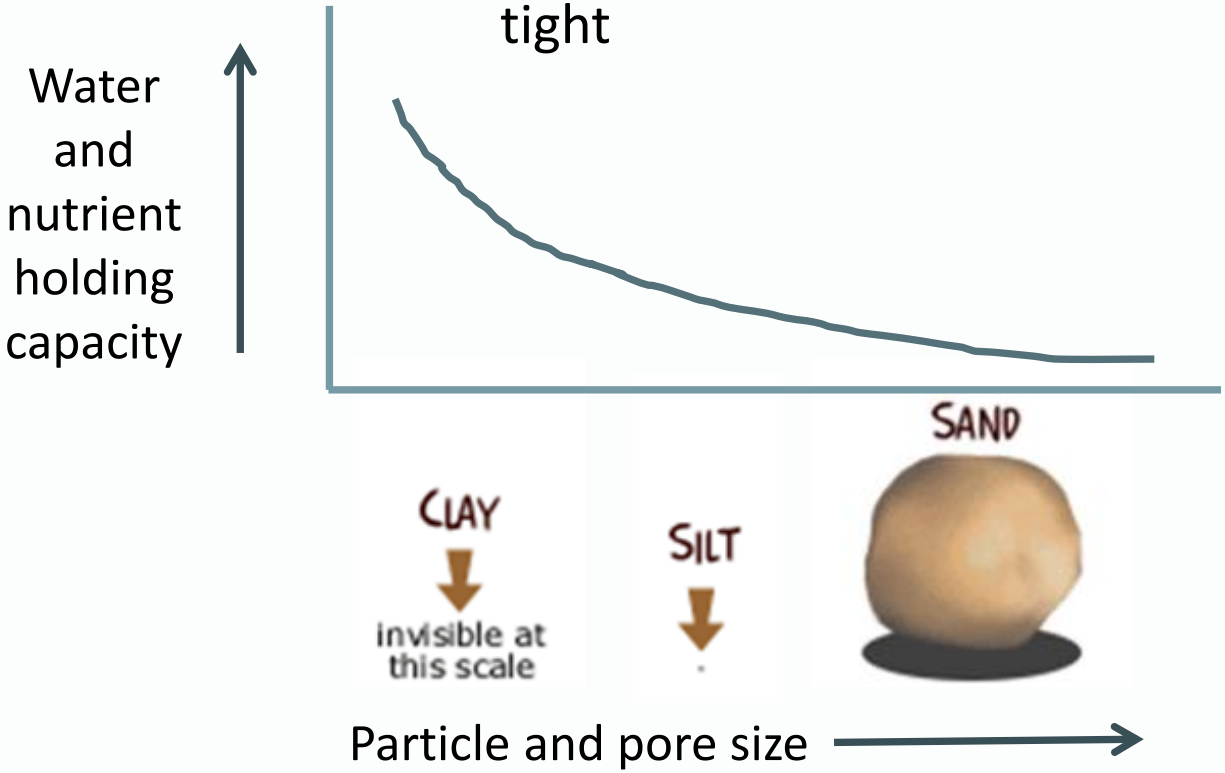
Soil properties that influence water and nutrient availability

Soil property	Water	Nutrients
Texture/surface area	x	x
pH		x
CEC (cation exchange capacity)		x
SOM (soil organic matter)	x	x

Soil texture

Sand: large pore space, low surface area = low water or nutrient holding capacity

Clay: small pore space, large surface area, often negative charge on surface = holds water and nutrients tight



Soil pH – which is true?

1. Has no influence on nutrient availability — 33%
2. Is difficult to alter — 33%
3. Most vegetables prefer pH > 7.5 — 33%

Response Counter

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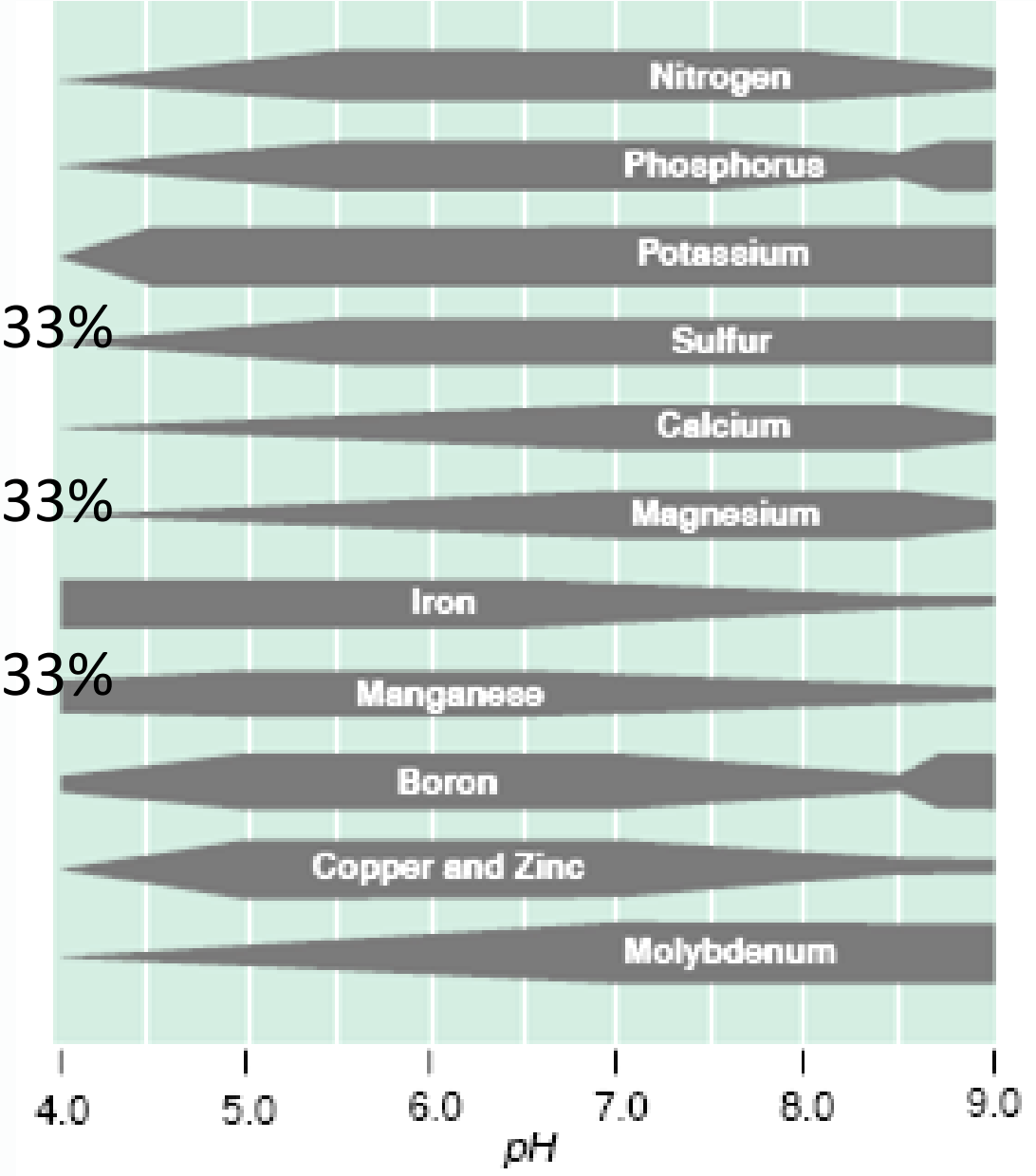
pH affects soil nutrient availability

Most Montana soils are:

1. Generally alkaline (pH > 7.0) — 33%
2. Generally acidic (pH < 7.0) — 33%
3. "Gumbo" = too difficult to sample — 33%



Response Counter

pH affects soil nutrient availability

Most Montana soils are:

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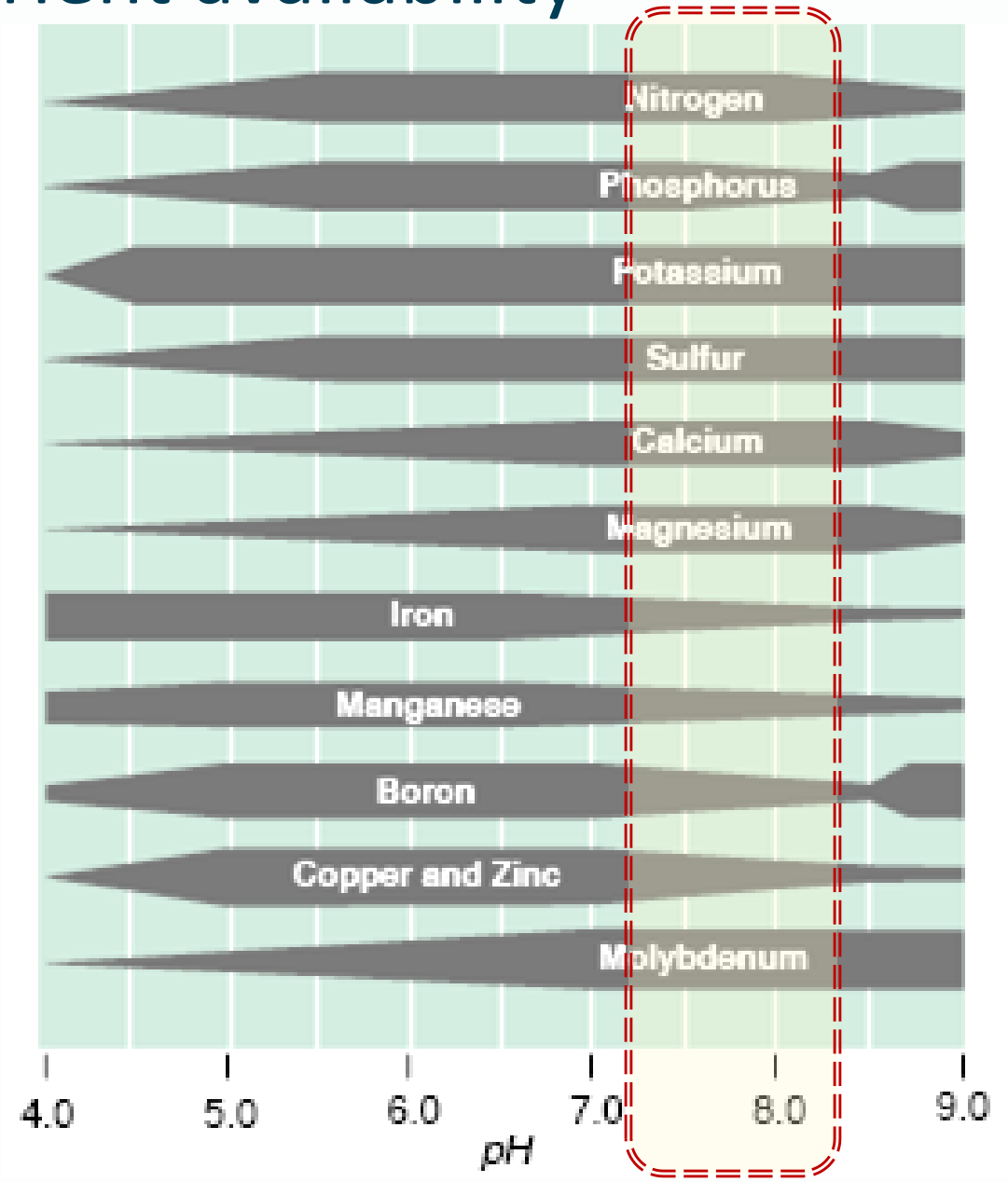
P, Fe, Mn, B, Cu & Zn might be limited



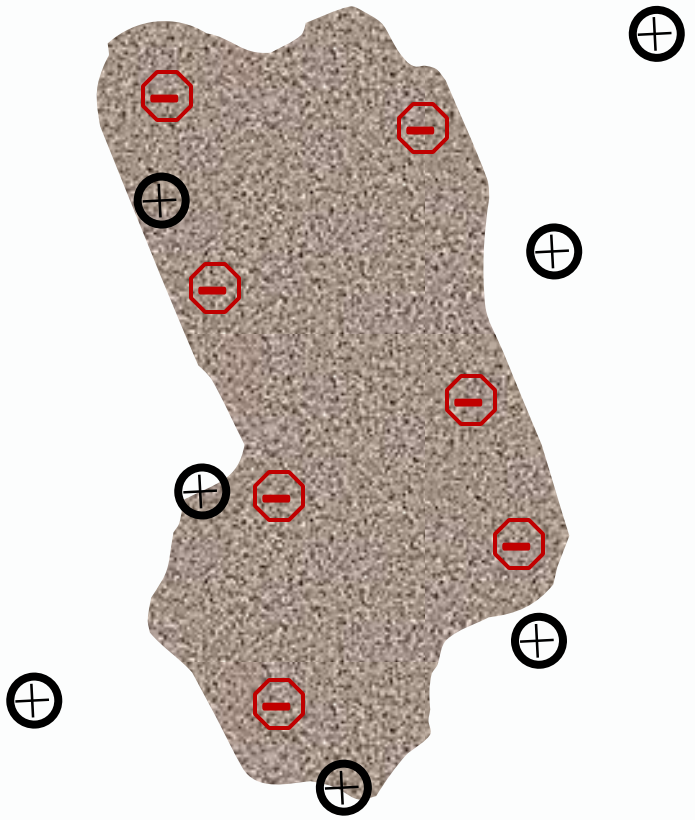
Why are MT soils high pH?

- Most MT soils are highly calcareous = alkaline
- Even if surface soil isn't alkaline, the subsoil usually is
- Liming to increase pH doesn't make sense in our soils
- Can I lower my soil pH? Can add elemental-S, but likely not economical, and soil S and salt levels may become too high

Mollisol – common in Montana and or semi-arid regions

CEC = Cation Exchange Capacity

- A measure of the soil's ability to hold onto and supply positive ions (e.g. NH_4^+) to a crop
- Many essential plant nutrients carry positive charges. e.g., Potassium (K^+) and Zinc (Zn^{+2})
- High CEC indicates a fertile soil which has the capacity to attract and hold these nutrients



SOM = Soil organic matter

- Is <6% of soil by weight but controls >90% of the function
- Has high surface area

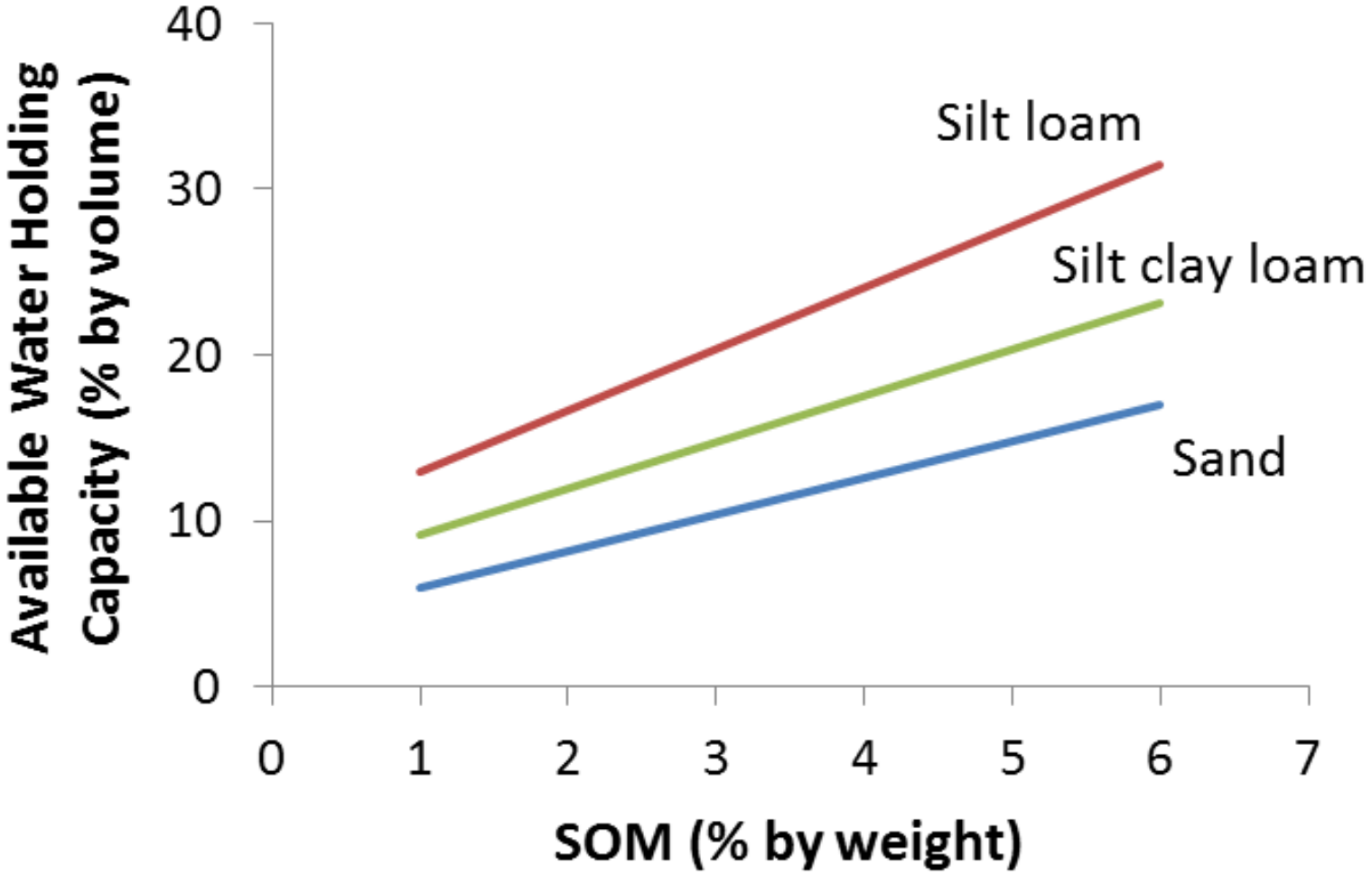
What does SOM do for soil?

- Increase CEC
- Can't change soil pH or CEC of mineral soil very well, but can increase SOM to influence soil CEC and . . .

What else does SOM do for soil?

- As decomposes it releases nutrients bound in OM structure
- Holds water which helps nutrients move from soil to plant roots

SOM increases available water holding capacity



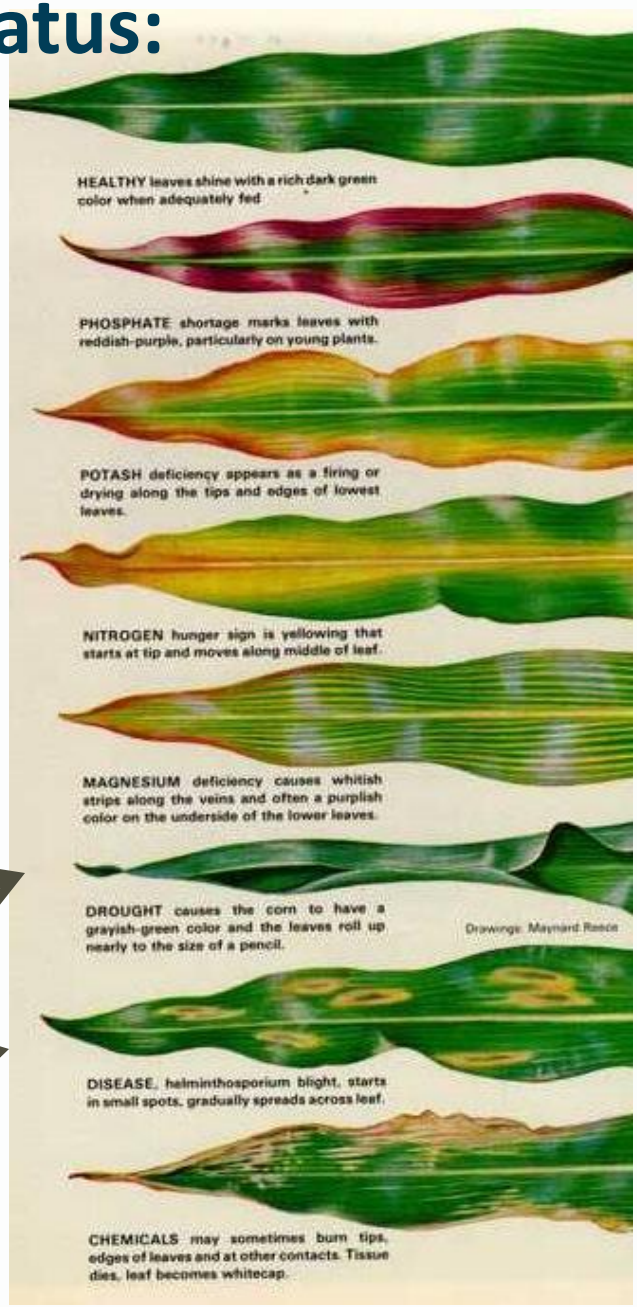
Hudson 1994

Questions?

How to evaluate soil nutrient status:

Visual assessment of tissue

- May identify what has been lacking to this point
- Hopefully caught before too late to correct
- Other issues can cause symptoms that look like nutrient deficiency symptoms
  - Insects
  - Salinity
  - Moisture stress
  - Disease
  - Herbicides



Ontario Ministry of Ag., Food & Rural Affairs

How to evaluate soil nutrient status: soil test

- Tells you what is currently available in the soil
- Identifies nutrient deficiency or imbalance
- Helps calculate fertilizer rates
- Can increase yield and/or save on fertilizer costs, and decrease environmental risks

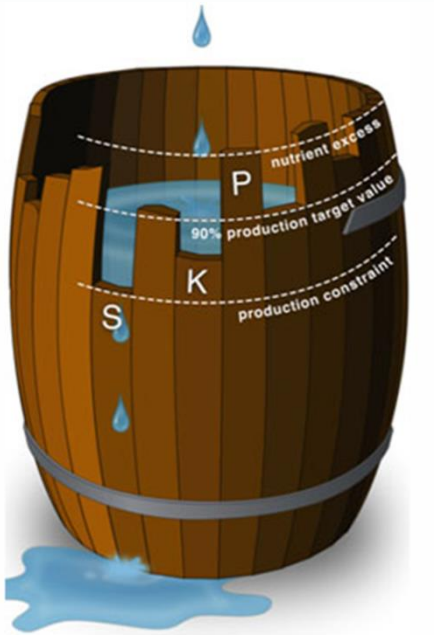


Illustration courtesy Government of Western Australia Dept. of Agriculture and Food

Soil testing

- Sample top 0-6 inches
- Combine 10 subsamples per 1000 sq. ft.
- Use probe, auger or tulip bulb planter
- Best done in early spring, but not when soil is wet, therefore in our climate perhaps best done in late fall (except this year)
- Air dry and send to reputable lab for analysis

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 6 ppm	Low	3 lb N/1000 sq ft
Olsen Phosphorus	15 ppm	Medium	2 lb P_2O_5/1000 sq ft
Potassium	192 ppm	Medium	1 lb K_2O/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		

What if lab doesn't provide a recommendation (or is from another state)? Use Table 3 from MontGuide (MT200705AG)

Soil Test		Organic Matter (%)		
Nitrate - N	Location	< 1.5	1.5 – 3.0	> 3.0
lbs /acre		lbs/1000 sq.ft.		
<20	Lawn	6	5	4
	Tree/shrub	3	2	2
	Garden	4	3	3
20-40	Lawn	4	3	2
	Tree/shrub	2	1	1
	Garden	2	2	2
40-80	Lawn	2	1	1
	Tree/shrub	1	0.5	0
	Garden	1	1	0.5
>80	All	0	0	0

Sample calculation

N required for soil with 3.4% organic matter and 12 lb N/acre soil test result (< 20 lb N/acre): **3 lb N/1000 sq ft** (Table 3)

APPLICATION RATE:

- Using a 10-15-10 fertilizer, 10% N (0.10 lb N/lb fertilizer), 15% P_2O_5 and 10% K_2O

- To calculate the amount of 10-15-10 fertilizer to apply:

(Required Amount of N) ÷ (Amount N/lb Fertilizer) = Amount of Fertilizer to Apply /1000 sq ft

(3 lb N/1000 sq ft) ÷ (0.10 lb N/lb fertilizer) = **30 lb of 10-15-10/1000 sq ft**

Sample calculation continued: P and K

If you add 30 lb of 10-15-10/1000 sq ft

How much P does this apply?

Fraction of P_2O_5 in 10-15-10 Fertilizer = 15% = 0.15 P_2O_5/lb fert.

30 lb of 10-15-10/1000 sq ft x 0.15 = **4.5 lb P_2O_5/1000 sq ft**

How much K does this apply?

Fraction of K_2O in 10-15-10 fertilizer = 10% = 0.10 K_2O/lb fert.

30 lb of 10-15-10/1000 sq ft x 0.10 = **3 lb K_2O/1000 sq ft**

Your turn

	OM %	Nitrate –N ppm	P ppm	K ppm	pH
Test	3.6	18	77	788	7.5

Using this data from a soil report and Table 3 from Montguide (slide x on your handout), how much N required for a garden?
N ppm x 2 = N lb/acre

1. 3 lb/1000 sq. ft. 33%
2. 2 lb/1000 sq. ft. 33%
3. 1 lb/1000 sq. ft. 33%

Response Counter

Your turn

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1. 3 lb/1000 sq. ft.
2. 2 lb/1000 sq. ft.
3. 1 lb/1000 sq. ft.

Lab recommended initial 1.5 lb/1000 sq. ft. , with up to an additional 1 lb split evenly over the growing season

How much 10-10-15 fertilizer is needed?

(Required lb N = 2) ÷ (lb N/lb Fertilizer) = Amount of Fertilizer to Apply /1000 sq ft

1. 30 — 25%
2. 20 — 25%
3. 10 — 25%
4. Mental math at this hour?! — 25%

Response Counter

How much 10-10-15 fertilizer is needed?

(Required lb N = 2) ÷ (lb N/lb Fertilizer) = Amount of Fertilizer to Apply /1000 sq ft

1. 30
2. 20
3. 10
4. Mental math at this hour?!

(2 lb N/1000 sq ft) ÷ (0.10 lb N/lb fertilizer) =
20 lb of 10-10-15/1000 sq ft

P and K

	OM %	Nitrate –N ppm	P ppm	K ppm	pH
Test	3.6	18	77	788	7.5
Optimal maximum			30	500	

20 lb of 10-10-15/1000 sq ft

How much P does this apply?

20 lb of 10-10-15/1000 sq ft x 0.10 = **2 lb P_2O_5/1000 sq ft**

How much K does this apply?

20 lb of 10-10-15/1000 sq ft x 0.15 = **3 lb K_2O/1000 sq ft**

Is this advisable?

Both P and K are already high. **What can you do?**

Questions?

Organic vs. conventional

- Feed the plant or feed the soil that feeds the plant

- Not all “organic” material is certified organic

Conventional/chemical

- No carbon
- Easy to store
- Higher nutrient concentration
- Custom formulated
- Easy to use
- Liquid or solid available

Compost/manure

- Bulkier
- Nutrient content low but diverse
- Nutrient content difficult to quantify
- Supplies organic matter

Both are available in forms that supply specific nutrients (e.g. bone/blood meal for P)

Application considerations

- Conventional
  - Apply and incorporate before maximum uptake which is BEFORE max biomass – most nutrients are in the plant early and move within plant to the maturing fruit
  - Sideband P and K near, but not with the seed
  - Side dress additional N mid season, if needed
- Organic material
  - Takes time to decompose and become available
  - N may be tied up in the short term

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
  - Of 67 Midwest gardens 92% had excess P and 88% excess K after just 1 to 6 years of ‘uninformed’ fertilization with composted dairy manure

    (Hansen unpub data, Ohio State Univ)
  - Feed to P and K demands
  - Use legumes or source such as blood meal to supply N

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

	N	P_2O_5	K_2O	
	lbs/1000 sq. ft.			
Removed annually	3.4	0.3	3.2	
1. Added by 1” manure	40	15	40	50%
2. Added by 1” manure	6	1	6	50%

Response Counter

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Nutrients removed by one season's harvest of the edible portion of garden vegetables

Crop	N	P_2O_5	N:P ratio
	lbs/1000 sq. ft.		
Broccoli	3.8	0.2	37:1
Lettuce	2.2	0.3	18:1
Pepper	3.2	0.3	26:1
Sweet corn	3.6	0.5	18:1
Tomato	4.1	0.5	19:1
Average	3.4	0.3	23:1

One local composted manure tested had a total N:P of 6:1

Morris, Ping, and Durgy. University of Connecticut.
http://www.newenglandvfc.org/pdf_proceedings/SoilOrganicAmend.pdf

Adding organic material is good, but…

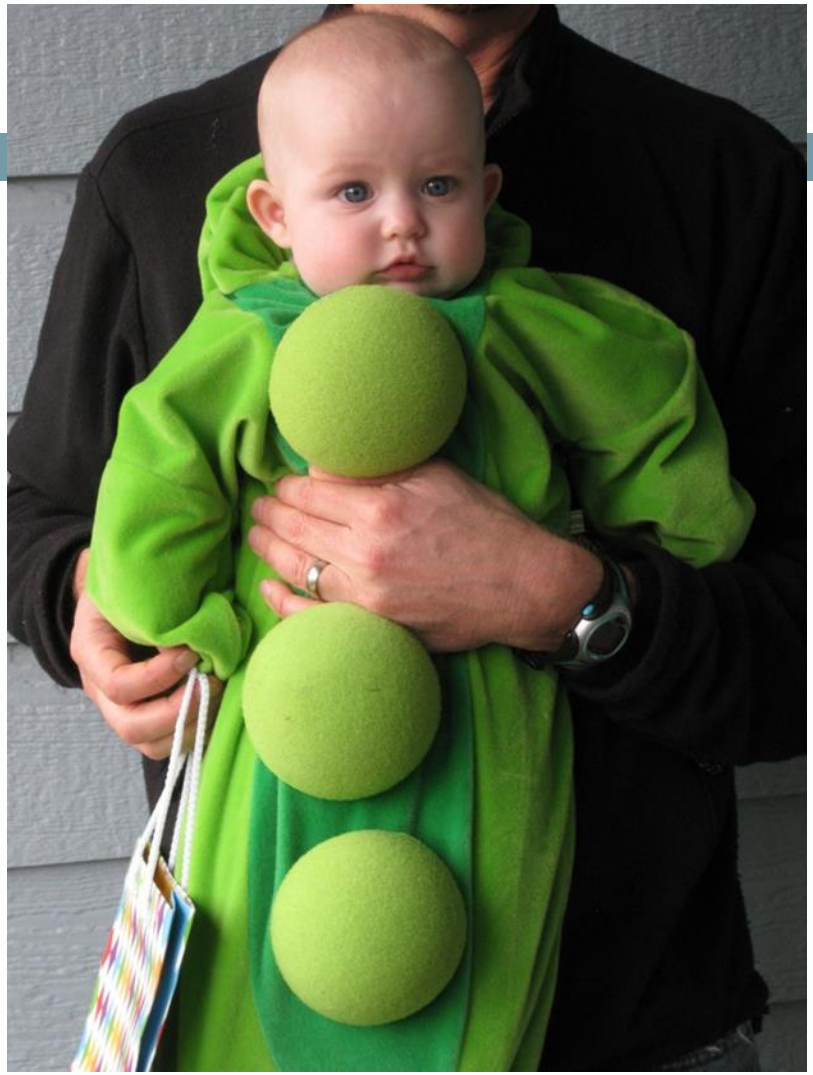
how can you increase soil organic matter without adding too much P and K?

- Add organic matter high in C (dry leaves, wood shavings, straw, peat), but remember, high C ties up N
- Add organic matter based on plant's P needs and add N with chemical fertilizer, organic fertilizer such as blood meal, or plant legumes

Questions?

Summary

- Understanding soils leads to wise nutrient use and promotes maximum plant health and yields
- Soil testing is an important tool to help prevent or correct plant growth problems
- The foundation of a healthy garden is a healthy soil
- With good soil fertility you can grow big pods



Questions?

For additional information on:

Home garden soil testing and fertilization guidelines

http://landresources.montana.edu/soilfertility/home-gardening.html

Soil testing (Module 1)
Nutrient deficiency symptoms (Module 9)

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