Fertilizer Management for Turf and Ornamentals

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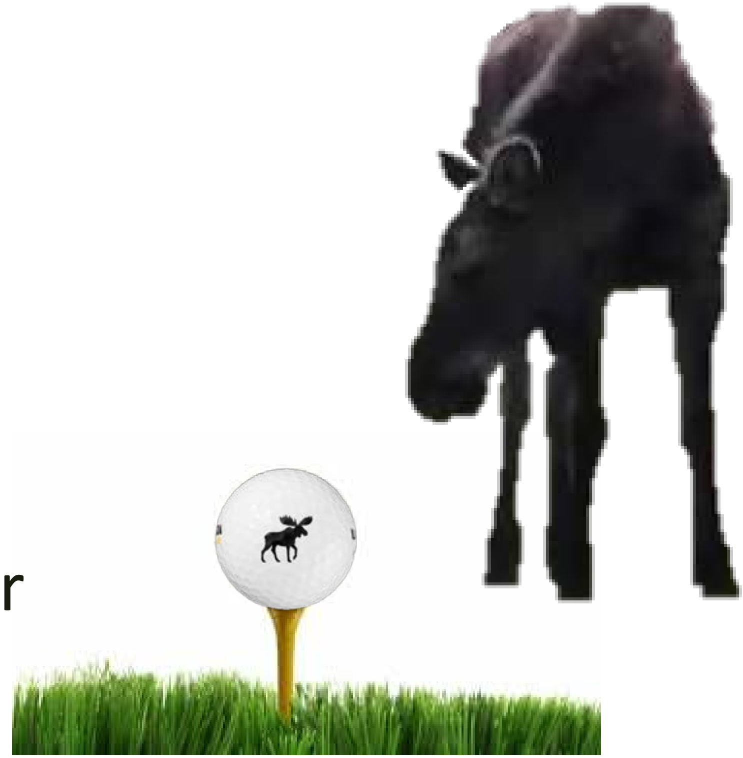
by Clain Jones, 406 994 6076; clainj@montana.edu

MSU

Dept Land Resources and Environmental Sciences

If you give a moose a clicker…it will:

A. Pay attention
B. Improve its golf score
C. Calculate fertilizer rates
D. Fertilize the turf for you



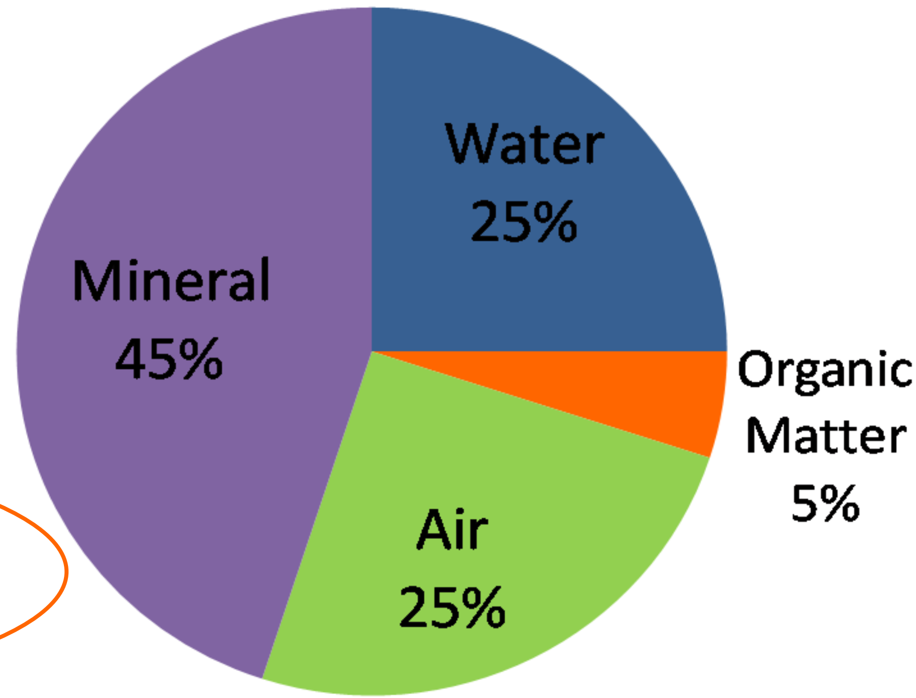
A.	25%
B.	25%
C.	25%
D.	25%

Todays objectives

- Explain soil properties that influence nutrient availability
- Discuss management to improve soil fertility
- Evaluate nutrient deficiencies/toxicities by visual assessment and soil testing
- Calculate fertilizer rates based on soil tests
- Review fertilizer sources and timing

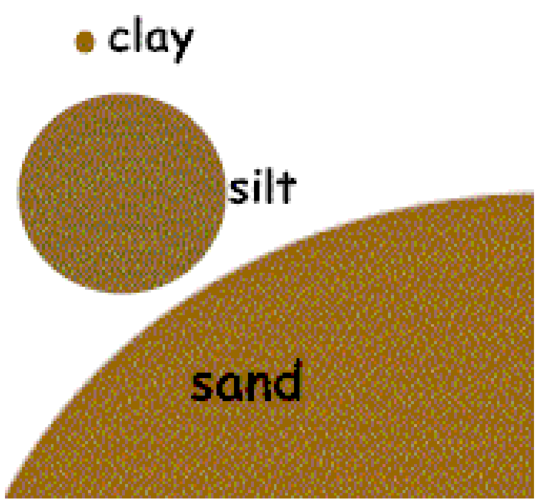
An Ideal Soil – yes, “soil”, not “dirt” ☺

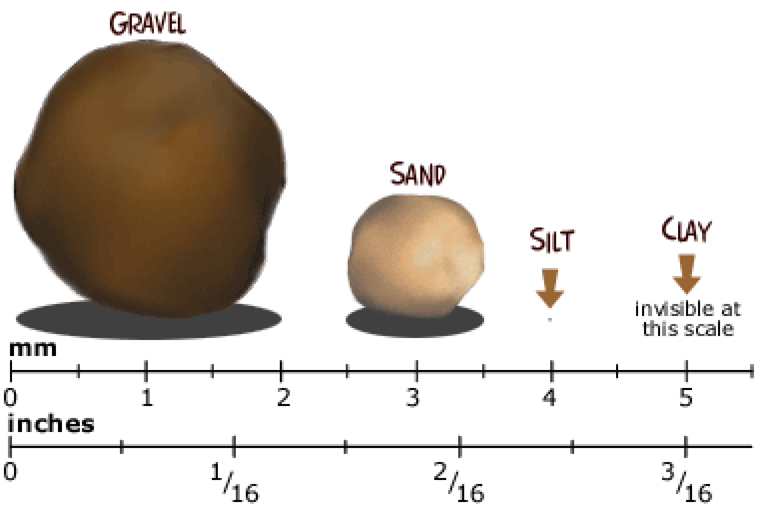
- 50% Pore Space
  - 25% Air
  - 25% Water
- 50% Solid Material
  - 5% Organic Matter
  - 45% Mineral



45% mineral = sand, silt, and clay

- Clay is hard when dry, sticky when wet, forms ribbon when rolled between fingers – doesn't drain well
- Silt feels smooth, floury – very fertile
- Sand feels gritty between your fingers when moist – doesn't hold water or nutrients well





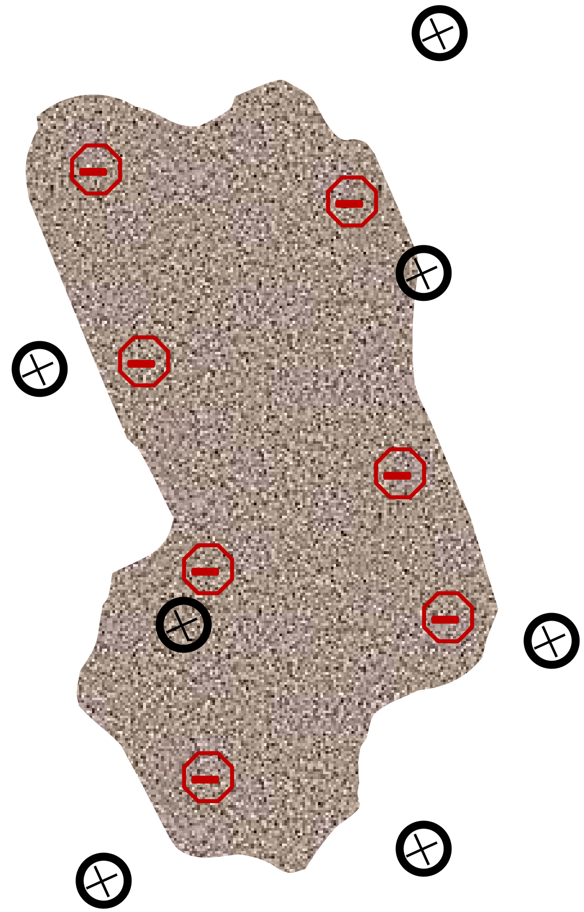
Texture effects on soil properties

	Drainage	Water holding capacity	Aeration	CEC
Sand	excellent	poor	excellent	low
Silt	good	good	good	med
Clay	poor	excellent	poor	high

Ideal is loam = approx. equal parts of each

Cation exchange capacity = parking spaces for nutrients on soil

- Indicates ability of soil to hold positively charged nutrients.
- Many essential plant nutrients carry positive charges. Example: Potassium (K^+)
- A fertile soil has the capacity to attract and hold these nutrients.
- Soils with large surface areas, such as clay and organic matter, have more CEC and surface area and therefore are generally more fertile.



pH affects soil nutrient availability

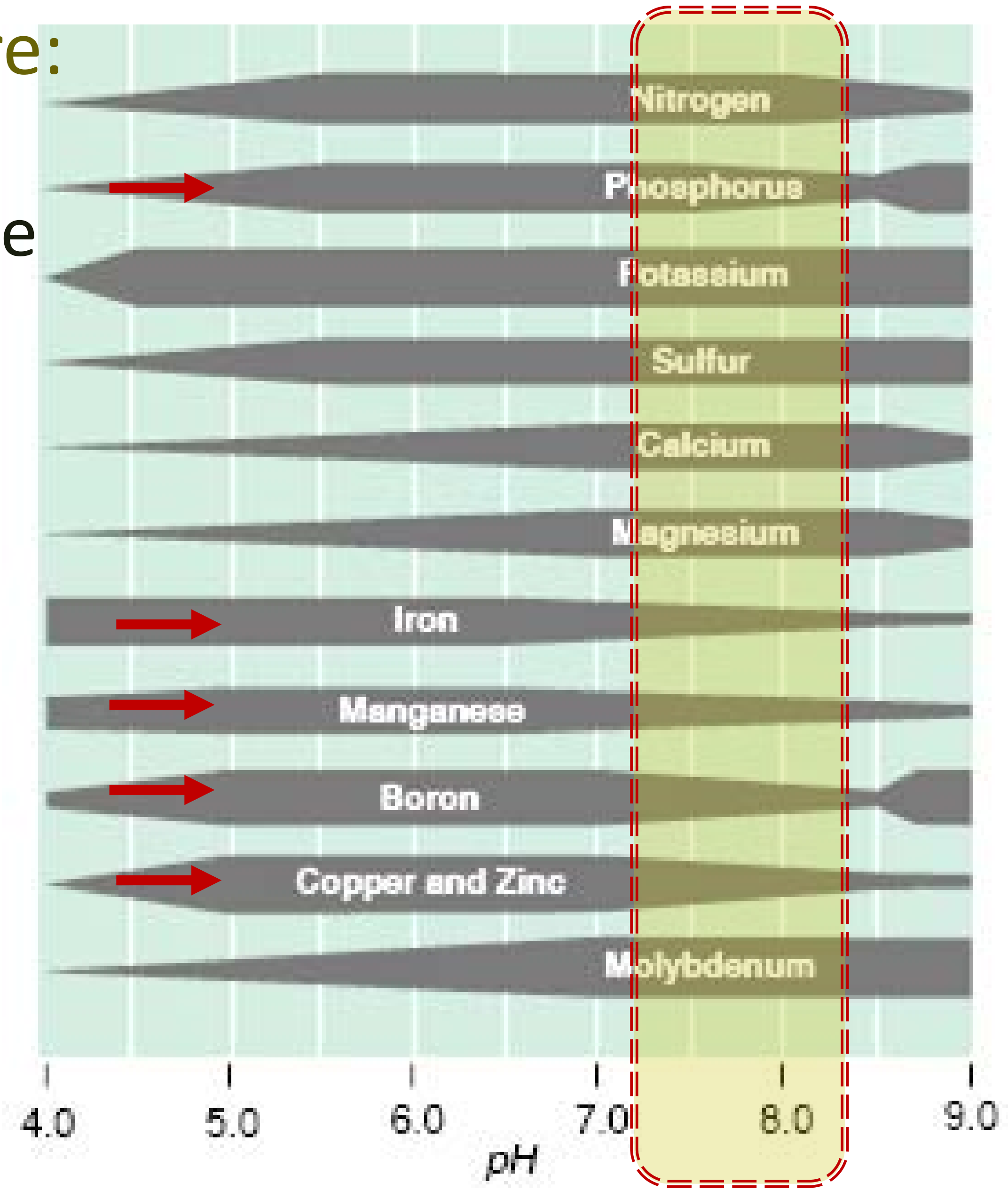
Most Montana soils are:

33% A. Generally alkaline (pH > 7.0)

33% B. Generally acidic (pH < 7.0)

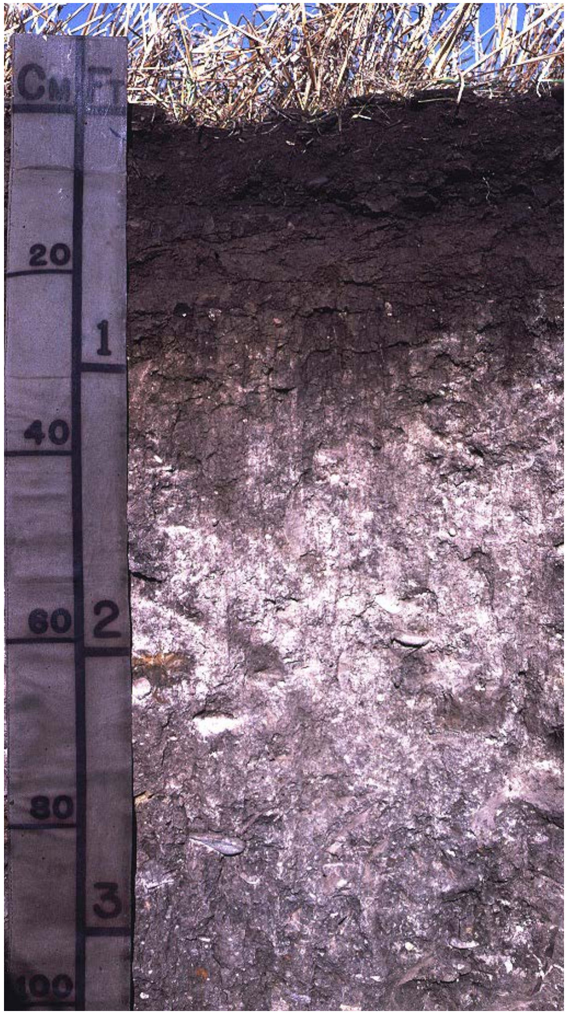
33% C. "Gumbo" = too hard to sample

Which nutrients to watch?



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



Mollisol – common in Montana and or semi-arid regions

What is the best option to lower pH in highly calcareous soils?

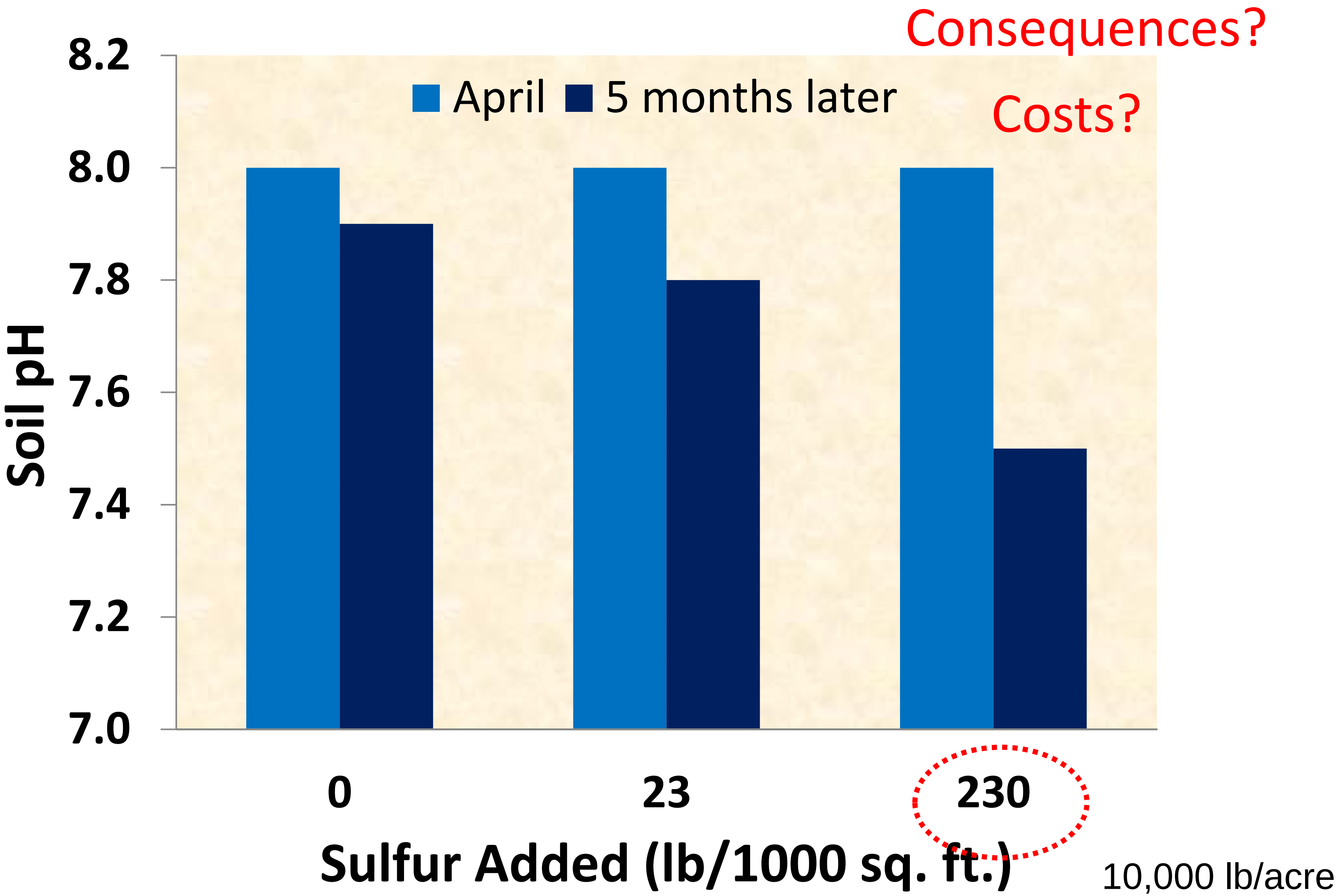
A. Add elemental sulfur (S) 25%

B. Add gypsum ($CaSO_4$) 25%

C. Add pine needles 25%

D. No reasonable option to lower significantly 25%

Adding elemental sulfur



AgVise Laboratories

What might happen if you add 230 lbs S/1000 sq. ft.?

A. You spend $366/1000 sq ft 25%

B. Your soil pH will drop by at least 1.5 units 25%

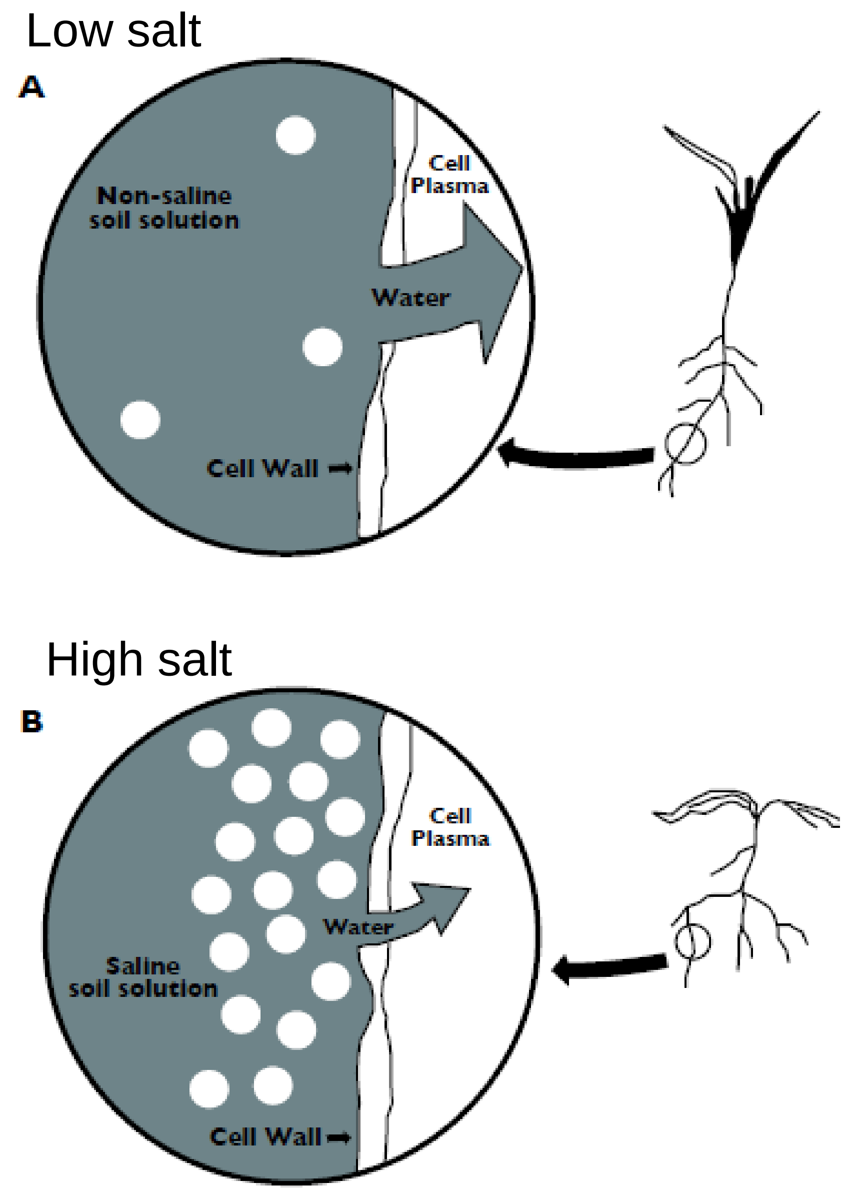
C. Soil S levels will remain well below toxic 25%

D. Soil salt levels will improve 25%

Same study site – added 115 lbs gypsum /1000 sq. ft. with no change in soil pH

Salinity

- High salts (EC > 4.0)
  - reduce water availability
  - plant energy expenditure to exclude salts and take up water
- Sources
  - excess fertilizer
  - road salt
  - shale



Soil & Water Management Module #2

Salinity

Image by J. LaForrest, Univ Georgia

Management:

- check irrigation water for salts
- water to flush salt below root zone – 8-12” to leach salts from top foot of soil, but will also leach nutrients
- fertilize plants only when necessary
- limit fertilization when moisture stressed (e.g., summer)
- plant salt tolerant species by roadway and protect foliage from road spray with burlap shield in winter

Questions?

On to nutrient deficiencies

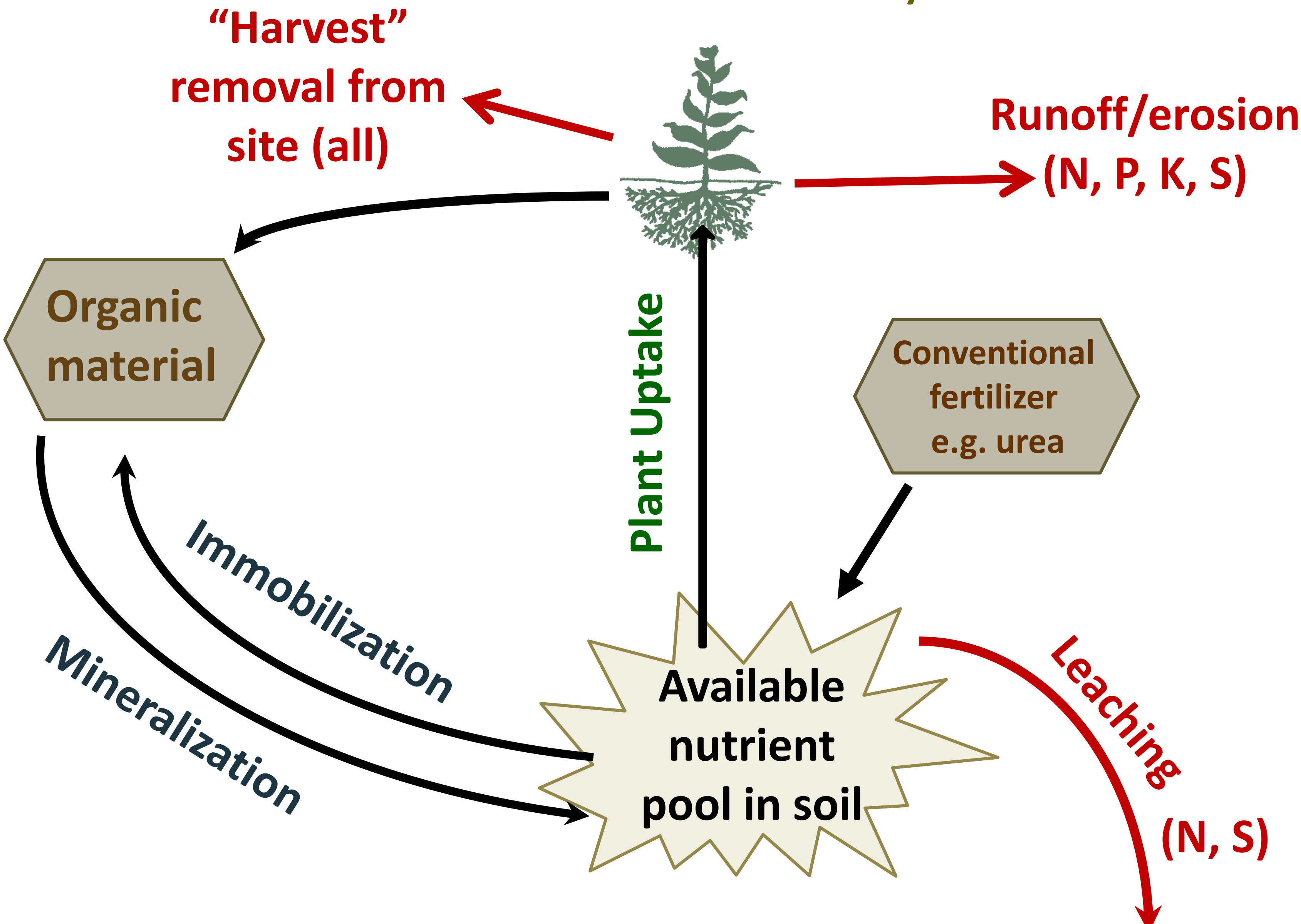
14 mineral nutrients have been found essential for growth of most plants:

Macronutrients	Micronutrients
Nitrogen (N)	**Boron (B)**
Phosphorus (P)	**Chloride (Cl)**
Potassium (K)	**Copper (Cu)**
Sulfur (S)	**Iron (Fe)**
Calcium (Ca)	**Manganese (Mn)**
Magnesium (Mg)	Molybdenum (Mo)
	Nickel (Ni)
	Zinc (Zn)

The macronutrients are simply needed in larger amounts by the plant than the micronutrients.

Nutrient deficiencies of the **bolded** nutrients have been observed in Montana

Nutrient cycling and major losses from system



How to evaluate soil nutrient status

- Visual assessment of tissue: may identify what has been lacking to this point

Visual tissue assessment

MOBILE NUTRIENTS
lower leaves first

Older/lower leaves affected — NO → Next page

YES ↓

Effects mostly generalized; plants dark or light green — NO → Effects mostly localized; chlorosis with or w/out spotting

YES ↓

Plants dark green, often becoming purple or red

YES → PHOSPHORUS (P)

NO ↓

Plants light green with leaves light green or yellow; no necrotic spotting

YES → NITROGEN (N)

NO ↓

Plants light green; necrotic spotting on leaves; pale leaves sometimes scorched, cupped or rolled

YES → MOLYBDENUM (Mo)

Effects mostly localized; chlorosis with or w/out spotting

YES ↓

Interveinal chlorosis; leaves sometimes red or with dead spots

YES → MAGNESIUM(Mg)

NO ↓

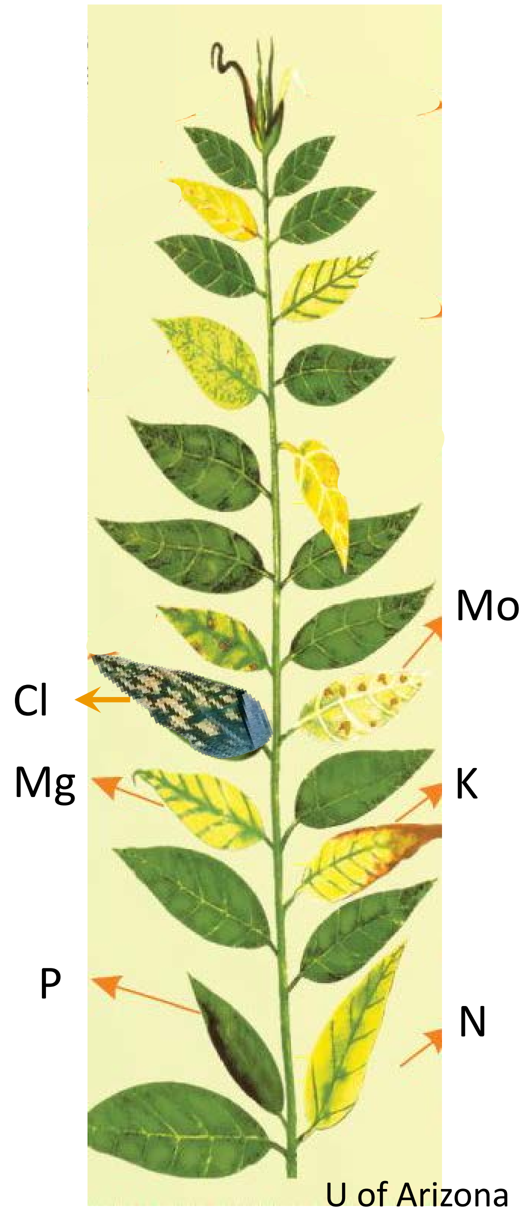
No interveinal chlorosis; chlorotic areas with a burning or spotting along leaf margins

YES → POTASSIUM (K)

NO ↓

No interveinal chlorosis; distinct chlorotic and necrotic lesions (spotting) with abrupt boundary between dead and alive tissue

YES → CHLORIDE (Cl)

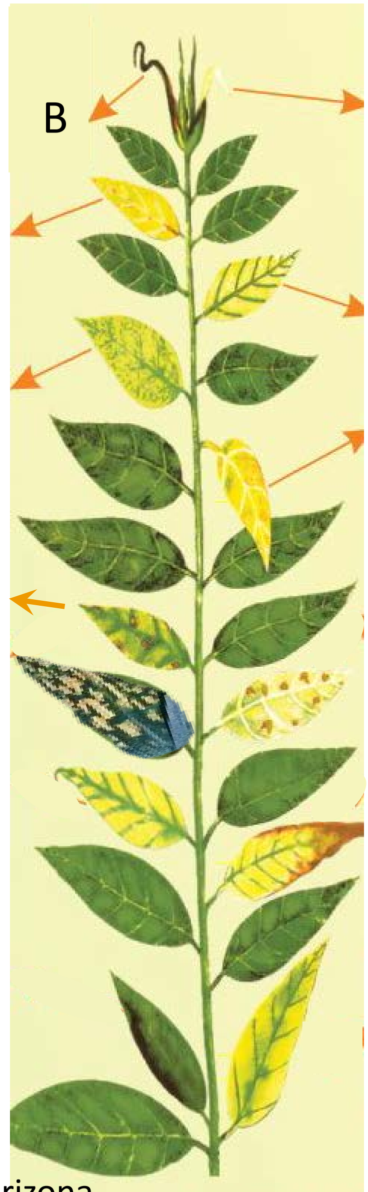


U of Arizona

In Nutrient Management Module 9
http://landresources.montana.edu/nm

Newer or younger leaves

IMMOBILE NUTRIENTS



U of Arizona

- Growing point (terminal bud) dies
  - YES → Leaves of terminal bud become light green at bases; leaves become twisted and brittle and die back at growing point; chlorosis of young leaves
    - YES → BORON (B)
    - NO → Young leaves of terminal bud hooked at first, finally turning brown and dying
      - YES → CALCIUM (Ca)
      - NO → Dark green zone next to blunted necrotic leaf tip, thickened curling leaves
        - YES → NICKEL (Ni)
  - NO → Growing point typically stays alive
    - YES → Chlorosis w/out interveinal chlorosis
      - YES → Leaves light green; typically no chlorotic spotting or striping
        - YES → SULFUR (S)
        - NO → Chlorosis of young leaves; tips appear withered and will eventually die
          - YES → COPPER (Cu)
      - NO → Young leaves with interveinal chlorosis
        - YES → Sharp distinction between veins and chlorotic areas
          - YES → IRON (Fe)
          - NO → No sharp distinction between veins and chlorotic areas; spotty appearance
            - YES → MANGANESE (Mn)
        - NO → Middle leaves with interveinal chlorosis; stunted growth
          - YES → ZINC (Zn)
            (Initially in middle leaves, young and/or old leaves become chlorotic in later stages of deficiency)

What is/was deficient here?

33% A. Ability to spell

33% B. Time to read the bag label

33% C. Shouldn’t have handed the moose the spreader

ID of ‘problem’ is not always clear cut

Response Counter

Questions?

On to soil tests

Advantages of soil testing

- ID current nutrient deficiency
- Help calculate fertilizer rates
- Save on fertilizer cost
- Decrease environmental risks

Soil testing

- Remove grass/mulch mat from top, sample 6 inches deep
- Combine 10 subsamples per 1000 sq. ft. or per acre turf
- Separate samples for, e.g., gardens, turf, shrub areas
- 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

Example soil test

LAWN AND GARDEN

ANALYTICAL LABORATORY FINDINGS

SAMPLE IDENTIFICATION	LINDA
LABORATORY NUMBER	26716192

ANALYTE	UNITS	RESULTS	LOW	MEDIUM	OPTIMUM	V. HIGH
NITROGEN						
ORGANIC MATTER	%	4.6				
NITRATE-N	ppm	4				
PHOSPHORUS	ppm	54				
POTASSIUM	ppm	186				
MAGNESIUM	ppm	566				
MICRO-NUTRIENTS						
SULFUR	ppm					
ZINC	ppm					
MANGANESE	ppm					
IRON	ppm					
COPPER	ppm					
BORON	ppm					
CALCIUM	ppm	2607				
SODIUM	ppm	88				
SOLUBLE SALTS	mmhos/cm	0.3				
EXCESS LIME RATE		L				
pH		8.1				
BUFFER INDEX						
C.E.C.	meq/100g	18.6				

MIDWEST SUGGESTIONS FOR GARDEN

POUNDS PER	100 sq. ft.	1000 sq. ft.	Acre	
SUGGESTED FERTILITY GUIDELINES				
NITROGEN (N)	0.29	2.87	125	
PHOSPHATE (P_2O_5)	--	--	--	
POTASH (K_2O)	0.11	1.15	50	
MAGNESIUM (Mg)	--	--	--	
SULFUR (S)				*For more information fertilizer applications www.lawnandgarden click on the Fertilizer Calculator link and en code: RCXKWDKF5G Surface Nitrate Depth*
ZINC (Zn)				
MANGANESE (Mn)				
IRON (Fe)				
COPPER (Cu)				
BORON (B)				
SUGGESTED AMENDMENT GUIDELINES				
LIME				
ELEMENTAL SULFUR				
GYPSUM				

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

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

Use Tables 4 & 5 from MontGuide (MT200705AG)

Olsen P (ppm)	Garden	Lawn	Trees/shrubs
	lb P_2O_5/1000 sq.ft.		
< 4	5	3	3
4 - 8	4	2	2
8 - 12	3	1	1.5
12 - 16	2	0	1
> 16	12	0	0
K (ppm)	**lb K_2O/1000 sq. ft**		
< 75	3	4	2
75 – 150	2	3	1
150 – 250	1	2	0.5
> 250	0	1	0

Lawns vs. trees/shrubs

- Lawns and golf courses
  - higher N = lush green grass
  - Don’t ‘bloom’ = less P & K
  - 70% sand, 15% silt, 15% clay = less compaction
  - Organic matter 33% by volume (2” in top 6”) incorporated
- Trees & shrubs
  - avoid high N, lush growth is not winter hardy
  - P & K good for blossoms
  - Aim for loam = equal parts sand:silt:clay

Sample calculation

N required for lawn with 3.4% organic matter and 12 lb N/acre (< 20 lb N/acre): **4 lb N/1000 sq ft** (Table 3)

APPLICATION RATE:

- Using a 20-6-12 fertilizer, 20% N (0.20 lb N/lb fertilizer), 6% P_2O_5 and 12% K_2O

- To calculate the amount of 20-6-12 fertilizer to apply:

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

(4 lb N/1000 sq ft) ÷ (0.20 lb N/lb fertilizer) = **20 lb of 20-6-12 /1000 sq ft**

Your turn

	OM %	Nitrate –N ppm	P ppm	K ppm	pH
Test	1.8	18	14	300	7.5

Using this data from a soil report and Table 3 from Montguide, how much N required for a lawn?
N ppm x 2 = N lb/acre

A. 3 lb/1000 sq. ft. 33%
B. 4 lb/1000 sq. ft. 33%
C. 5 lb/1000 sq. ft. 33%

How much 20-6-12 fertilizer is needed?

(Required lb N = 3) ÷ (lb N/lb Fertilizer) = Amount of Fertilizer to Apply /1000 sq ft

25% A. 30

25% B. 15

25% C. 5

25% D. Mental math before lunch?!

Hint: 20-6-12 means 0.20 lb N/lb fertilizer

(3 lb N/1000 sq ft) ÷ (0.20 lb N/lb fertilizer) =
15 lb of 20-6-12/1000 sq ft

Phosphorus (P) and potassium (K)

	OM %	Nitrate –N ppm	P ppm	K ppm	pH
Test	1.8	18	14	300	7.5

15 lb of 20-6-12/1000 sq ft

<u>How much P does this apply</u>?

15 lb of 20-6-12/1000 sq ft x 0.06 = **< 1 lb P_2O_5/1000 sq ft**

Appropriate? See Table 4 **Suggests 0 lb P_2O_5**

<u>How much K does this apply</u>?

15 lb of 20-6-12/1000 sq ft x 0.12 = **1.8 lb K_2O/1000 sq ft**

Appropriate? See Table 5 **Suggests 1 lb K_2O**

Selecting fertilizer grade

15 lb of 20-6-12/1000 sq ft

= < 1 lb P_2O_5/1000 sq ft vs. suggested 0 lb P_2O_5 = a little too much P

= 1.8 lb K_2O/1000 sq ft vs. suggested 1 lb K_2O = a little too much K

What can you do? Will this fertilizer work for shrubs?

Based on Tables 3, 4, and 5

	OM %	Nitrate –N ppm	P ppm	K ppm
Test	1.8	18	14	300
Tree/shrub need		1 lb N	1.5 lb P_2O_5	0 lb K_2O

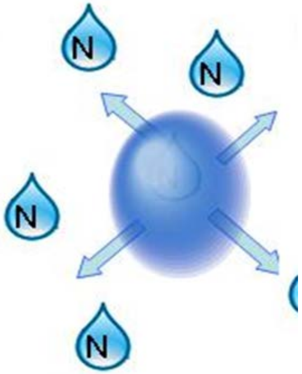
Chances are one grade will not fit needs of both lawns and shrubs

Questions?

On to fertilizer sources and timing

Conventional/chemical fertilizers

- No carbon
- Easy to store
- Higher nutrient concentration
- Custom formulated
- Easy to use – but calibrate your equipment
- Liquid and solid
- Coated specialty products reduce leaching, volatilization, runoff losses.

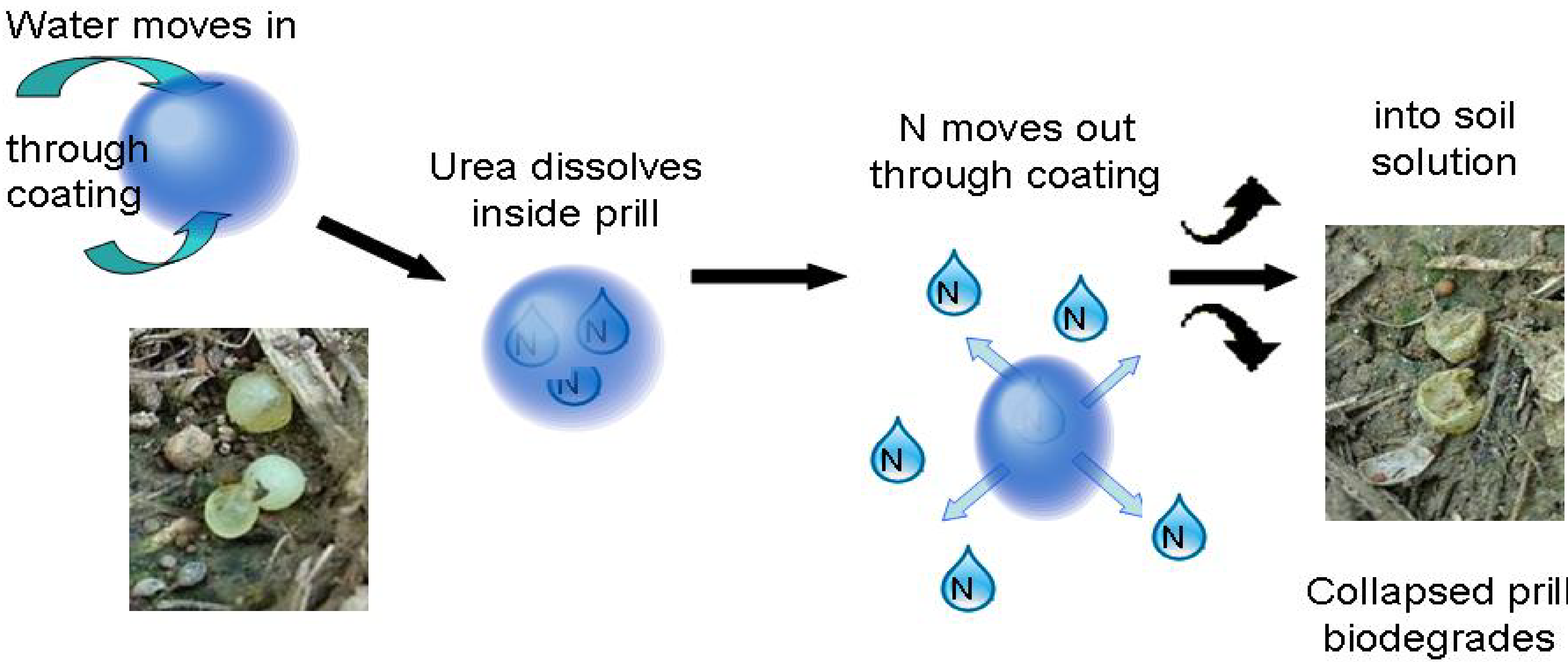


Organic Fertilizers

- Bulkier
- Nutrient content low
- Nutrient content difficult to quantify
- Supply organic matter and other soil quality benefits

	General % of dry weight		
Type	N	P_2O_5	K_2O
Manure compost	0.3 - 0.5	0.1 – 0.5	0.2 – 0.6
Garden waste	1 – 1.5	0.2 – 0.5	0.5 – 1.5

Slow Release Fertilizers



- Release quickest in warm moist environments.
- Incorporate and apply early in growing season or use blend of quickly available source and slow release.

Application considerations

Conventional

- Water soluble sources can be lost to leaching or runoff, do not apply on snow, before heavy rains or snowmelt
- In active healthy soil (e.g. not frozen) can be taken up within a few days

Organic material

- Takes time to decompose and become available
- N may be tied up in the short term
- Manure creates rapid build up of P and K if fertilizing to meet N needs, can burn with salts, may contain residual herbicides

Timing

Shrubs/trees

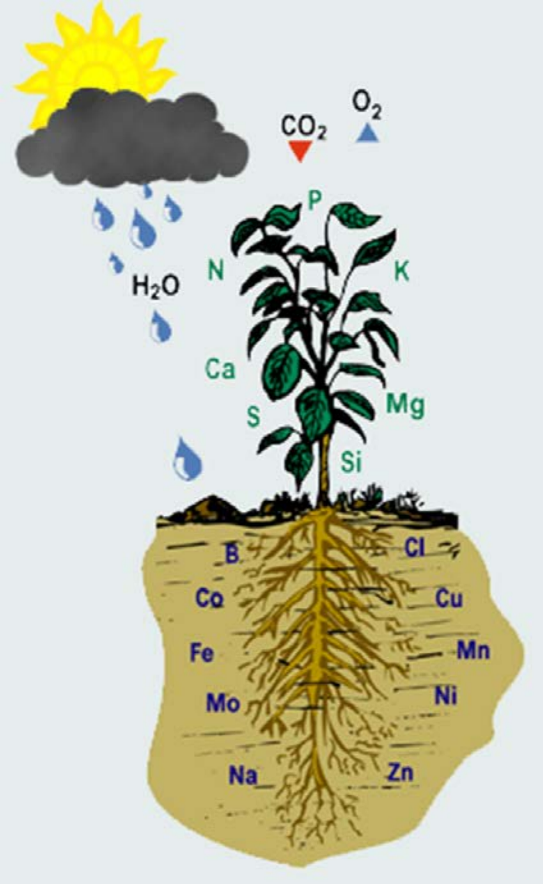
- Newly planted: best to provide fertile soil than fertilizer first 1-2 years to minimize damage to roots and excessive vegetative growth
- Established: early spring

Lawn

- New: early spring or prior to spring seeding
- Established:
  - split total into monthly applications each max 0.5 lb/1000 sq. ft
  - home lawns, 3 times, about Memorial day, Labor day, and after last mowing but 4 weeks before soil freezes
  - If skip one, then skip the first. Last is most critical for the following year green-up.
- Too much in fall encourages gray snow mold

Summary

- Understanding soil properties guides proper fertilization
- Soil testing is an important tool to calculate fertilizer rates, maximize plant heath, protect environment
- The right source, rate and timing leads to optimal fertilizer use and plant health.
- The foundation of healthy plants is healthy soils



For additional information on nutrient cycling and fertilization

http://landresources.montana.edu/soilfertility

Click on “Home Gardening” for Montguide pdf

Upcoming KSU webinar: “Solving Turf puzzles”, March 8, 9 am.
To join go to: http://msuextensionconnect.org/gpdn2/

Questions?