Water Smart Landscapes

Soil Savvy: A Key to Successful Front Range Gardens and Landscapes

Dr. Jean Reeder

2010 Business Environmental Program Series
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CSU Extension Information

- *http://cmg.colostate.edu/pubs*
  - CMG *GardenNotes* : 2-20 pages long
  - Extension Fact Sheets : 2-6 pages long
  - Plant*talk* Colorado: brief 1 page
  - *Soil, Plant Selection, Xeriscapes, Irrigation*
    - *Flowers, Trees & Shrubs, Lawn, Vegetables & Fruit, Insects, Diseases, Raised Bed & Container Gardening, Compost, Mulches.*
  - Can do a key word search with Google box in upper right corner of screen
  - Can download full listing of available information

- *http://www.soiltestinglab.colostate.edu*
  - Soil, plant and water sample analyses
  - Can download a sample submission form + sampling instructions
  - *Or pick up a soil sampling kit (Extension Office, local nurseries)*

CSU Extension Information *(cont.)*

- *http://csuturf.colostate.edu*
  - Dr. Tony Koski, CSU turf expert
  - Home lawn care *(fertilizer, watering, mowing, renovating.)*
  - CSU Extension Fact Sheets *(links to 23 fact sheets on lawn care: insects, diseases, watering, fertilizing, mowing, thatch, compaction/aeration etc.)*
  - Recent presentations
  - Books, references

CSU Extension Information:

Colorado research-based information for our soils and climate

Landscape Challenges

Semi-Arid Climate: Obvious contributor to plant problems

- **Dry** *(most landscape plants require irrigation)*
- **Cool** *(short growing season)*
- **Variable** (*precipitation and temperatures)*
- **Windy** (*intensifies water loss from soil and plants)*

Water Smart Landscapes are a really good idea here!

Landscape Challenges

The most common inciting factor to plant disorders in Colorado landscapes is…

the condition of the soil

Yet soil is the resource we usually know the least about!

Soil: <u>The</u> fundamental component of any landscape

Soil conditions contribute to >80% of <u>all</u> landscape plant problems

- Crucial to plant health:
  - Supplies nutrients
  - Supplies water
  - Supplies O_2 for root metabolic processes

If the soil isn't healthy, plants won't be either

"Feed and nurture the soil and the soil will feed and nurture the plant"

–How can you manage/nurture the soil if you don't know anything about it?

–If you know the basic properties of your soil…

–You can use that information to improve soil health, and better manage/nurture your landscape

–Get a soil test to determine soil properties

See handout "Soil Testing FAQs"
CSU Soil sampling kits available

Know the basic properties of your soil

- **Texture** *(sand/silt/clay)*
- **pH** *(influences nutrient availability and type of plants grown)*
- **Free lime** ($CaCO_3$) *(common in Colorado soils, influences pH level)*
- **Organic matter content**
- **Salinity** *(influences plant growth and microbial activity)*
- **Plant-available nutrient contents**

  Enough? Deficient? Too much?

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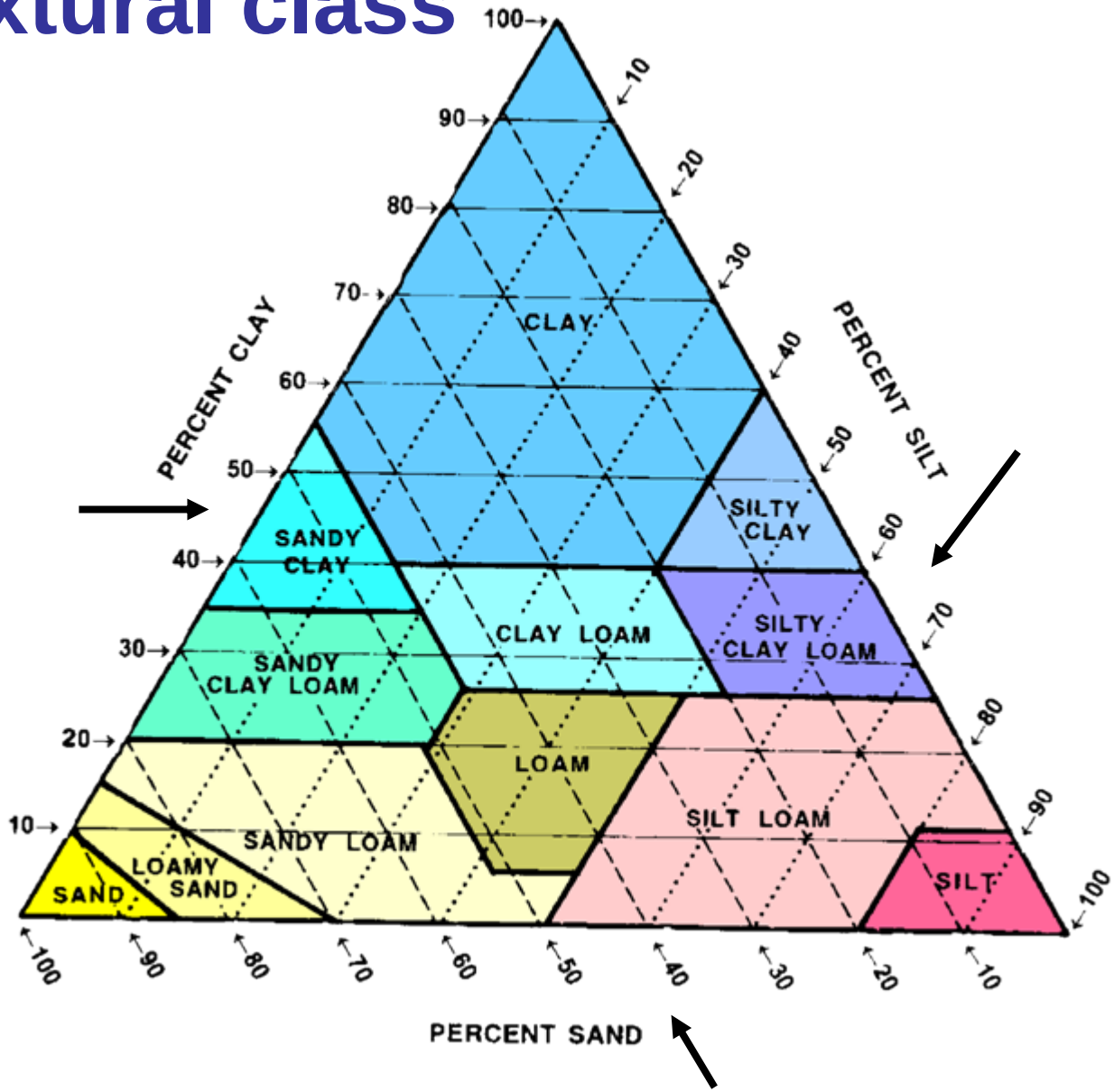
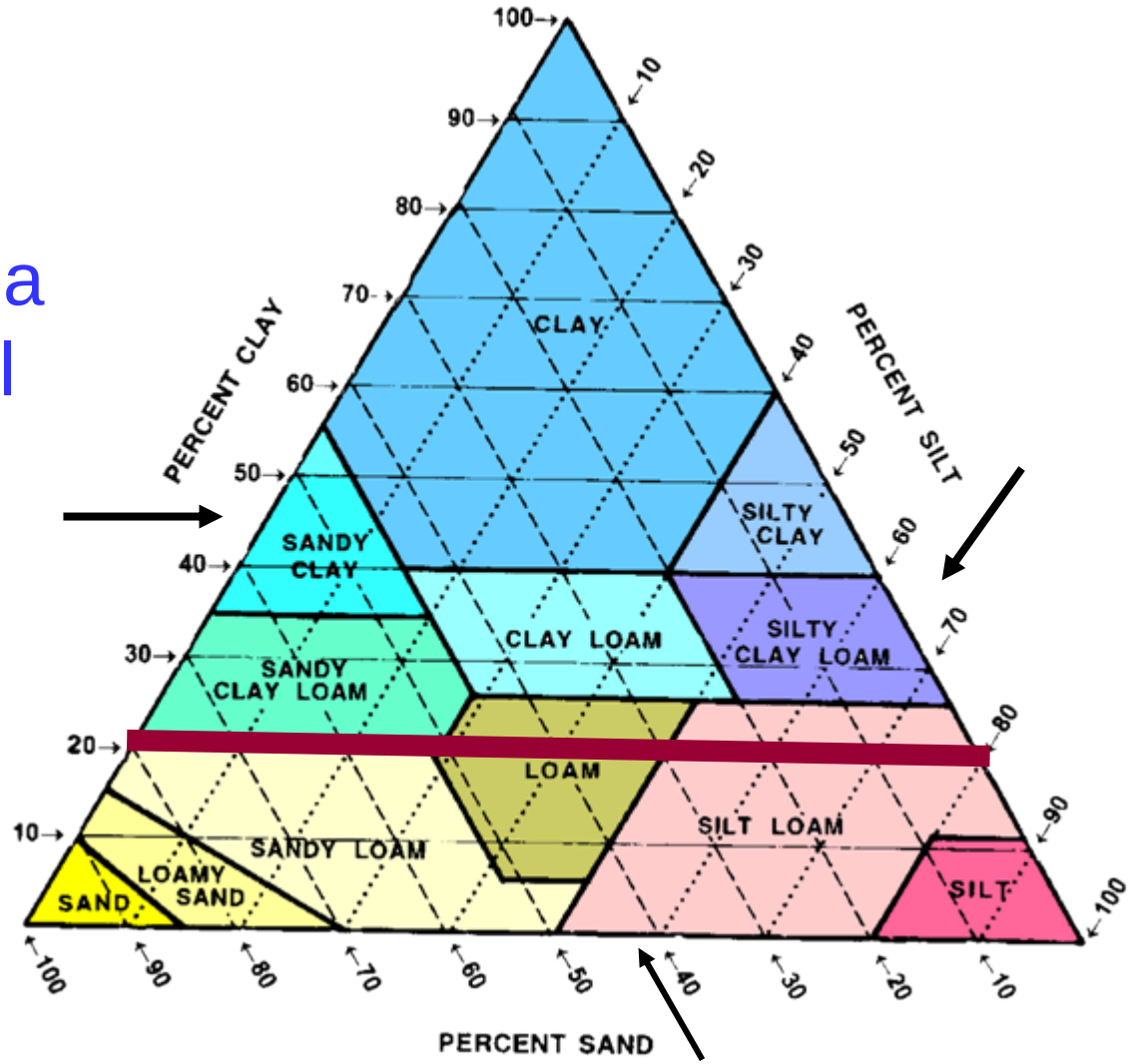
Soil textural class



TEXTURE: *Sand, Silt,* and *Clay*

20% clay

- ✓ Behaves as a "***clayey***" soil



Properties of Clayey and Sandy Soils Differ

(affects how the soil is managed)

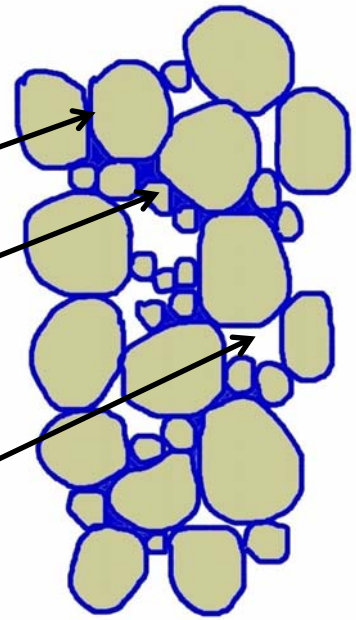
	Clayey	Sandy
Water holding	**high** ***(2-4x)***	**low**
Nutrient holding	**high** ***(3-6x)***	**low**
Pore size	**small**	**large**
Infiltration/Drainage	**slow** ***(≤1/4"/hr)***	**fast** ***(≥1/2"/hr)***
Aeration problems	**yes**	**no**
Spring warming	**slow**	**fast**
Crusting / compaction	**yes**	**no/sometimes**
Salinity issues	**yes**	**seldom**

Problems:
- Slow infiltration/drainage
- Poorly aerated
- Compact easily
- Salinity buildup

Problems:
Low WHC
Low NHC

Source: CSU Extension

How Texture Influences Water Holding Capacity

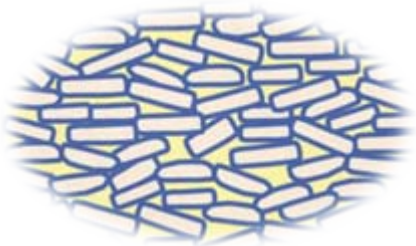


Water

- Coats soil particles
- Fills **small** pore space

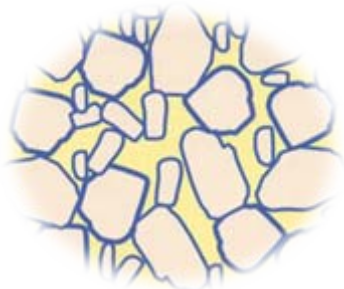
Air

- Fills **large** pore space



Clayey soil
Small pores

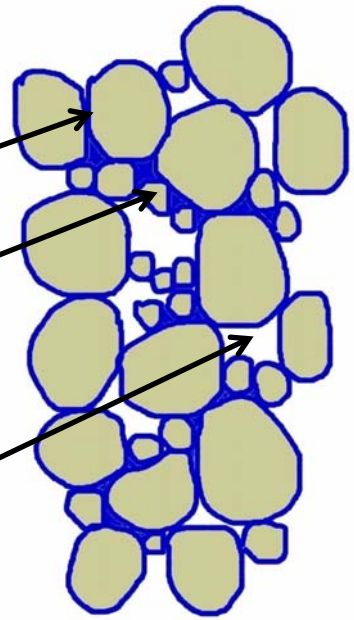
Lacks large pores for rapid drainage and to hold air



Sandy soil
Large pores
Lacks small pores to hold water

CSU Master Gardener Slide
Drawings by David Whiting

How Texture Influences Water Holding Capacity



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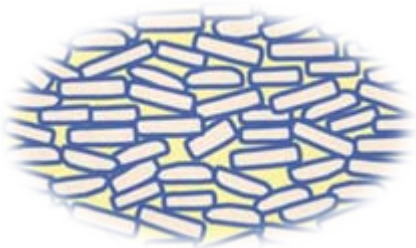


Clayey soil
Small pores

Lacks large pores for rapid drainage and to hold air

Low soil oxygen (due to the lack of large pore space) is the most limiting growth factor for trees along the Front Range

Porosity influences water movement

sandy soil

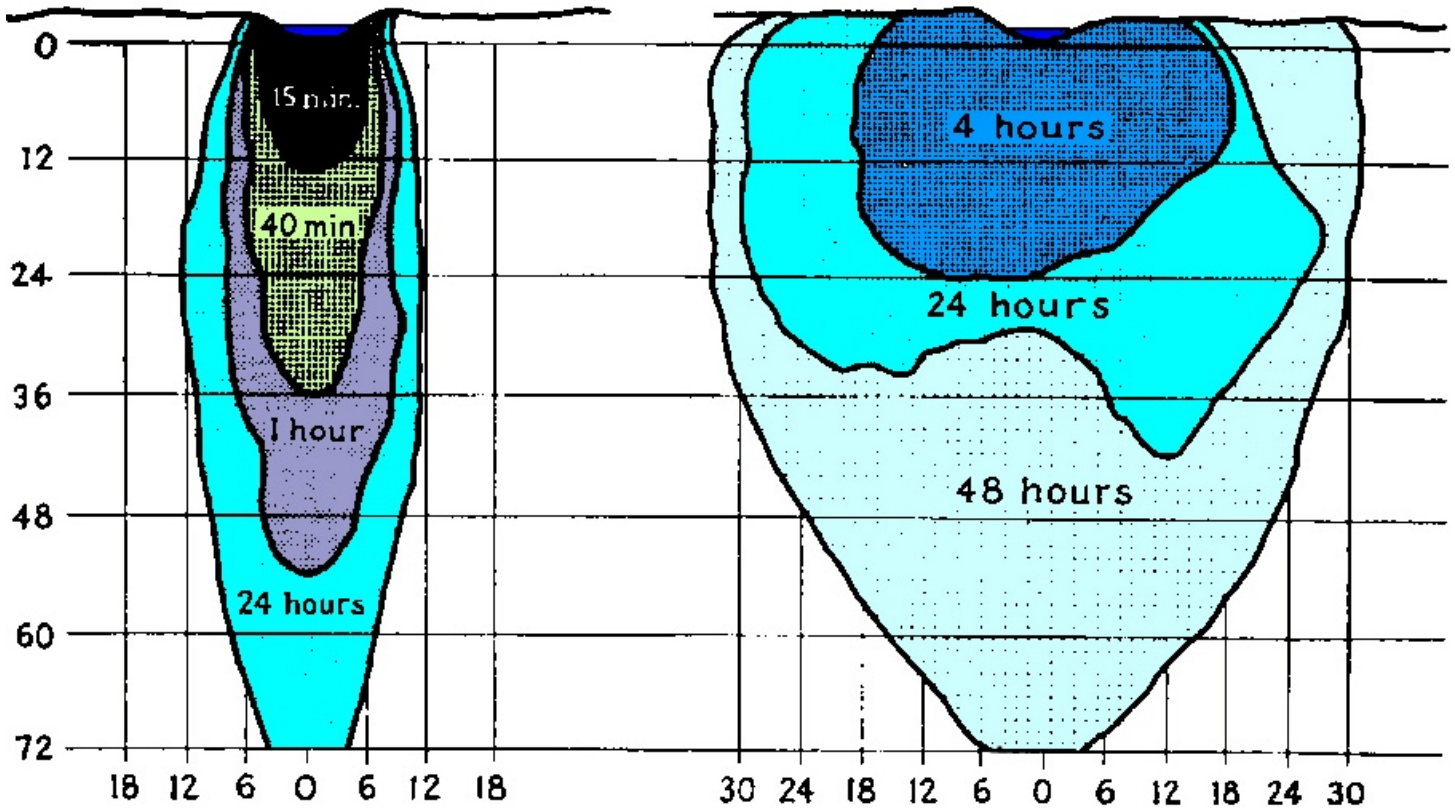
large pore space

Gravitational Pull

clayey soil

small pore space

Capillary Action



Source: CSU Extension

Porosity influences water movement

sandy soil

large pore space

Gravitational Pull

clayey soil

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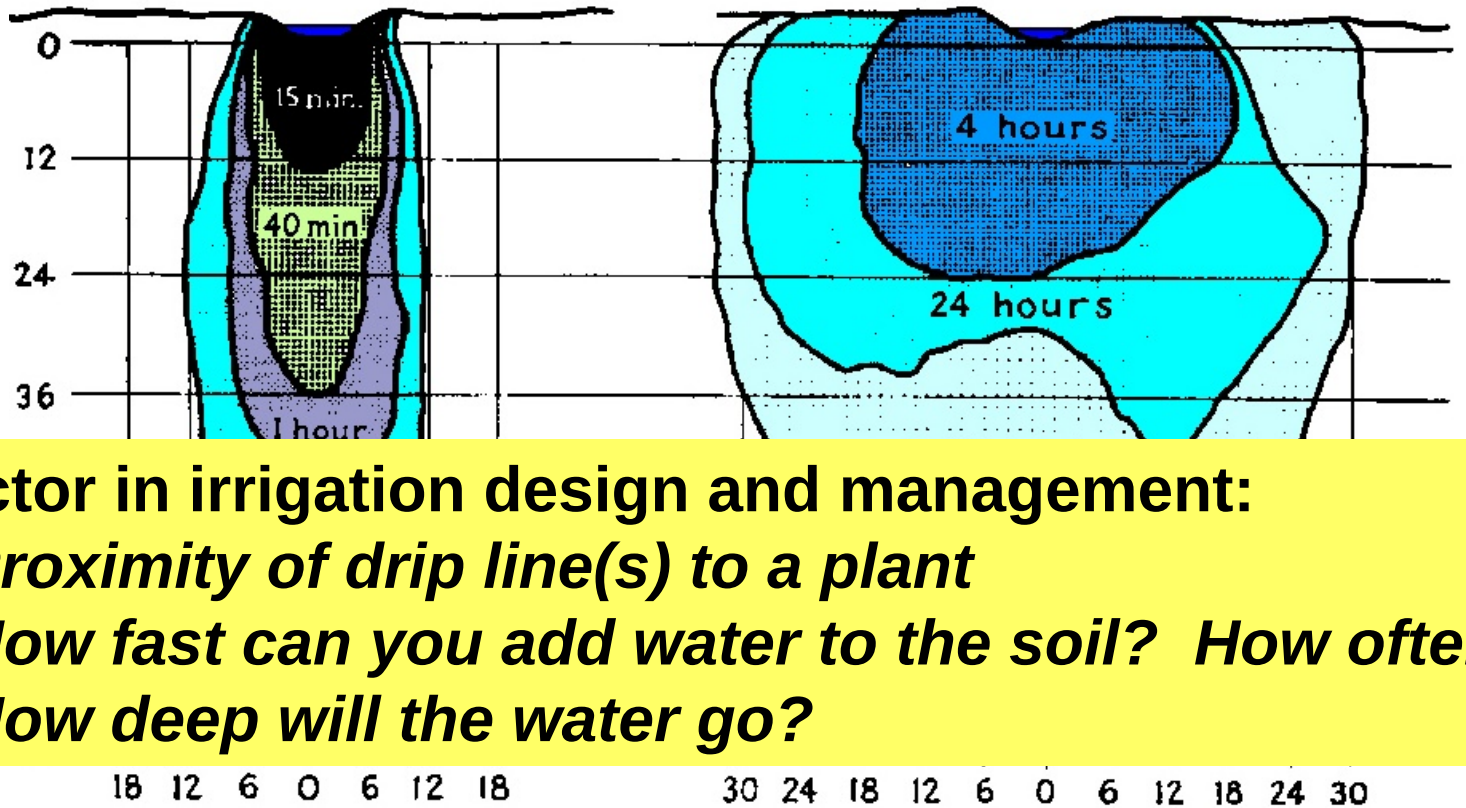


Factor in irrigation design and management:

- ***Proximity of drip line(s) to a plant***
- ***How fast can you add water to the soil? How often?***
- ***How deep will the water go?***

Source: CSU Extension

Irrigating

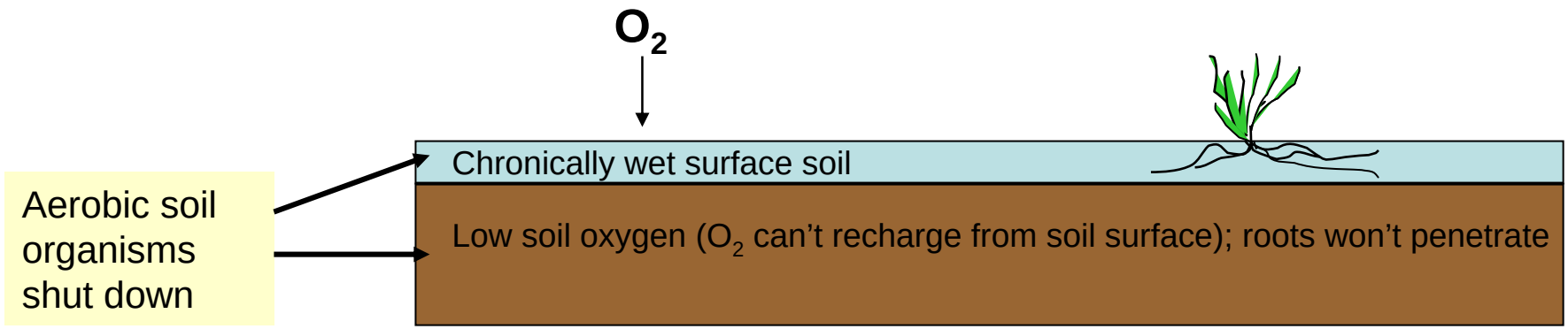
- Clayey soils
  - Water infrequently
  - Water thoroughly (deeply)
- Sandy soils
  - Water more frequently
  - Shorter watering sessions

Why is proper irrigation so important?

- Water is wasted if it runs off *(and your plants are still thirsty!)*
- Clay soils: often irrigated shallowly and frequently
  - surface soil often remains too wet too much of the time: poor aeration *(the #1 problem in clay soils).*

  Can greatly improve soil health by irrigating properly to keep the soil well aerated as well as well hydrated.

- Poor aeration = Restricted rooting zone *(roots won't expand into soil that is poorly aerated); aerobic soil organisms shut down*



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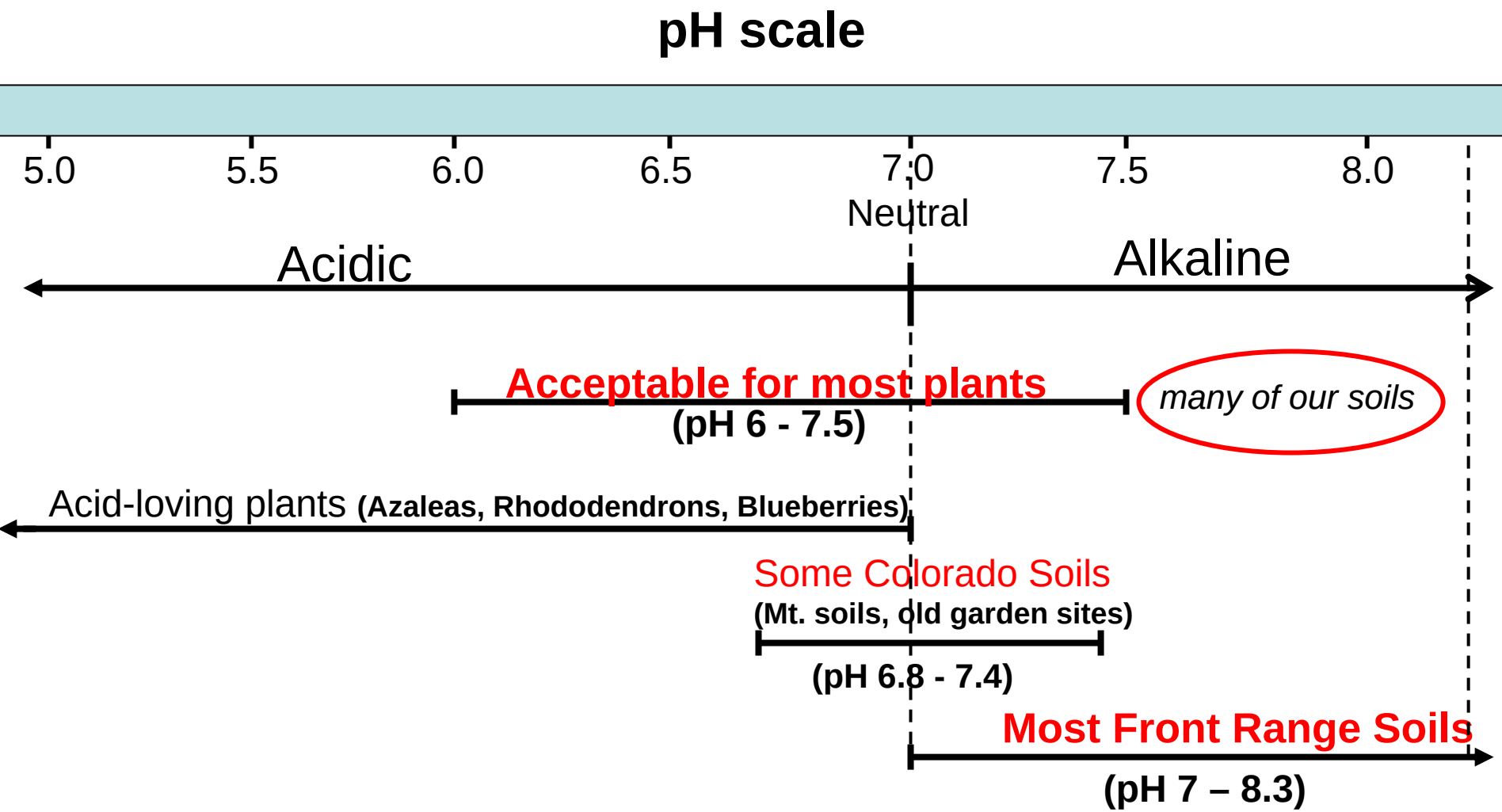
  Enough? Deficient? Too much?

Soil pH:

Soil pH influences:

- Nutrient availability
- Microbial activity
- Plant growth

Soil Test: pH and Lime Content

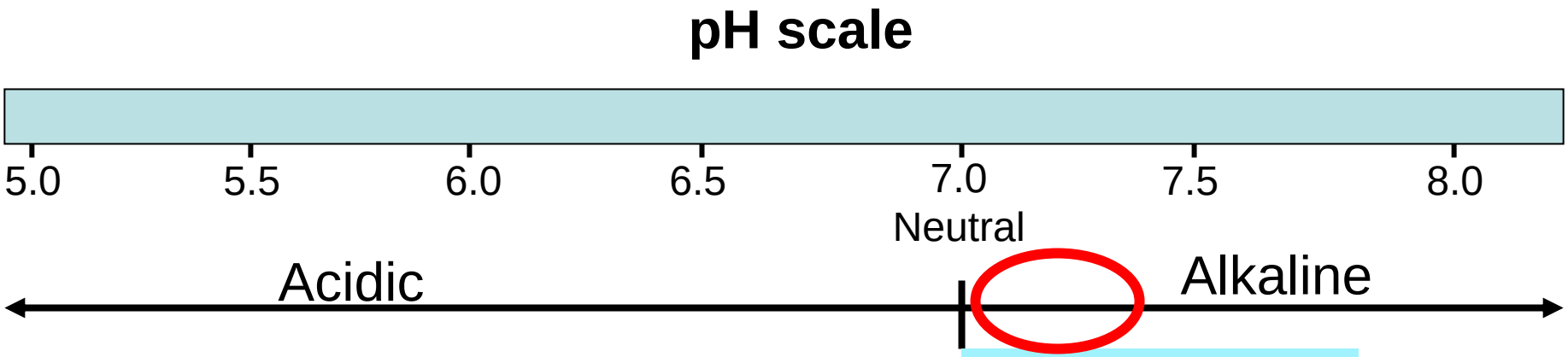


Soil Test: pH and Lime Content

Can we lower the pH of our soil?

e.g. to raise acid-loving plants?

Soil Test: pH and Lime Content



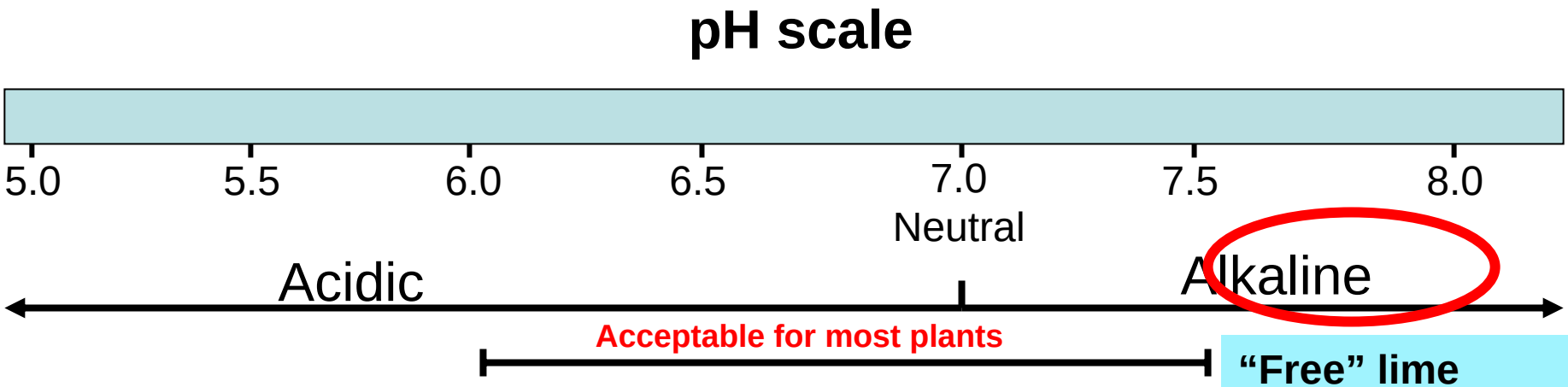
Our soils are well buffered—changing the pH takes a lot of work, and the results are usually temporary

This isn't the mid-west!
Select alkaline-tolerant plants
Grow specialty plant in a pot

pH 7 – 7.5
Can lower the pH by adding acidifier e.g. Sulfur

ONLY IF there is no free lime in the soil

Soil Test: pH and Lime Content



<u>Soils with free lime and high pH:</u>

- Iron chlorosis is common

- May also have deficiencies of:
- **Phosphorus**
- **Zinc**
- **Manganese**

"Free" lime $CaCO_3$
(soil fizzes when vinegar added)

-Keeps pH high

-Cannot effectively lower pH
-($CaCO_3$ neutralizes any added acid)

Soil Test: High pH and Lime Content

Plants with high susceptibility to iron chlorosis:

- Fruit trees: apple, cherry, peach pear
- Small Fruits: grapes, raspberries
- Conifers: Pine, Douglas-fir, Juniper, Spruce
- Ornamental trees: Crabapple, Flowering dogwood
- Deciduous trees: Aspen, Beech, Birch, Elm, Maple, Mountain-ash, Honeylocust, Linden
- Shrubs: Azalea, Bumaid spiraea, Cotoneaster, Magnolia

Will require higher maintenance/effort to grow these plants in high pH soils

Source: CSU Extension

Soils with high pH and Lime Content

Alternative: ***Select plants that are less susceptible to iron chlorosis & better adapted to our soil properties:***

Fact sheet #7.229 “Xeriscaping: Trees & Shrubs”
Fact sheet #7.230 “Xeriscaping: Ground Cover Plants”
Fact sheet #7.231 “Xeriscaping: Garden Flowers”
Fact sheet #7.233 “Wildflowers in Colorado”
Fact sheet #7.242 “Native Herbaceous Perennials for Colorado Landscapes”
Fact sheet #7.421 “Native Trees for Colorado Landscapes”
Fact sheet # 7.422 “Native Shrubs for Colorado Landscapes”

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- **Organic matter content** *(living and non-living)*
- **Salinity** *(influences plant growth and microbial activity)*
- **Plant-available nutrient contents**

  Enough? Deficient? Too much?

Healthy Soil: A Living Ecosystem

Soil organisms: *Direct influence on plant health*

- Break down organic litter
  - *Release nutrients for plant use*
  - *Form humus*

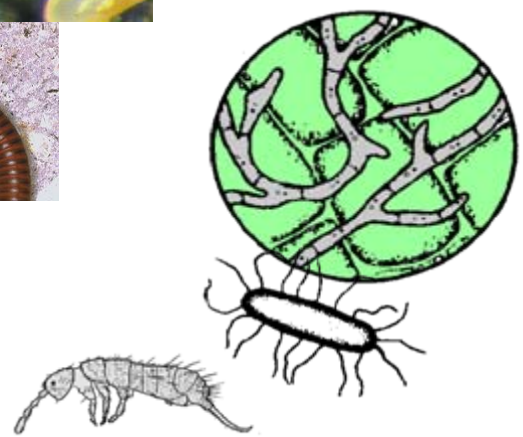
- Microbial exudates glue soil particles into aggregates (*improved aeration and drainage)*

- Mycorrhizal fungi expand plant root systems 100 -1000% *(increases water and nutrient uptake)*

Photo: USDA NRCS

"Feed and nurture the soil and the soil will feed and nurture the plants"

Poor management: unhealthy soil organisms, unhealthy plants



Drawings and photos courtesy of David Whiting

Soil Test: Organic Matter (OM)

>4% OM High *(depends on what you're growing)*
- goal for a vegetable garden: ~5%
- probably too high for native xeric plants

2 – 3 % OM Adequate, good *(depends on what you're growing)*

<2% OM Low *(depends on what you're growing)*
- probably adequate for natives and xeric plants
- can get good plant growth; requires higher maintenance

Soil Test: Organic Matter (OM)

Why add OM to the soil??

-Improves aeration and drainage in clayey soils

-Increases water and nutrient holding capacities in sandy soils

-Slowly releases some plant-available nutrients (e.g.N, P, S)

-Stabilizes soil pH

-Improves soil structure/tilth

-Feeds soil microorganisms/increases population size and activity

- Organic Amendments
  - Compost
  - Biosolids (sewage sludge)
  - Sphagnum peat
  - Worm castings

No regulations
No standards for bagged
Voluntary standards for bulk
No analyses have to be given
High salts possible in animal composts & biosolids ***USE WITH CAUTION***

- Organic Fertilizers

(organics w/concentrated nutrients)

- "Meals" (alfalfa, soybean, cottonseed, corn gluten)
  - "Meals" (bone, blood, feather)
  - Bat guano
  - Fish meal, powder
  - Seaweed
  - Kelp
  - Rock powders

By law, products designated as "fertilizer" must guarantee the minimum percentages of nutrients, at least N-P-K

Source: CSU Extension

Organic amendments considerations: *Salt Potential*

Doesn't mean that salts <u>are</u> high; means salts <u>may be</u> high

High

Biosolids
Manure
Animal-based composts

Most commercially available products

Low

Plant-based compost

Not available in stores as bagged product?

Learn to make plant-based compost at home!

How much amendment is "safe" to add to avoid salinity problems?

One-time, or Annually, for first 3 years:

- **Plant-based compost** (low salt potential)
  - 2-3" on soil surface; incorporate into top 6-8" of soil
- **Animal-based compost or biosolids** *(sewage sludge)* (high salt potential)
  - ≤1" compost on soil surface; incorporate into top 6-8" of soil
  - *This dilution ratio may still be too salty if soil is already border-line saline and the compost is very salty.*

4th year: cut back, check salinity levels & OM content

Source: CSU Extension

3 cu yd covers 1000 sq.ft ~1" deep

Adding too Much Organic Matter

- Salt buildup
- Large release of nitrogen
- Buildup of phosphorous
- Imbalance in K, Ca, Mg, Fe
- Pollution

CSU Master Gardener Slide
Photo by David Whiting

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If salt levels in the soil are too high:

- Reduce water uptake by plants/dehydration *(even if soil contains plenty of H_2O)*
- Restrict/burn root growth
- Cause burning of the margins of leaves
- Inhibit flowering
- Limit seed germination
- Reduce fruit and vegetable yields
- Salt injury is more severe in hot, dry weather
- Negatively impacts most soil organisms

  ("unhappy soil organisms = unhappy plant")

Crop yields can be reduced by as much as 25% without any damage being apparent.

CSU Master Gardener
Slide
Photo by David Whiting

Soil Test: Salinity

Electrical Conductivity, E.C. (mmhos/cm = dS/m)

E. C.	Salinity Level	Effect on Plant Growth
0 – 2 ***(0-1 is better)***	Non-saline	None
2 – 4	Slightly saline	Sensitive plants inhibited
4 – 8	Moderately saline	Many plants inhibited
8 – 16	Strongly saline	Most plants inhibited
>16	Very strongly saline	Few plants are tolerant

Most soils are not naturally saline

Management factors contributing to soil salinity:

- Soil amendments
  - "Topsoils", manure, biosolids, and composts made with manure or biosolids are often *very high in salt*.
  - -Use sparingly, and routinely monitor salt levels

- Excessive/Unnecessary Fertilizer Applications
  - •Inorganic fertilizers are salts
  - •Slow-release inorganic fertilizers: *less impact of salt*
  - •Organic fertilizers: *generally a low salt index*

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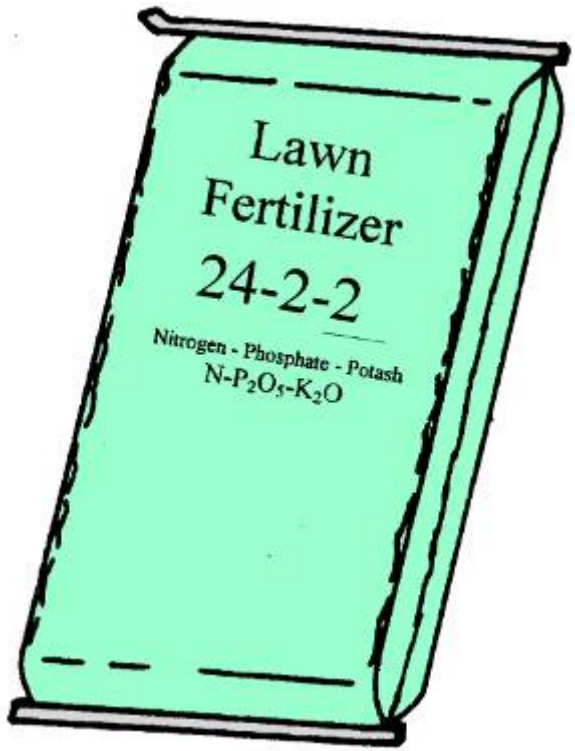
Plant-available nutrient contents in the soil

- Adequate? Deficient? Too much?
- Get a soil test to determine whether or not you need to add fertilizer.
- Add only what you need.

Fertilizing Excessively

(i.e. adding more nutrient than the plants or microorganisms need or will use

- Can create pollution
- Increases the soil salt level
- Can cause imbalances in soil nutrient ratios/interfere with plant's ability to take up another nutrient
- Can become toxic to plants



CSU Master Gardener Slide Illustration by David Whiting

Evaluation of your soil

- **Send soil sample into lab for analysis**

See handout "Soil Testing—FAQs"

- The BEST way to:
  - Evaluate basic soil properties
  - Determine whether fertilizers or amendments are needed
  - Determine whether you have a soil-related problem (pH, salinity, O.M., nutrient)

  - CSU Soil Testing Lab *http://www.soiltestinglab.colostate.edu*

    Soil sampling kit:
    sample bottle
    submission form
    sampling instructions
    optional mailer

    $28.00 Routine Garden and Landscape Soil Test
    $38.00 Routine Manure, Compost and Potting Soil Analyses
    Other specialty analyses available

Soil Testing

- Provides valuable information needed to manage your landscape
  - *Knowledge of the basic properties of your soil to a large degree determines how you should manage your landscape*
  - *An important tool in your management tool kit, but not a "magic bullet"*

- ***Soil testing won't provide all the answers to all your landscape problems.***

What Soil Testing Won't Tell You

- Over-, under-, or inconsistent watering
- Diseases
- Insect damage
- Weed competition
- Too much shade
- Poor plant varieties
- Basic neglect
- **Compaction**: *poor aeration & drainage*

Take-Home Points for soil health

- Avoid excessive use of manure, animal-based compost or biosolids. ***(These are concentrated—use sparingly!)***

- Don't add something if you don't know what's in it.
  - "If it's organic it's always good" ***Not always!***
  - "If a little is good, more is better" ***Don't count on it!***

- Add only what you need.
  - Get a soil test to determine what you need.
  - Learn how to calculate fertilizer application rates

- Learn how to irrigate properly *(Keep the soil well aerated as well as well hydrated)*