Soils 201: Athletic Field Soils and How to Manage Them

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Soils 201: Athletic Field Soils and How to Manage Them

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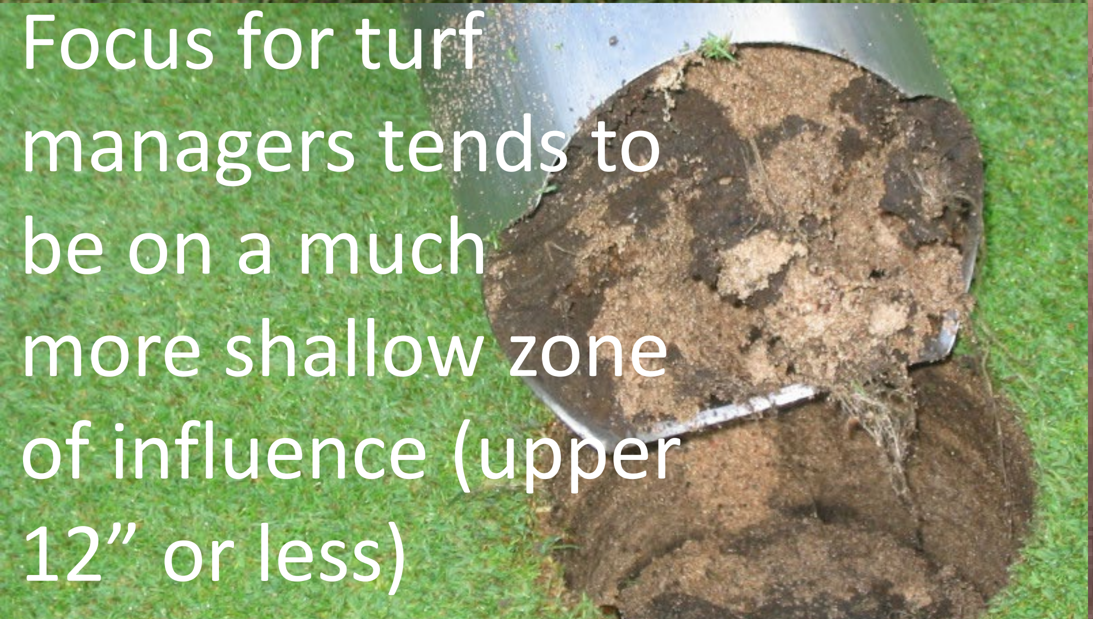
What is Soil ?

Soils are <u>dynamic</u> ecological systems rich in:

- **mineral particles, organic matter,**
- **gases,**
- **nutrients and…**
- **living organisms**

which <u>when infused with water</u> provide a medium for plant growth.

Turf Soils vs. Crop Soils



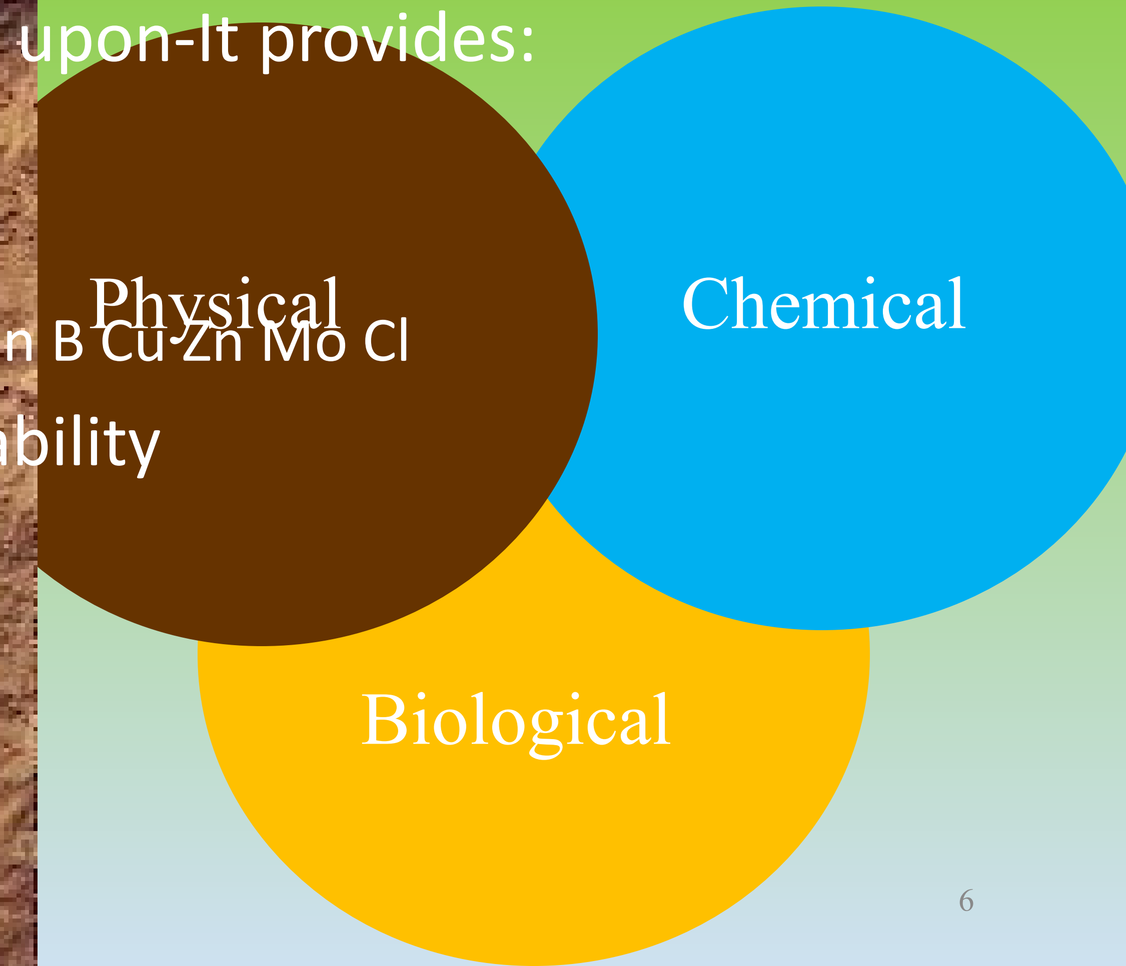
Focus for turf managers tends to be on a much more shallow zone of influence (upper 12” or less)

What’s Different about Athletic Field Soils?

- **Turf Soils** are different from Agricultural soils in that there is no opportunity to till them and open them up.
- **Athletic Field Soils** differ from most turf soils in the amount of traffic they receive.
- High expectations: despite receiving excessive traffic, a high quality, persistent field is still expected.

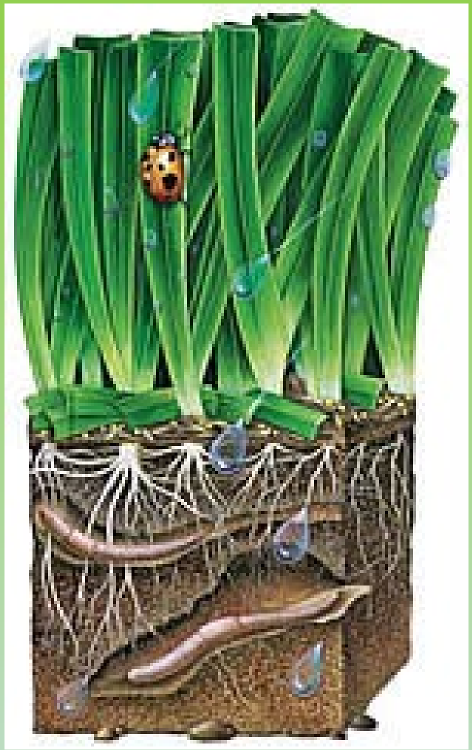
Role of soil in plant growth

- A quality soil is the foundation that a quality athletic field is built upon-It provides:
- Water reservoir
- Nutrient Supply
  - N P K Ca Mg S Fe Mn B Cu Zn Mo Cl
- Support, anchor, stability
- Microbial life
- Air: Oxygen, O_2



What makes a Healthy (Quality) Soil?

- Soil quality and soil healthy are used interchangeably
- To me they are different. The state of health of a soil depends on other things: an arid soils could be perfectly healthy for an arid soil but would not be considered healthy if crop productivity were taken into account.



Soil Quality

- A simple definition would be “the capacity of soil to function.”
- It includes physical, chemical and biological characteristics.
- USDA has defined a simple kit for measuring soil quality

Soil Quality

- Biological properties measured are soil respiration rate (CO_2) and a simple count of earthworms.
- Physical properties measured are bulk density, water content, infiltration rate, aggregate stability, slaking, and morphological characteristics.
- Chemical properties measured are pH, electrical conductivity (EC), and soil nitrate levels.

General soil respiration class ratings (Woods End Research, 1997)

Soil respiration rate (lbs CO2 – C/ac/day	Class	Soil condition
0	No soil activity	Virtually sterile
<9.5	Very low soil activity	Soil is depleted of organic matter and has little activity
9.5-16	Moderately low soil activity	Soil somewhat depleted of organic matter and activity is low
16-32	Medium soil activity	Soil is approaching or declining from ideal state
32-64	Ideal soil activity	Soil in ideal state of biological activity
>64	Unusually high activity	Very high activity usually do to application of large quantities of fresh OM

Components of all soils

- Mineral (inorganic)
- Organic (living and dead, plants and animals)
- Water (and dissolved salts)
- Soil atmosphere
  - (N_2, O_2, CO_2, H_2O, CH_4, H_2S)

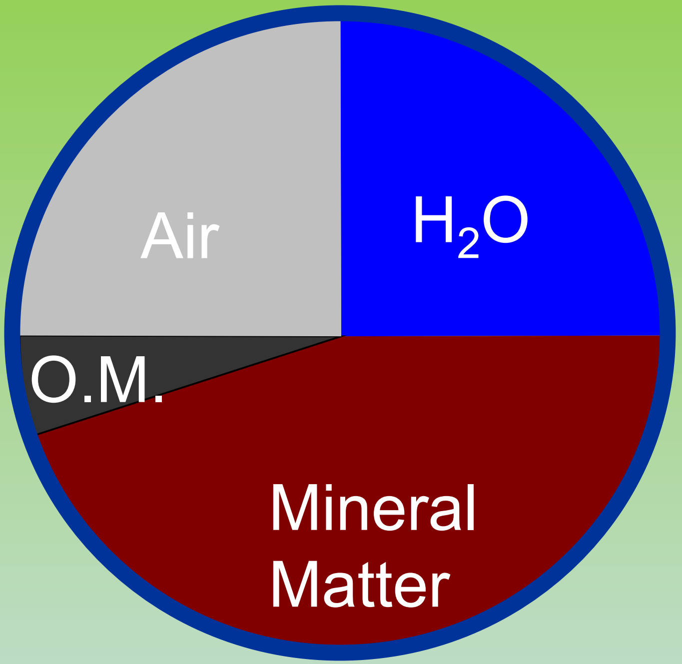
Preferred Soil Composition for Optimum Plant Growth

- **Solids = 50%***

  A combination of mineral and organic matter

  ***by volume**

- **Air = 25 %**
- **Water = 25 %**

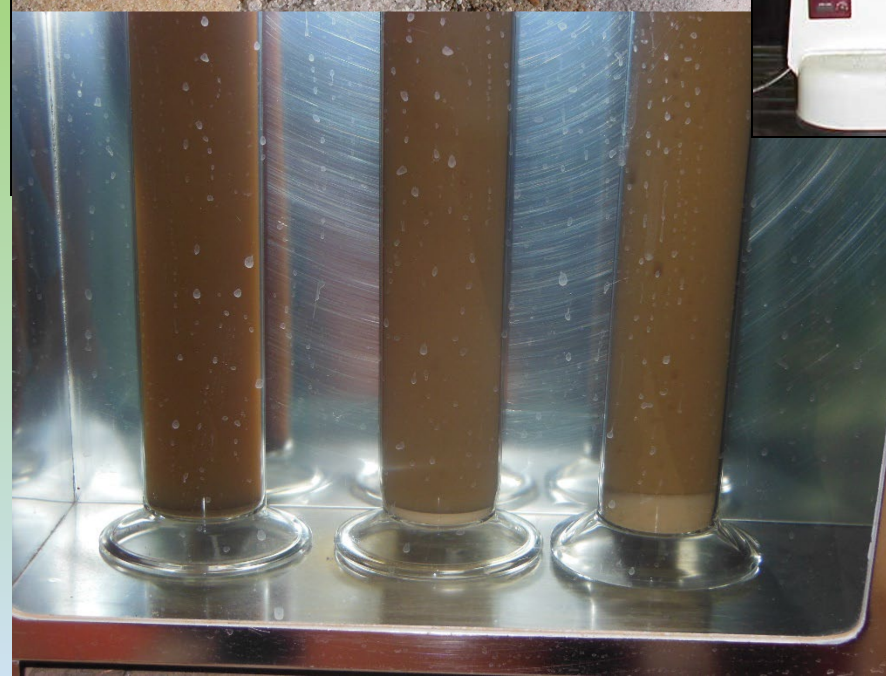


11 Things You May Want to Know About Athletic Field Soils !!!

Thing 1 and Thing 2:

Particle Size Distribution and Gradation

- Provides information on how our soil will behave and give insights into capacity for use and future cultural practices.
- Soil hydrometer test and sand sieving test.
- Many ways to interpret the results

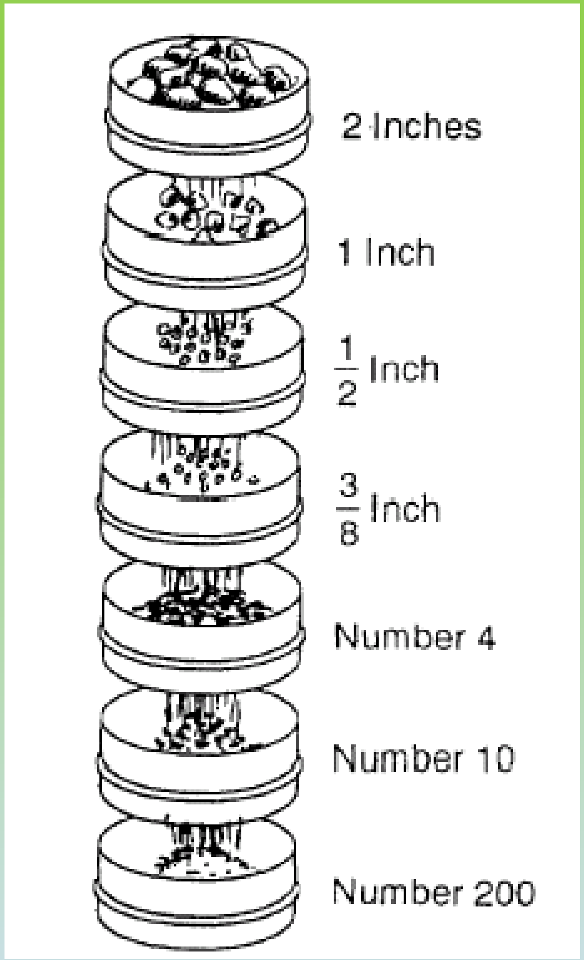


Soil Texture

How big are "Soil" particles???

- Soil particles are officially defined as those soil mineral particles that are < 2.0 mm.
- Larger particles (> 2 mm) occur in soil but are classified as gravel and rock.

Dry Sieve Analysis



Grain Size Groups

Size Group	Sieve Size	
	Passing	Retained On
Cobbles	No Maximum Size	3 inches
Gravels	3 inches	No. 4 (≈0.25 inches)
Sands	No. 4 (≈0.25 inches)	No. 200 (0.072 mm)
Fines (silt or clay)	No. 200 (0.072 mm)	No minimum Size
In military engineering, the maximum size of cobbles is accepted as 40 inches, based on the maximum jaw opening of a rock-crushing unit.		

Soil mineral matter

- Size separates and characteristics:
- Silt (0.002 - 0.05 mm)
  - mineralogy
- Clay (< 2 micron)
  - plate like structure
  - High surface area - related to small size
  - mineralogy (secondary minerals)
  - negative charge
  - Large source of cation exchange capacity (CEC) - the sum of the exchangeable cations that a soil can adsorb
  - adhesion of water

The “dirty water” in these sedimentation cylinders is due to suspended slit/clay

Notice the heavier sand at the bottom

Soil mineral matter

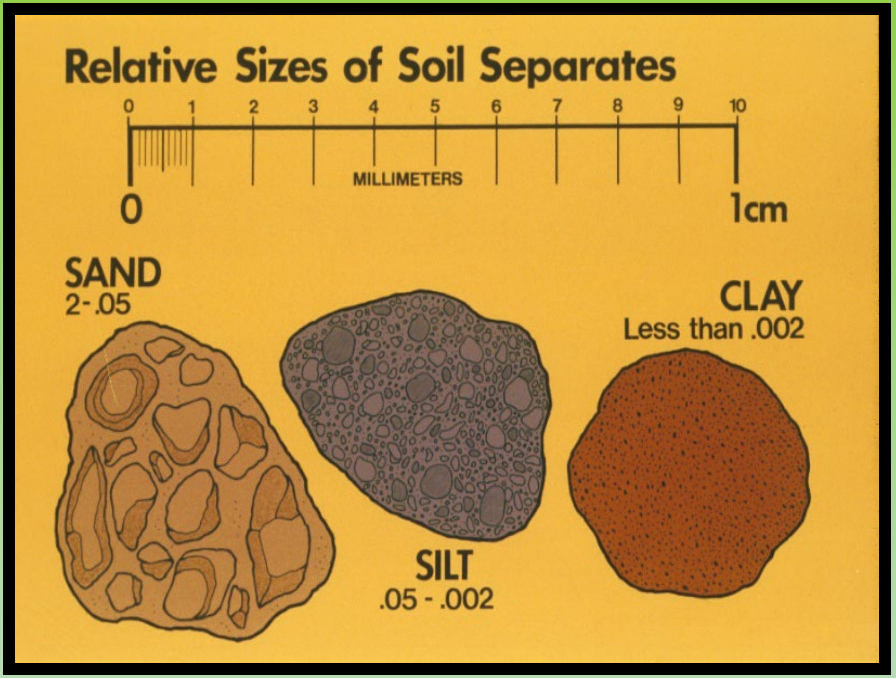
- Sand (0.05 - 2 mm)
  - sand separates
    - very coarse: 1 - 2 mm
    - coarse: 0.50 - 1 mm
    - medium: 0.25 - 0.50 mm
    - fine: 0.10 - 0.25 mm
    - very fine 0.05 - 0.10 mm
  - distribution of size range = packing/firmness/stability
  - Particle shape: rounded vs angular (firmness)
  - Mineralogy – normally mostly quartz (very stable) in many parts of the USA

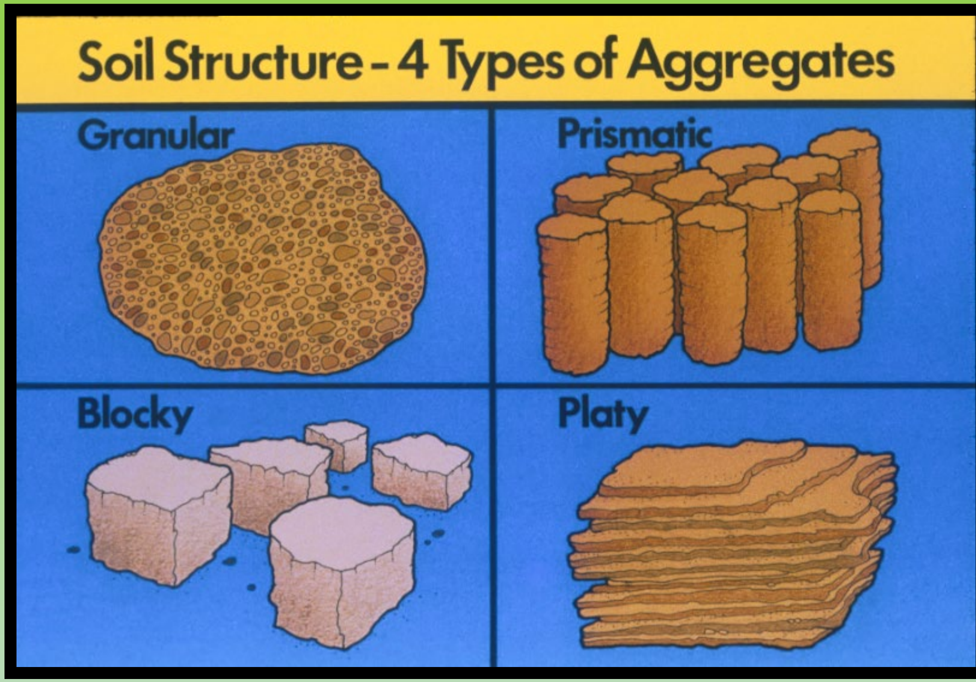
PARTICLE-SIZE ANALYSIS

F. Gravel	(2.0-3.4mm)
VCoS	(1.0-2.0mm)
CoS	(0.5-1.0mm)
MS	(0.25-0.5mm)
FS	(0.10-0.25mm)
VFS	(0.05-0.10mm)
Si+Cl	(< 0.05mm)

Sand and Gravel Sizes for Putting Green Rootzones

Soil Texture vs. Soil Structure





Ratio (%) of sand, silt and clay

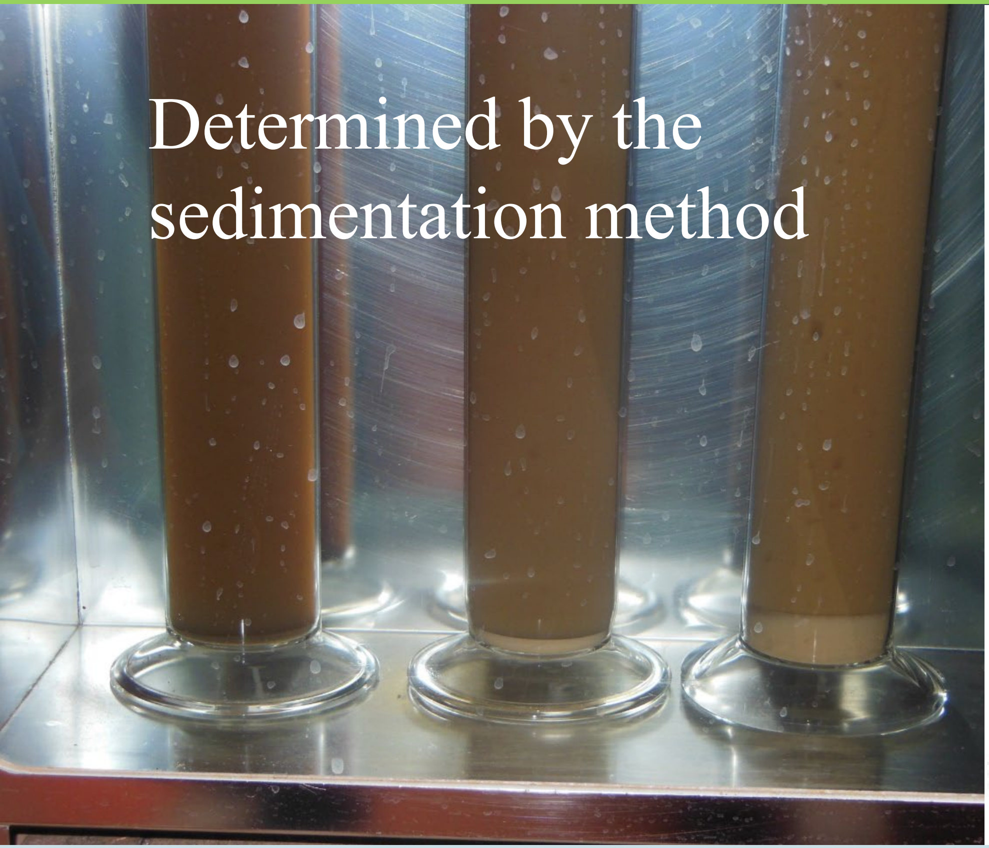
Arrangement of those particles

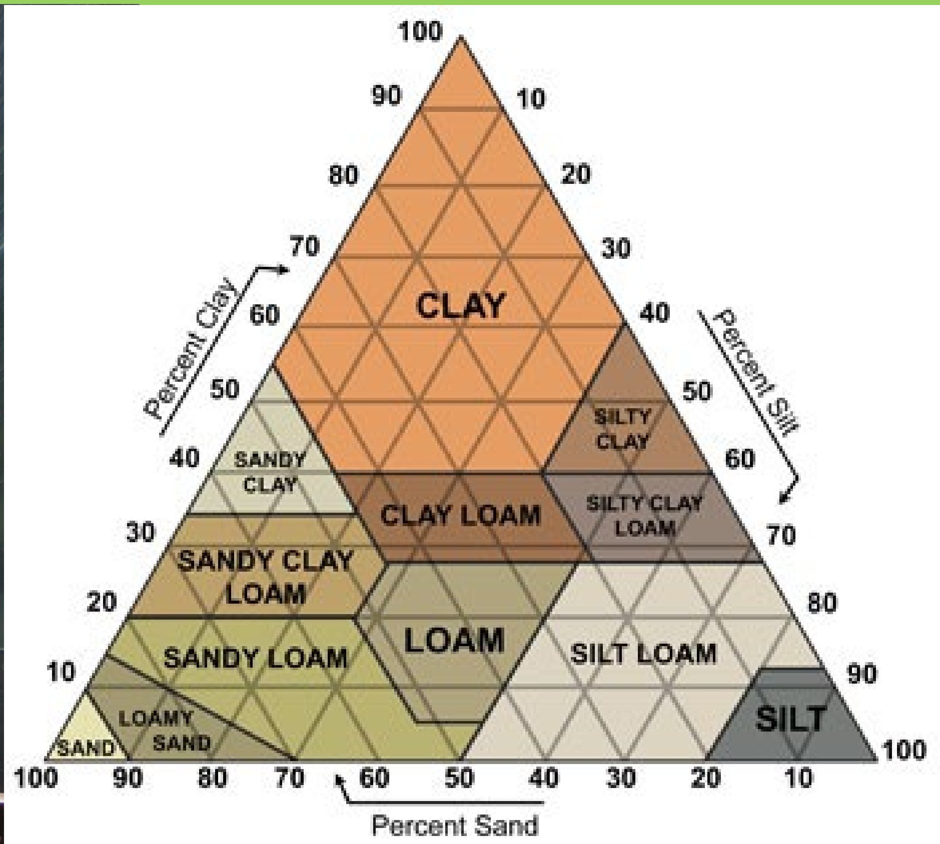
Soil mineral matter

- Soil texture - percentage of sand, silt and clay in soil
  - influenced by parent material, weathering (clay formation), transport of clay, erosion/sedimentation
  - textural classes
    - textural triangle
  - profile textural differentiation

Soil texture is the relative proportion of Sand, Silt and Clay

Regardless of compactive forces imparted the soil texture does not change



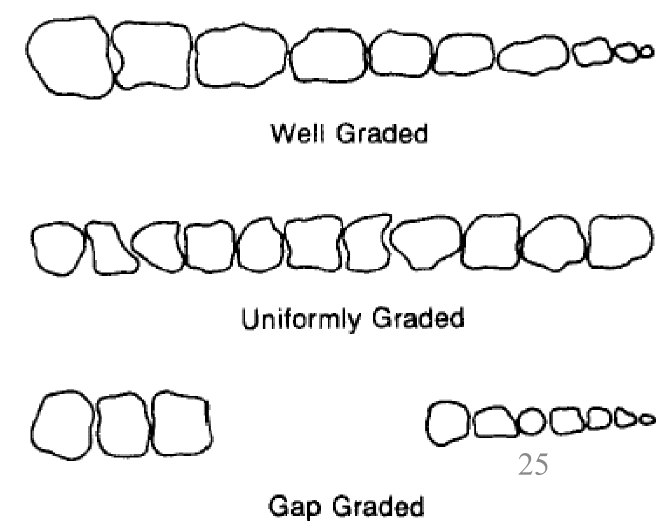



Soil Structure
Granular Structure

Soil-Rootzone Particle Gradation

- Distribution of particle sizes within a soil.

- Soils are either:
  - Well graded – good distribution of particle sizes
  - Poorly graded – bad distribution of particles sizes
    - Uniformly graded – only one soil size = unstable
    - Gap graded – missing soil sizes

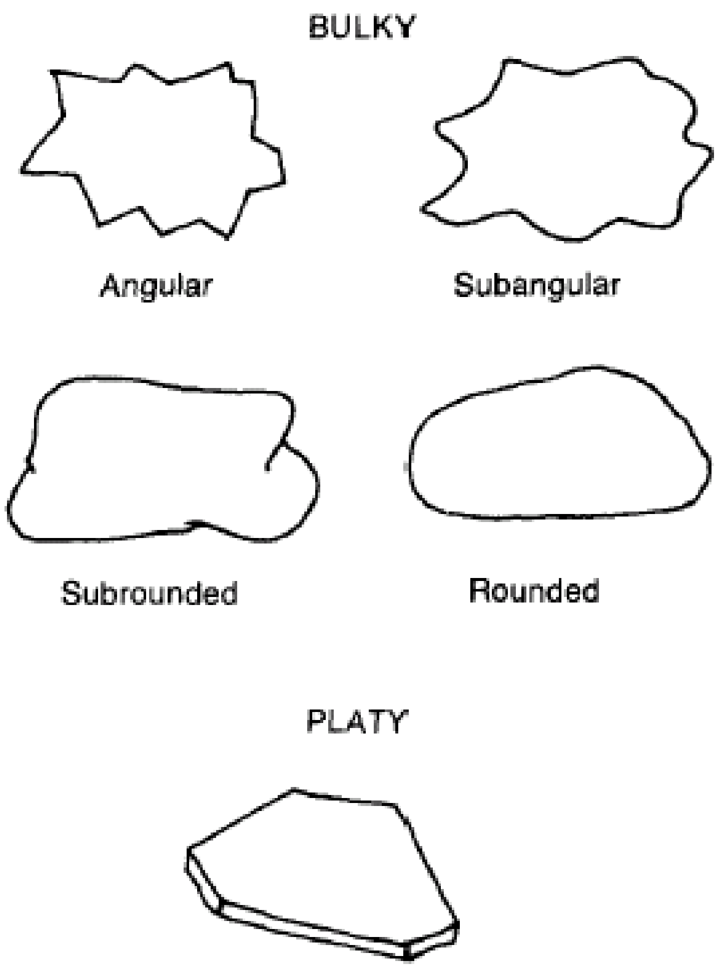


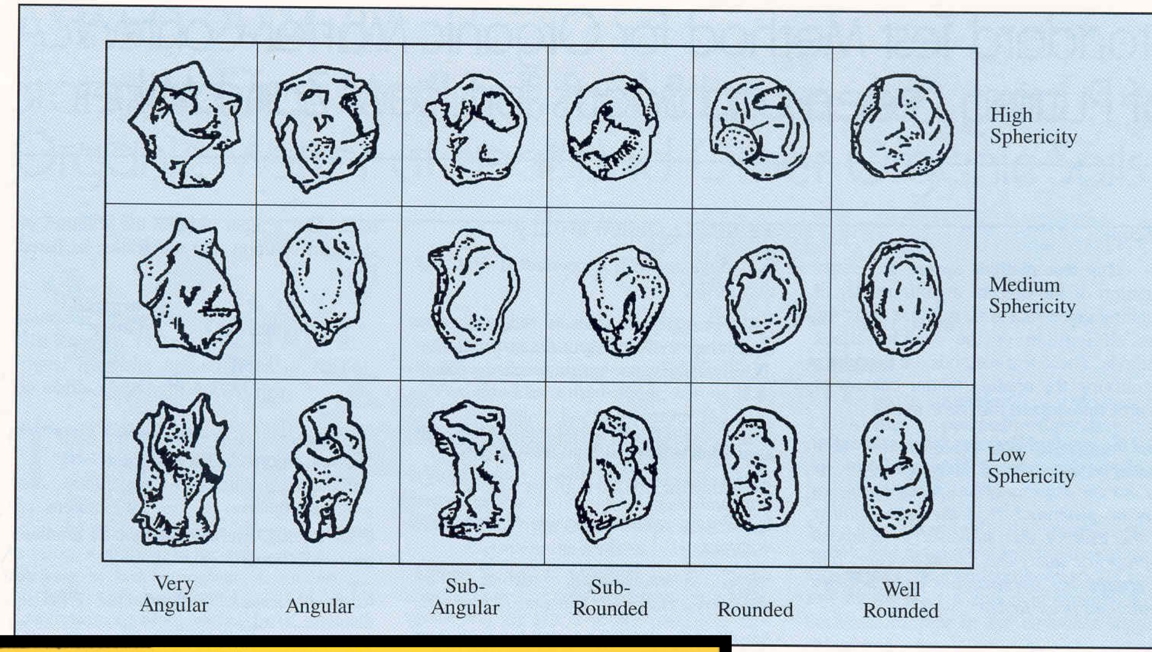
Grain Shape

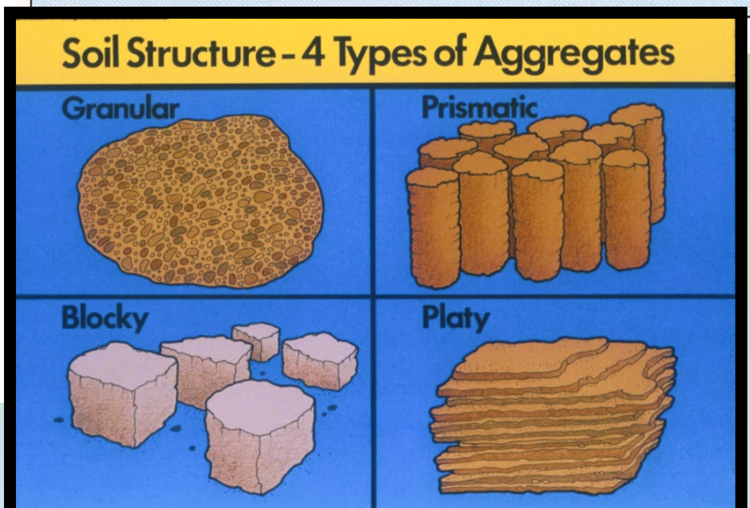
- Influences a soils strength and stability

- Two general shapes:
  - Bulky – three dimensional
    - Angular – recently been broken
    - Sub angular – sharper points and edges are worn
    - Sub rounded – further weathered than sub angular
    - Rounded – no projections and smooth in texture
  - Platy – two dimensional

Soil-Sand Particle Shapes







Platy structure in surface soil resulting from compaction

Particle Shape and Gradation Affects Firmness

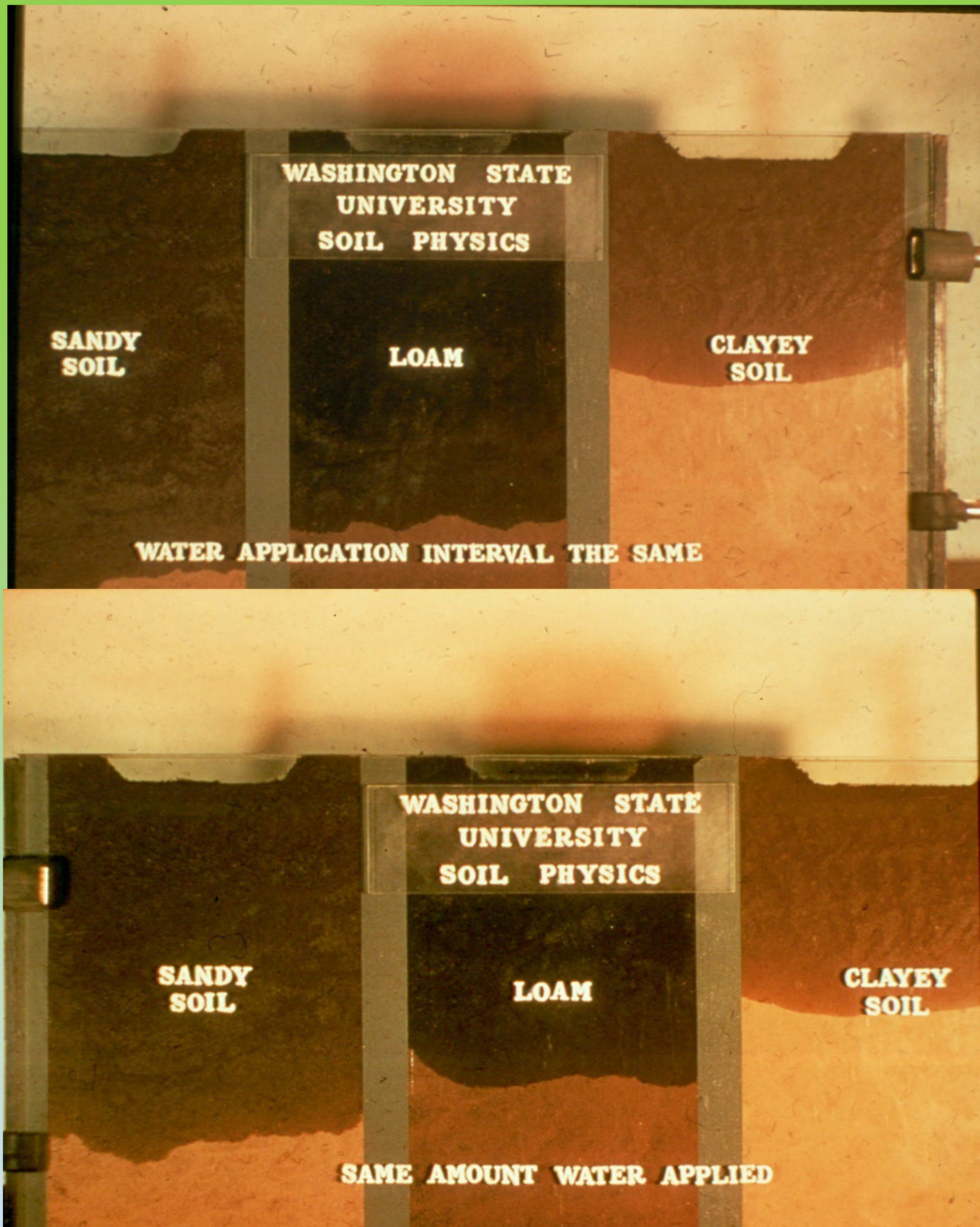
- Relationship to Stability
  - As important as particle-size distribution in affecting strength characteristics.
    - angular particles display greater stability than rounded particles.
    - because of source and variability, often more effective to control stability by selecting appropriate particle-size distribution.
    - A single particle size will be unstable

importance of texture

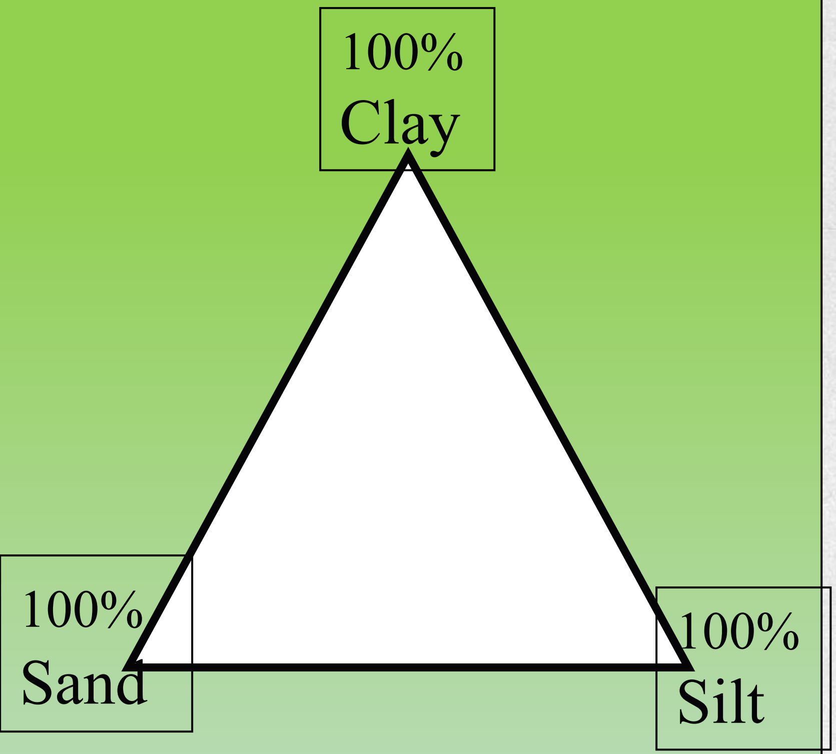
- pore space
- aeration
- water retention, available water
- water infiltration and percolation
- runoff, erosion
- cohesion, plasticity
- shrink-swell character

Importance of texture

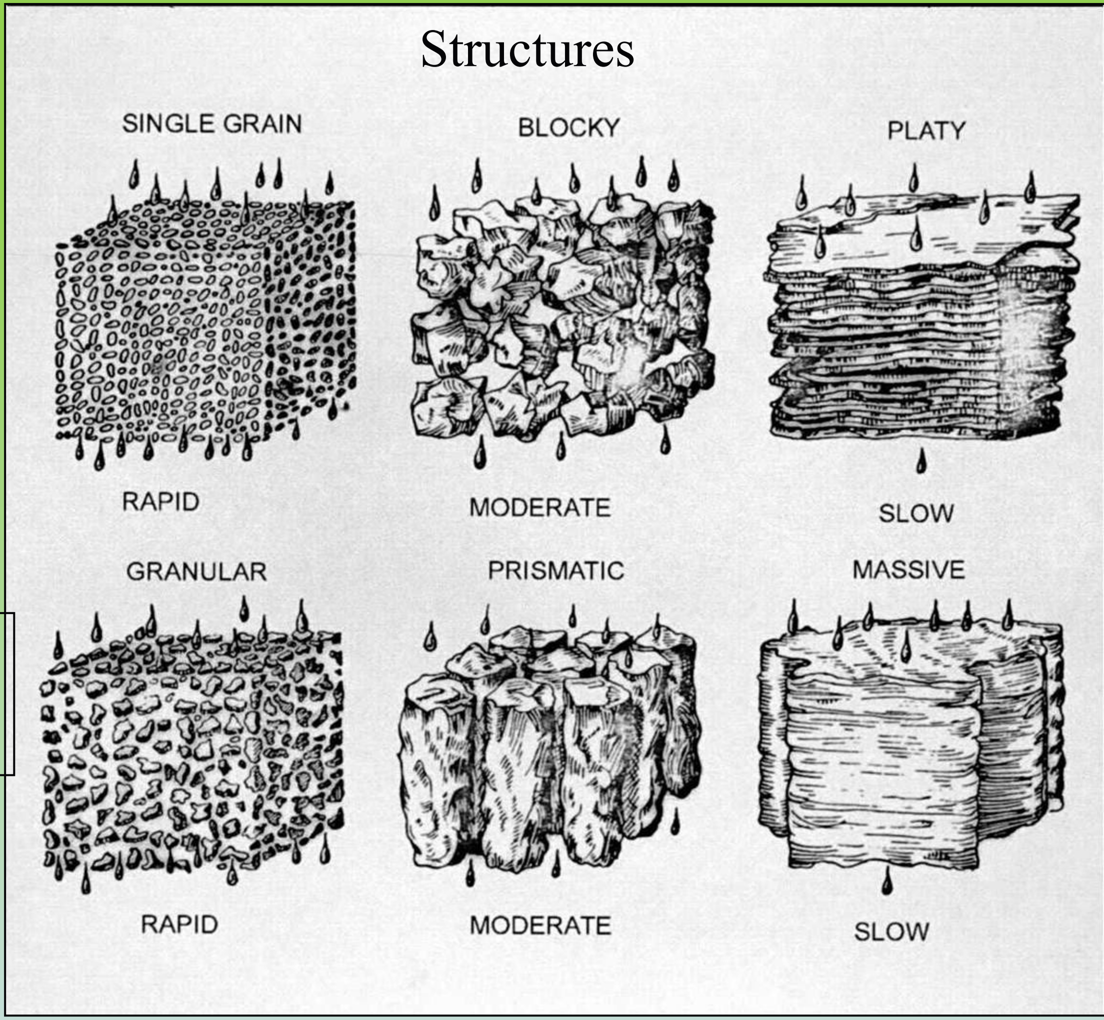
- Affects soil structure
- Water movement and retention
- Management - tillage
- Microbial activity, o.m. content
- Soil pH (acidity)
- Soil temperature
- Fertility, productivity



Importance of Texture and Structure to Water Movement



Easy H_2O Movement



Management

- Soil Texture can be improved over time with a topdressing and hollow tined aerification approach.
- Often we have to manage what we are given, but knowing what we are dealing with is helpful.
- Perhaps we can manage this up front by choosing sites with good soils or building our turf rootzone from the best quality materials.

Thing 3

Bulk Density/Compaction

Soil Bulk Density

- Bulk Density: refers to the mass of oven dry solids in a given bulk volume, expressed as grams solids per cm^3 bulk volume.

- Typical values:

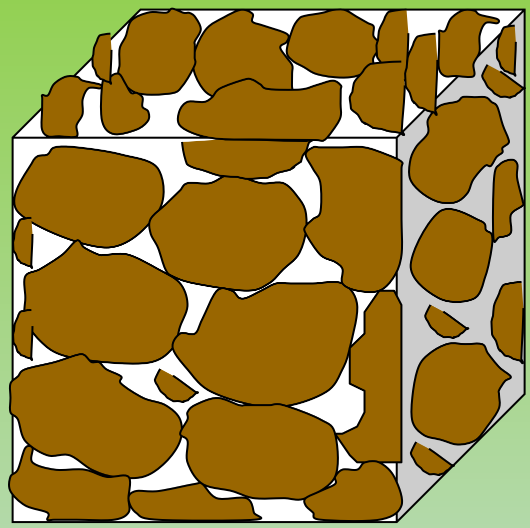
  Organic Materials (Peat) = 0.2 to 0.5 g/cm^3

  Clays-silt loams = 1.0 to 1.6 g/cm^3

  Sandy soils = 1.2 to 1.8 g/cm^3

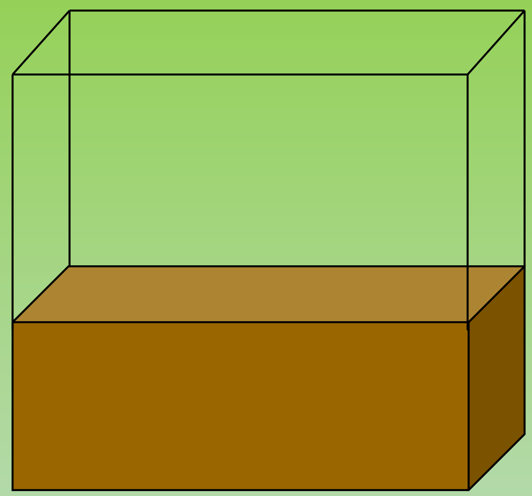
  Highly compacted sub-soils 2.0 g/cm^3

Bulk Density vs. Particle Density



Bulk Density

1.1 to 1.9 g/cm^3



Particle Density

2.6 g/cm^3

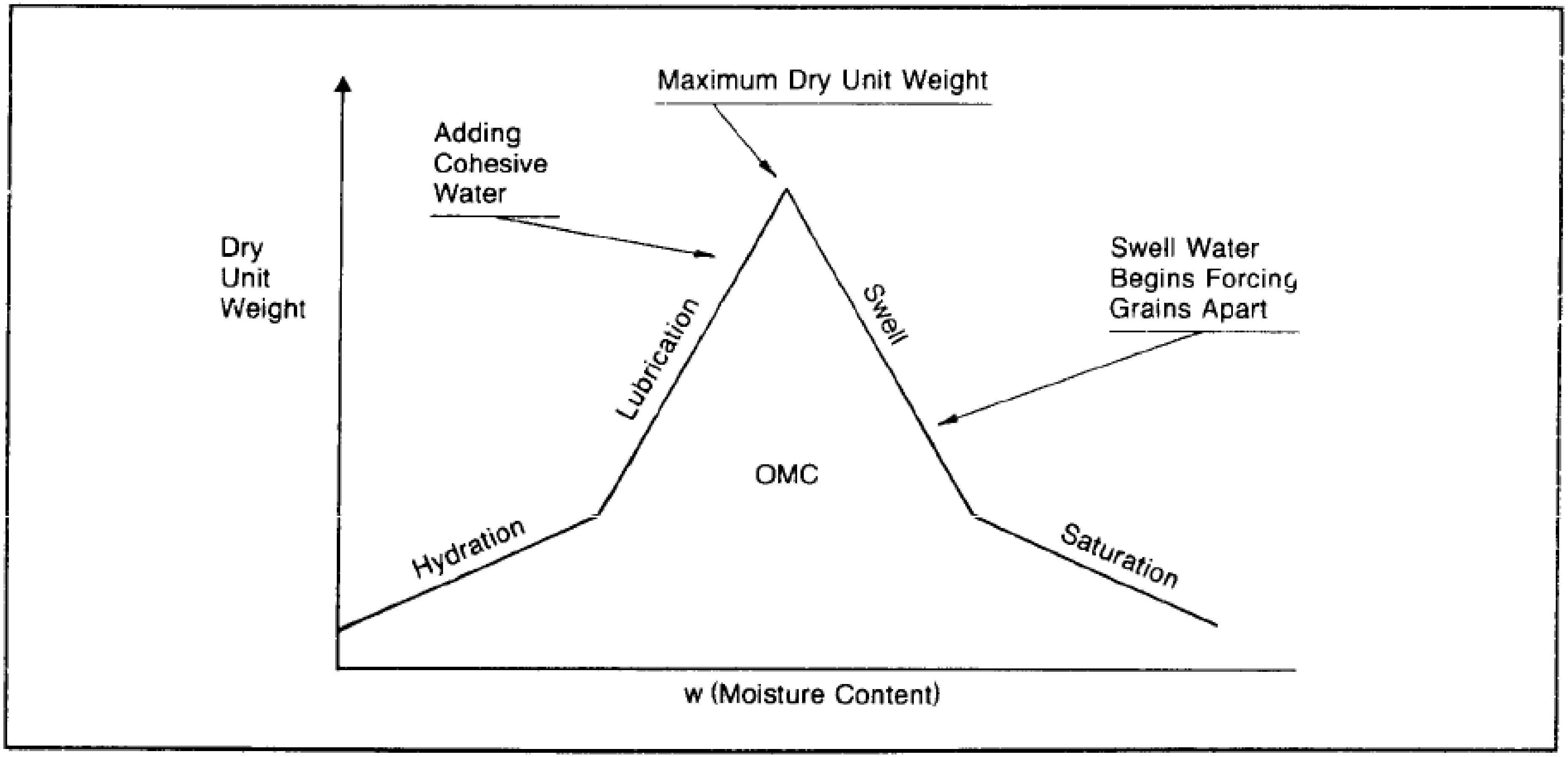
Measuring Bulk Density

- Most common method is to use a core sampler. Takes core of a known volume.
- Sample is usually then weighed wet, then oven dried to a constant weight at 105 C. (usually 24 hrs).
- You now have a mass and a volume of soil
- BD = mass of OD soil (g)/ vol. soil (cm^3)

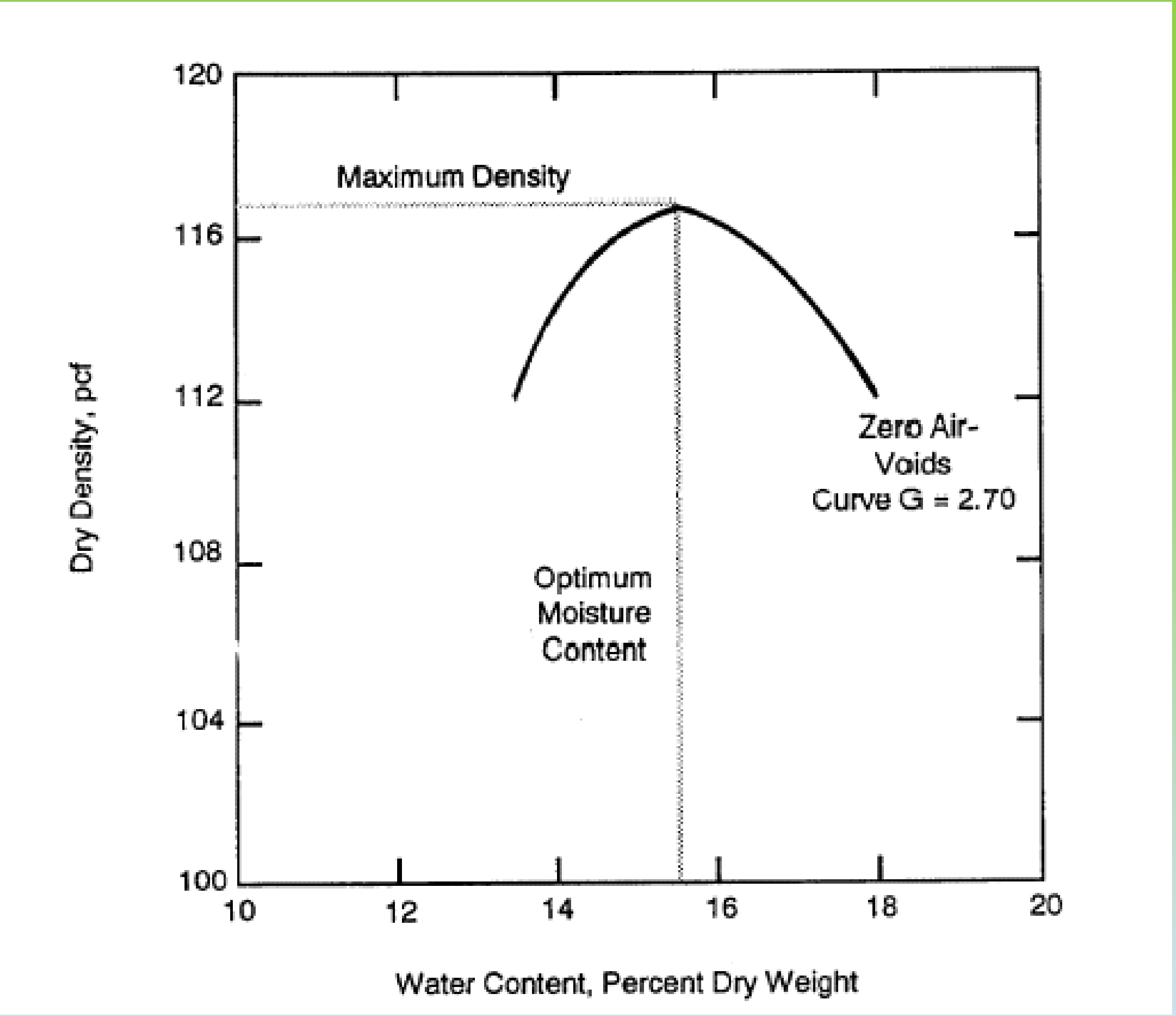
Bulk density

- dry weight of a given volume of soil
- Used to characterize structure
- More porespace = less weight = lower BD
- Texture influences structure and density
- Range for mineral soils: 1.1 - 1.5 g/cm^3 (68.7 - 93.6 lbs/cf)
- organic soils: 0.1 - 0.6 g/cm^3 (6.2 - 37.4 lb/cf)

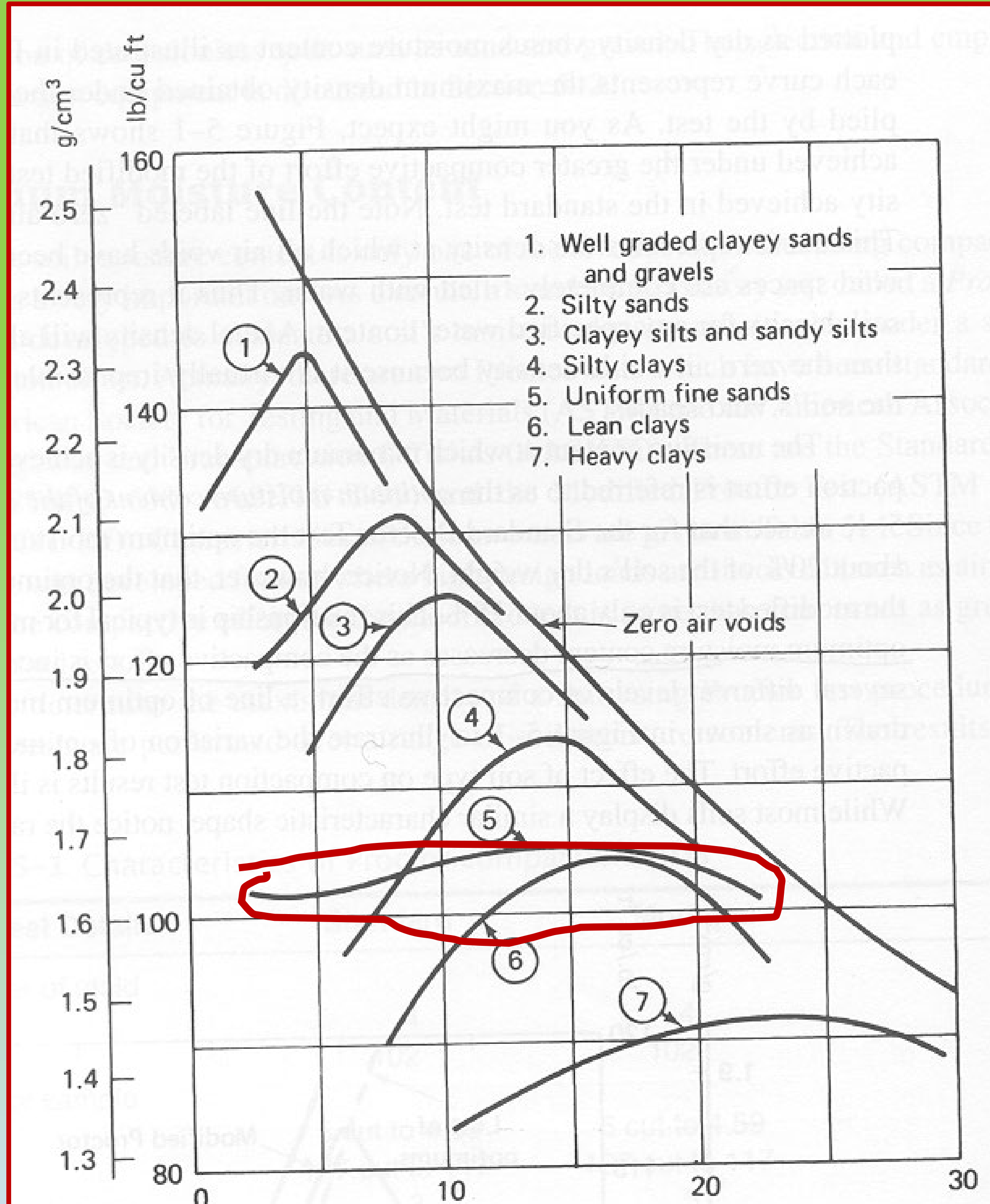
Effect Of $H2O$ on Density



Typical H2O-Density Relationship



Compaction Characteristics of Various Soils



Pore Space

General relationship of BD to root growth based on soil texture

Soil Texture	Ideal BD g/cm^3	BD affecting root growth	BD restricting root growth
Sands, Loamy Sands	< 1.60	1.69	> 1.80
Sandy loams, loams	< 1.40	1.63	> 1.80
Sandy clay loams, clay loams	< 1.40	1.60	> 1.75
Silts, silt loams	< 1.30	1.60	> 1.75
Silt loams, silty clay loams	< 1.40	1.55	> 1.65
Sandy clay, silty clay, some clay loams	< 1.10	1.49	> 1.58
Clays < 45% clay	< 1.10	1.39	> 1.47

Hollow Tine Core Aeration

What good does it do?

• Punches a hole	YES
• Decreases compaction	YES
• Returns loosened material to surface	YES
• Potential to break down thatch	YES
• Creates a large pore	YES
• Breaks through layers	YES
• Adds material to profile	YES

Hollow-tine Core Aeration

- Physical removal of a core of various diameters and depths from the soil. Typical tine size and depth: 1/4-1" diameter, 3-12" deep
- The Most Critical Tool in a Cultivation Program!
- HTC is also the most surface disruptive procedure…must be scheduled around events
  - Cores can affect footing
  - Holes can catch cleats
- If cores removed, what to do with them?

For Larger Areas
(Not Usually Putting Greens)

Other Slicing Devices (Large Areas)

Native Soil Turf Management: Focus On Soil Physical Properties
Pore Space and Compaction Relief

Figure 1. Upon completion of fall sports, core aerate heavily trafficked athletic fields where soil compaction can restrict turf recuperation. (Photo courtesy of Ben Ewing.)

Thing 4

“Soil reaction” aka: Soil pH

Soil Reaction (pH): Defined

- measure of the acidity or alkalinity of the **soil solution**

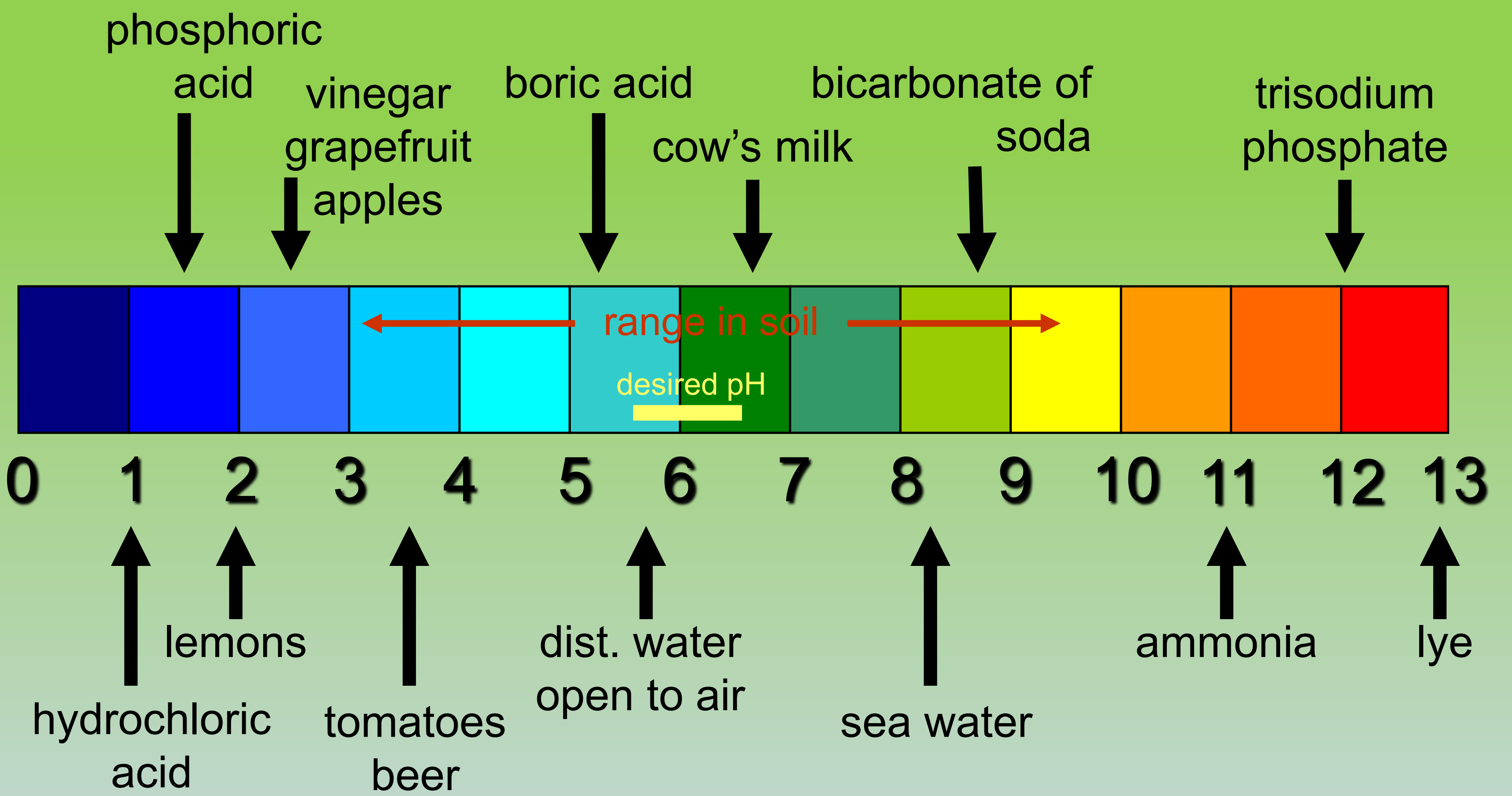
- pH = - log[H^+]

Soil pH

pH	[H+]	[OH-]	
7	10^{-7} or 0.0000007	10^{-7}	neutral
3.5	$10^{-3.5}$ or 0.00032	$10^{-10.5}$	acidic
9	10^{-9} or 0.000000001	10^{-5}	alkaline

•note that the exponents of [H+] and [OH-] add to -14.
•When both are -7 the ions are in equal concentration,
•therefore the system is neutral

pH scale


phosphoric acid
vinegar
grapefruit
apples
boric acid
cow's milk
bicarbonate of soda
trisodium phosphate
range in soil
desired pH
0
1
2
3
4
5
6
7
8
9
10
11
12
13
hydrochloric acid
lemons
tomatoes
beer
dist. water open to air
sea water
ammonia
lye

Soil pH

- Many of our soils are highly weathered. This means that most of the basic cations (K, and especially Ca and Mg) have been leached out of the soil. They are replaced by protons (H), which results in soil acidity.
- Younger soils or soils in drier climates are less weathered and may actually be alkaline (pH> 7).

pH range in soil is usually from 3 to 9

Acid | Basic

pH Range in Soil

3 — 7 — 9

0.001 molar or 10^{-3} M

0.000000001 molar or 10^{-9} M

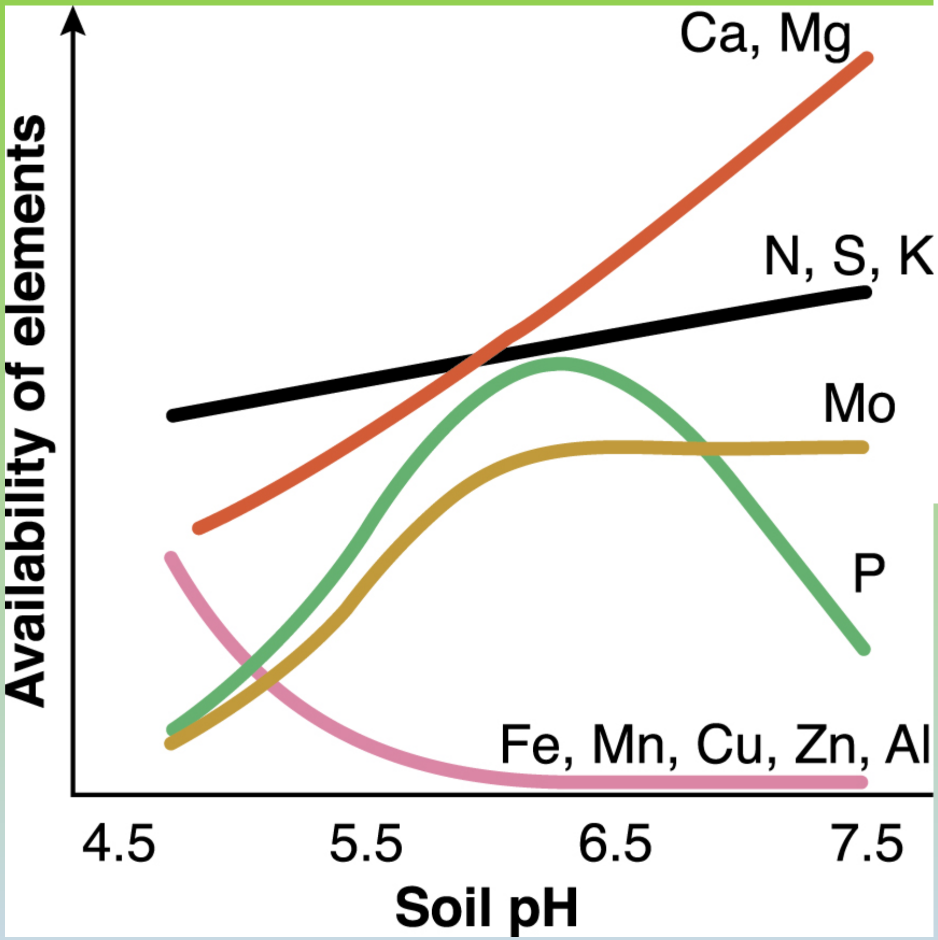
As pH changes from 3 to 9, the $[H^+]$ decreases by a factor of 1,000,000! ---- not a linear scale!

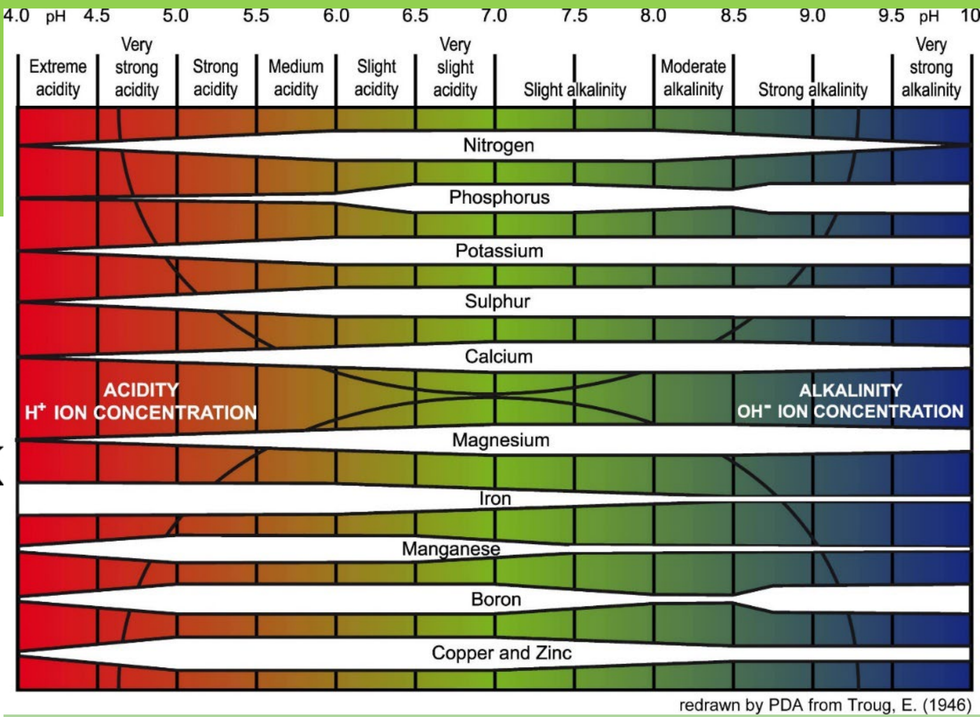
pH is expressed on a logrithomic scale.

Importance of Soil pH

- pH affects the availability of plant nutrients
- Affects fate and activity of pesticides and many other organic compounds
- Affects biological activity – bacteria, fungi, etc.
- Affects soil physical properties
- Some plants have optimum pH's for growth
  - Corn, Wheat pH 6.5
  - Kentucky blue grass pH 5.8-6.5
  - Pines pH 5.5

Soil pH Affects Nutrient Availability

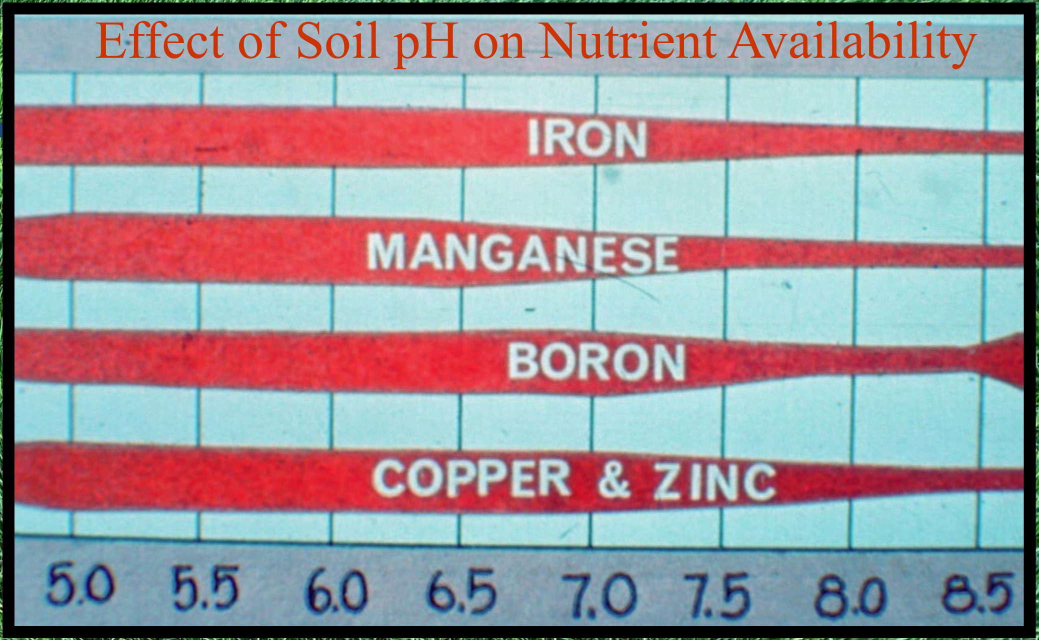




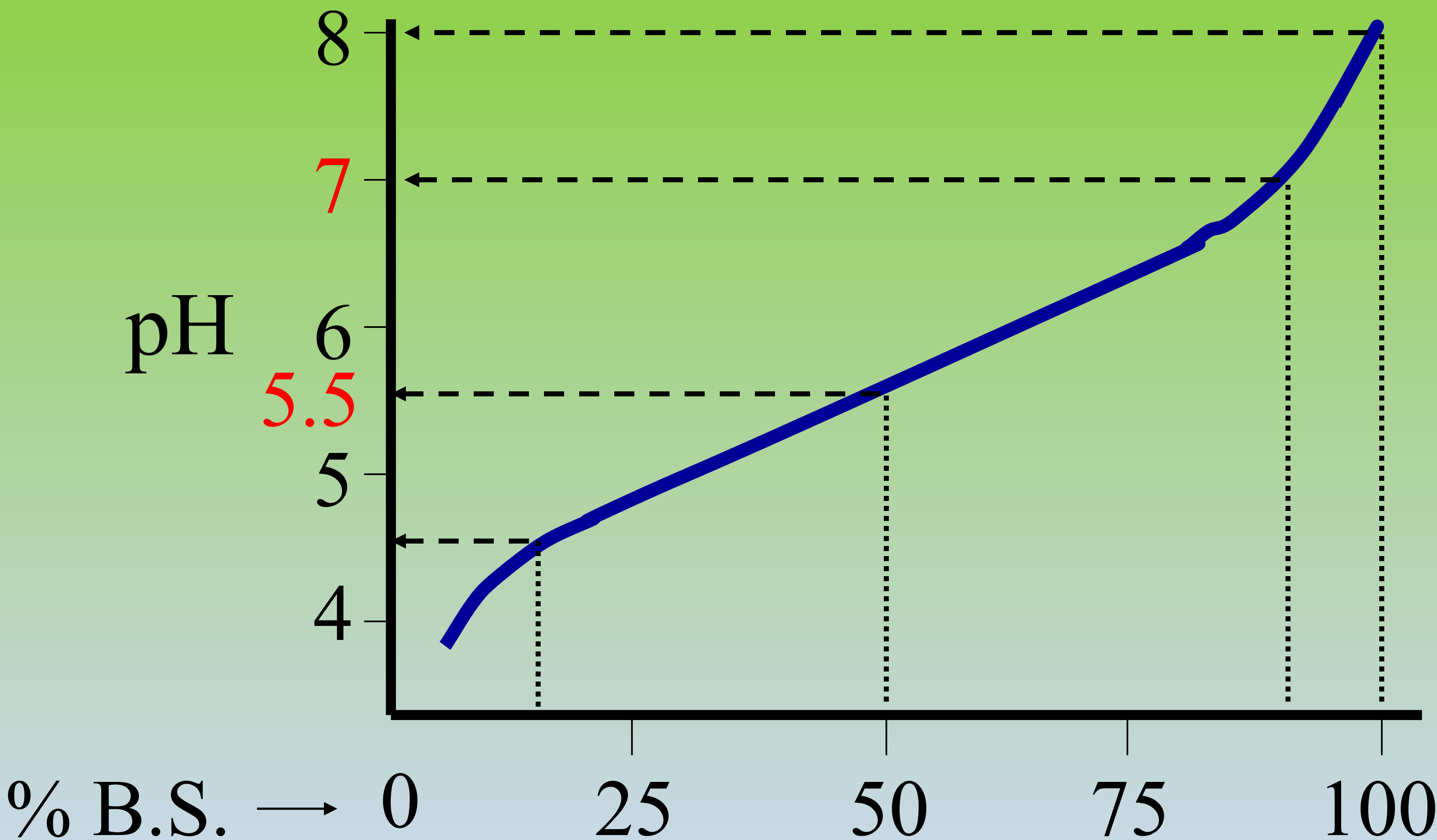
Calcareous soils may suffer from Fe deficiency and other micro-nutrients

Summer induced iron chlorosis is common in Midwest high pH soils

Note that Fe availability increases significantly below pH 6.0



Relationship Between Base Saturation and Soil pH



The importance of soil pH

- indication of weathering (parent material, leaching)
- availability of nutrients
- toxicity of metals, esp, Al^{3+}
- oxidation of reduced S (think black layer)

Active acidity in soil solution

- H^+ [measured as pH]
- Exchangeable acidity (Reserve)
- Residual acidity (Bound)

$$Al^{3+} + H_2O \longrightarrow Al(OH)^{2+} + H^+$$

$$Al(OH)^{2+} + H_2O \longrightarrow Al(OH)_2^+ + H^+$$

$$Al(OH)_2^+ + H_2O \longrightarrow Al(OH)_3 + H^+$$

Processes increasing soil acidity

- CO_2 (from respiration) + H_2O + HCO^{3-} + H^+
- Organic acids
- H^+ releases upon cation uptake by the root
- leaching of anions (Cl^- , SO_4^-) requires leaching of equal + charge
- Oxidation of reduced substances (e.g. sulfide minerals, organic matter, ammonia fertilizers)
- Acid rain

Buffering capacity of soils

- Resistance to change in pH of soil solution
- Exchange site equilibrium with soil solution
- Higher the CEC, the greater the buffering capacity

Processes increasing alkalinity

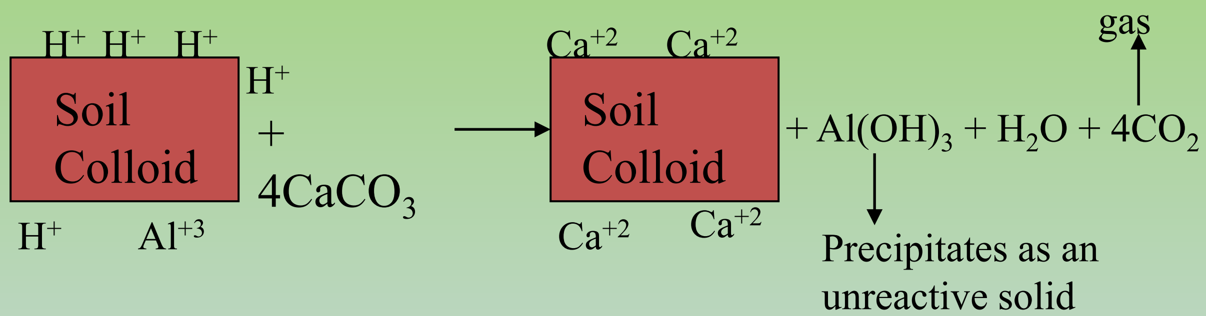
- Reduction of Fe^{3+}, Mn^{4+} consumes H^+ or releases OH^-
- $Fe(OH)_3$ + e^- $Fe(OH)_2$ + OH^- (anaerobic situations)
- Recycling of basic cations by deep-rooted plants - maintains B.S.
- Liming (calcium carbonate)

Modifying Soil pH

- How to raise pH – add lime (carbonates, oxides or hydroxides of Ca, Mg
  - Limestones (carbonates) – calcitic, dolomitic, dolomite
    - $CaCO_3 + 2H^+ \rightarrow Ca^{2+} + H_2O + CO_2$
    - $MgCO_3 + 2H^+ \rightarrow Mg^{2+} + CO_2 + H_2O$
  - Burned or Quicklime (oxides) – produced by heating limestone
  - Hydrated lime (hydroxides) – water added to burned lime

Liming

- Lime is an amendment used to raise soil pH
- Calcium carbonate ($CaCO_3$): Lime
- $Mg(CaCO_3)$: dolomitic lime



Approx. Lime Amounts to Raise pH to 6.5

Pounds of limestone/1000 ft^2			
pH	Sandy	Loamy	Clayey
6.0	20	35	50
5.5	45	75	100
5.0	65	110	150
4.5	80	150	200
4.0	100	175	230

Finer the lime, the quicker it reacts, but harder to apply

Lime Requirement – Factors determining amount to add

- pH change desired
- soil's buffer capacity
- chemical composition and purity – guarantee
  - Compare H^+ neutralizing power per weight
- Calcium Carbonate Equivalent (CCE)
  - fineness of lime - finer particles react more quickly

Lower pH

- Add organic matter
- Elemental sulfur
  - $2S + 3O_2 + 2\ H_2O \rightarrow 4H^+ + 2SO_4^{2-}$
  - $FeSO_4 \rightarrow Fe^{2+} + SO_4^{2-}$

  $Fe^{2+} + 2H_2O \rightarrow Fe(OH)_2 + 2H^+$

  Ferrous sulfate

  $4Fe^{2+} + 6H_2O + O_2 \rightarrow 4Fe(OH)_2^+ + 4\ H^+$

  Aluminum sulfate

  $Al^{3+} + 3H_2O \rightarrow Al(OH)_3 + 3H^+$
- Long-term reductions in soil pH is next to impossible in calcareous soils

Thing 5

Surface Hardness

Surface Hardness

- Different from compaction. Especially with sands a soil may be firm without necessarily being compacted.
- Compaction – Excessive compaction negatively affects plant growth
- Surface Hardness – Excessively hard surfaces pose a safety issue
- Can be measured using devices like the Clegg Impact Tester

Excessively Hard Soils Affect Player Safety

Surface Hardness Management

- Avoid excessively dry rootzones
  - Add water
- Aerification with small solid tines
- Sand topdressing?
- Crumb rubber?
- Grow more grass!

Thing 6

Organic Matter

Soil organic matter

- Defined: organically derived fraction of soil, including plant, animal, & microbial residues in various stages of decomposition
- Organic residue degradation and formation of humus
  - residue addition to soil – plant, animal, microorganisms
  - microbial activity (decomposition)

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Soil organic matter

- How to measure – Most soil testing labs have a CN or CNS analyzer. For a minimal fee you can know your soil organic matter content and its C:N ratio.

Fungi	9:1
Actinomycetes	5:1
Bacteria	4:1
Young Legumes	12-20:1
Young Grasses	20-40:1
Oat/Wheat Straw	80-90:1
Tree Leaves	60-100:1

Soil organic matter

- With additions of high carbon residue (e.g. sawdust, etc.), N becomes the limiting nutrient
- If residue C:N < 20:1, excess N is released as residue decomposes
- If residue C:N > 30:1, microorganisms require soil N, (competing with plants)
- Residue C is respired (CO_2↑) during decomposition, but N is recycled as microorganisms die; so C:N decreases

Soil Carbon to Nitrogen Ratios

- residue is transformed
- humus results – relatively stable modified organic molecules resistant to further breakdown
  - C 50-60%
  - N 5%
  - P 0.6-1.2%
  - S 0.5%

Characteristics of Soil Organic Matter

- low bulk density
- negative charge; high CEC compared to mineral fraction
- buffering capacity
- water holding capacity
- source of N, P, S, micronutrients

Organic matter in soils

- Amount
  - range in A horizon 0.5-7.0%
  - subsoils have less: 0.25-1.75%

Soil Organic Matter Affects Numerous Soil Properties

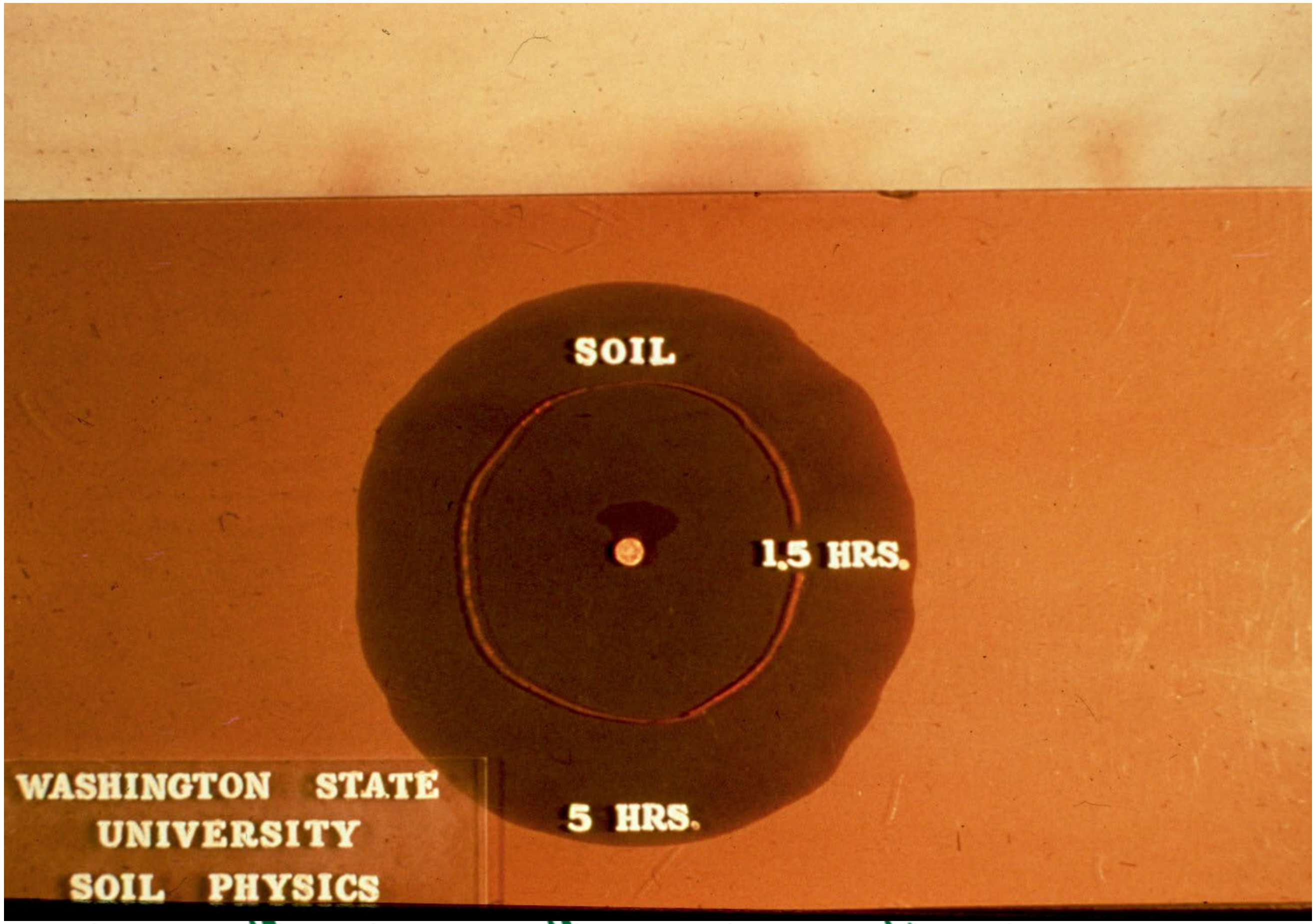
- Soil bulk density, porosity
- Soil structure stability, resilience
- Water holding capacity
- Fertility (N, P, S contents, CEC, chelates)
- pH buffer
- supports microbial biomass
- adsorbs some pesticides
- heat absorption (color)


Thinking of increasing Soil OM by adding Topsoil?
Consider Topsoil Quality?
Choose Carefully!!!

Thing 7

Water Movement: Infiltration/Percolation Rates


Heavily trafficked, fine-textured native soils have
significant drainage and turf health problems



TURFGRASS MANAGMENT

Infiltration Rate

- Soil texture, compaction and layers (like excess thatch) all affect infiltration rates.
- Gold Standard is the double ring infiltrometer but even those can be squirrelly.
- Pounding a coffee can with ends removed into soil works ok except in sand based soils.
- Best is to watch your field drain after a heavy rain and look for trouble spots. Then look for source of bad drainage/standing water.

Thing 8

Nutrient Levels

Soil Testing Nutrient Levels

- Stick with the same lab using the same procedure
- Use a lab without skin in the game
- Keep track of numbers (benchmarking).
  - Should be able to build fertility into fine textured soils. In sandy soils you may end up chasing numbers you cannot attain. Best is to watch your field drain and look for trouble spots. Then look for source of bad drainage/standing water.

MLSN Guidelines

	MLSN Guidelines		SLAN Carrow et al 2004	
	Lbs/A	Lbs/1000 ft^2	Lbs/A	Lbs/1000 ft^2
Potassium (K ppm)	74	1.7	>234	>5.4
Phosphorus (P ppm)	42	1.0	>110	>2.5
Calcium (Ca ppm)	696	16.0	>1500	>35
Magnesium (Mg ppm)	94	2.1	>242	>5.5
Sulfur (S ppm)	14	0.3	>82	>2

Soil Testing Nutrient Levels

- Stick with the same lab using the same procedure
- Use a lab without skin in the game
- Keep track of numbers. Should be able to build fertility into fine textured soils. In sandy soils you may end up chasing numbers you cannot attain. Best is to watch your field drain and look for trouble spots. Then look for source of bad drainage/standing water.

Thing 9

Surface Grade/Drainage

There Are 3 Major Rootzone Construction Methods

1. “Native soil”-Natural soil rootzones
2. Modified “soil”
3. Synthetic Rootzones (e.g. sand-based, normally “a layered system”)

- The “X” factor in the success of any of the above is DRAINAGE!!!
  - Normally a combination of both surface and subsurface drainage is a recipe for long-term success

It's Important to give water a place to go

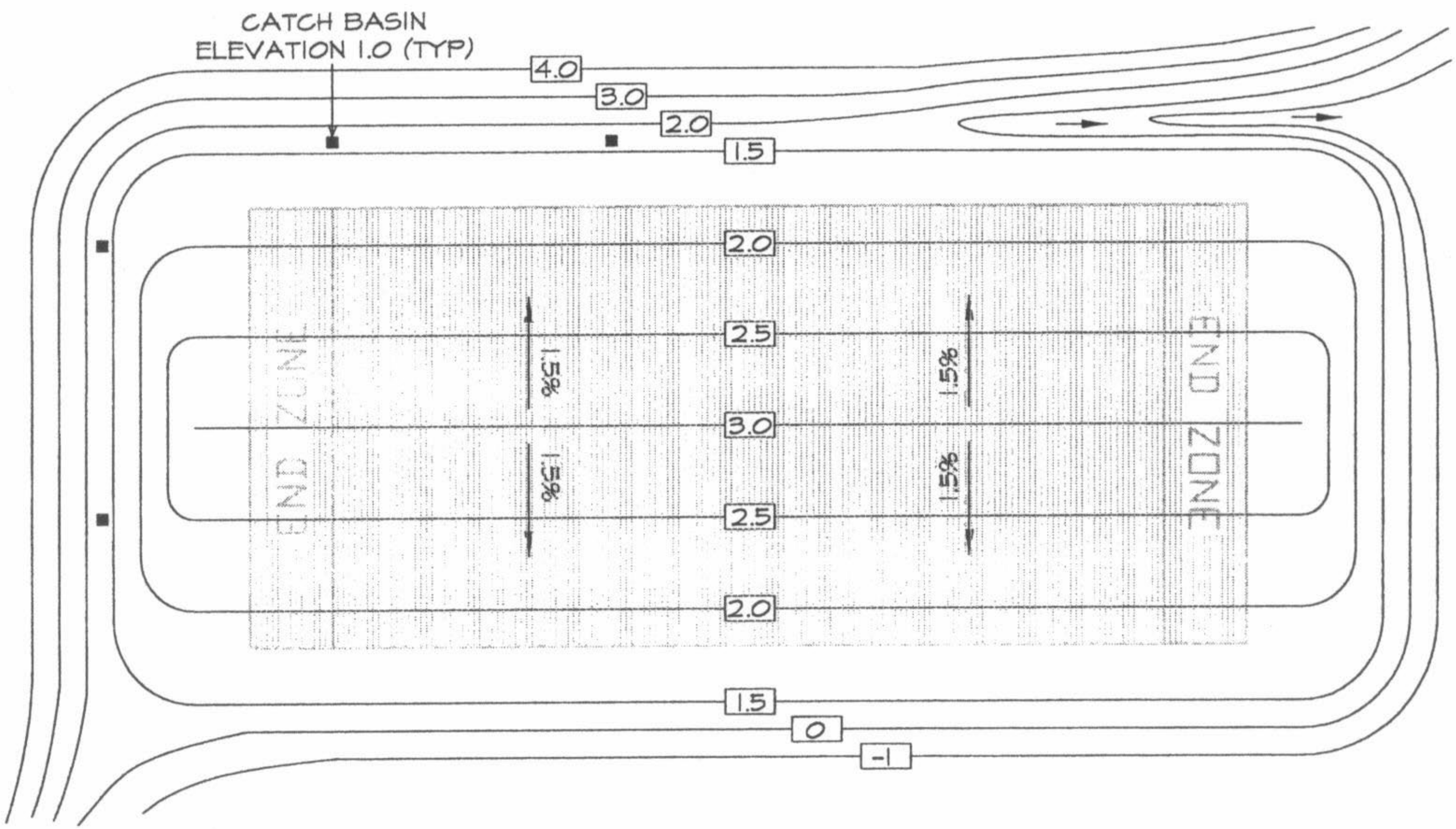


Figure 12.1. Crowned field with level sidelines—elevations noted in feet.

Crowning Solves Flat Field Drainage

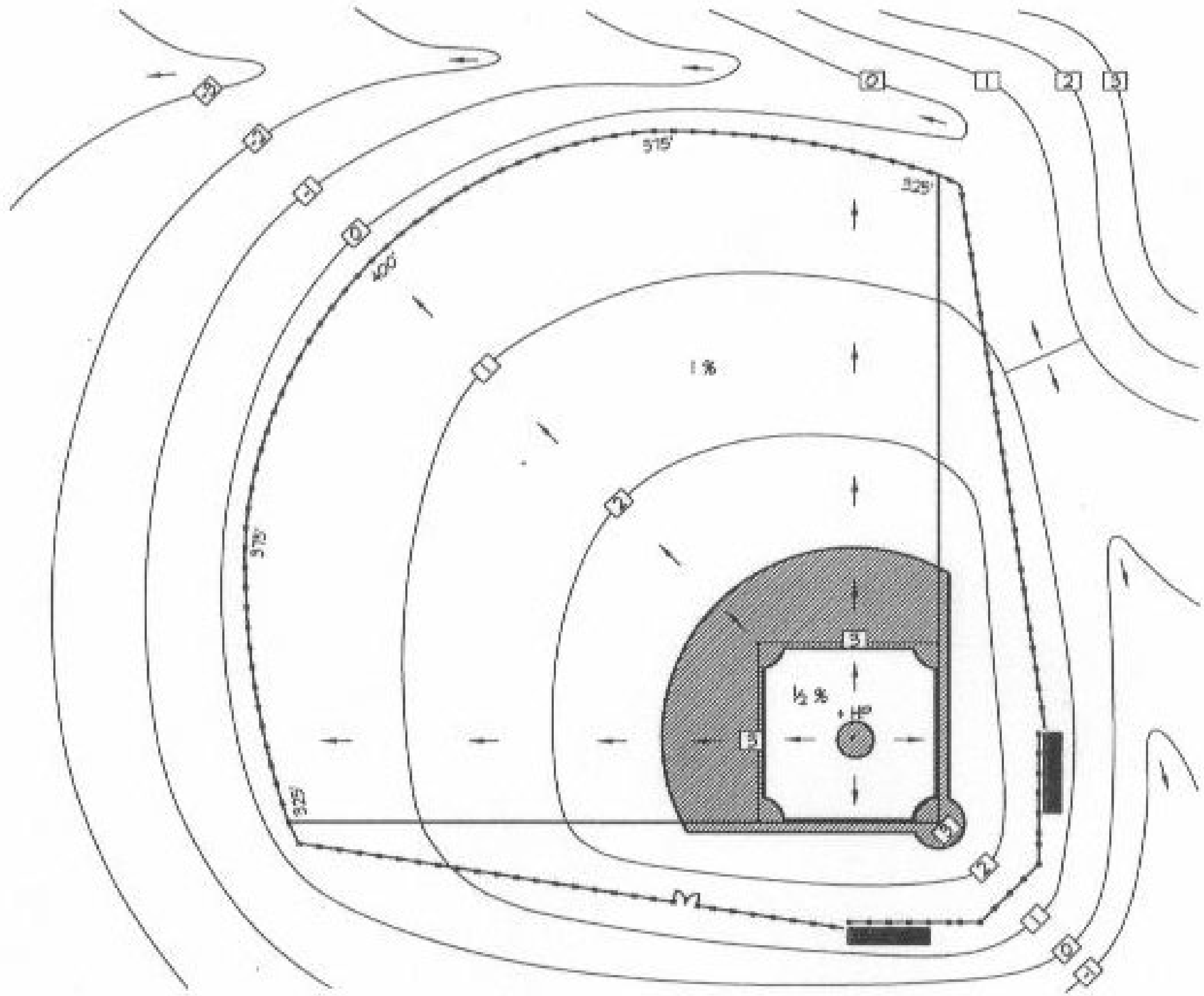


Figure 11.1. The simplest and most common (good) field design—elevations noted in feet.

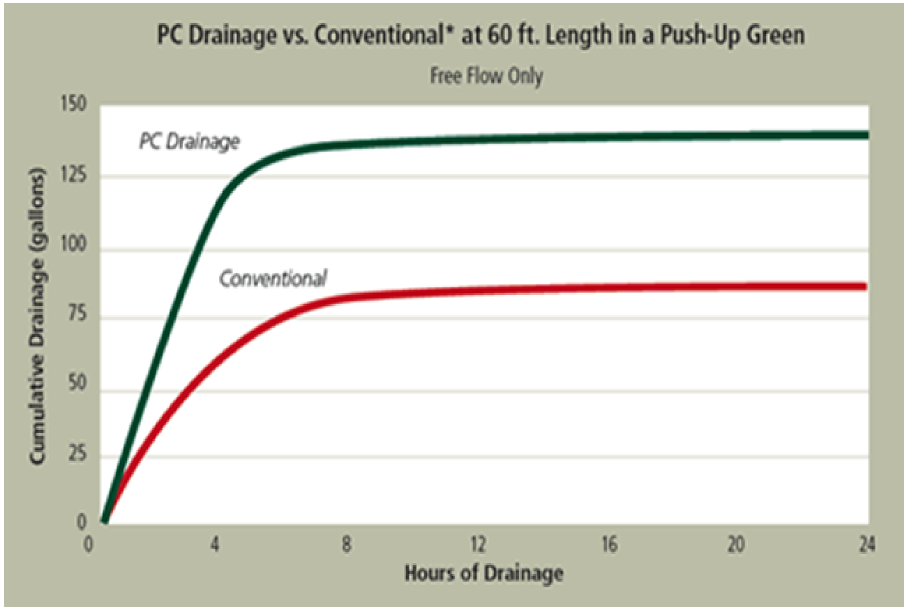
Passive Capillary Drainage

PC Drainage systems are installed selectively on 3' centers, targeted only on excess moisture areas

What superintendents say:
"We had areas with poor drainage that troubled us for years. PC Drainage solved those problems fast, and the members never missed a day of play."

Compared to traditional 2" plastic pipe systems...

- **Faster installation**
- **Extremely cost effective**
- **Site-specific solution; treat only the low areas**
- **Installed at 3' spacing for more consistent drainage**
- **Dual action: gravity and capillary**
- **Enhances existing drainage systems**
- **Contract installation or install yourself**



*"Conventional" drainage system refers to 2" perforated polymer pipe at 6' spacing

Passive Capillary Drainage Installation Process

Sand-capped fields are an economical method of sports field construction

Sand-Cap Build-Up System

The Built-Up Sand-Capped Athletic Field System

A.R. Kowalewski, J.R. Crum and J.N. Rogers, III

Michigan State University
Department of Crop and Soil Sciences

April 7, 2010

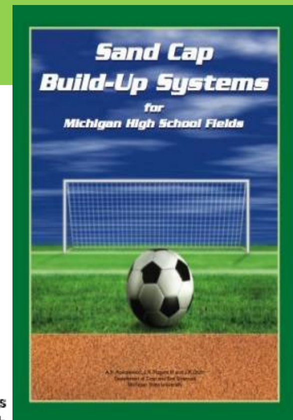
The typical high school athletic field serves as a focal point for social gatherings and adds to a sense of community pride. It is typically one of the few fields in town with lights, making it host to a variety of after school and work events including football, lacrosse, soccer, cheerleading, and band. Therefore, having an aesthetically pleasing and functional high school athletic field is often important to a variety of members in the average community.

Okemos high school soccer field, Okemos, MI, May 20, 2009, renovated using the *Built-Up Sand-Capped System* in May 2008.

The Problem

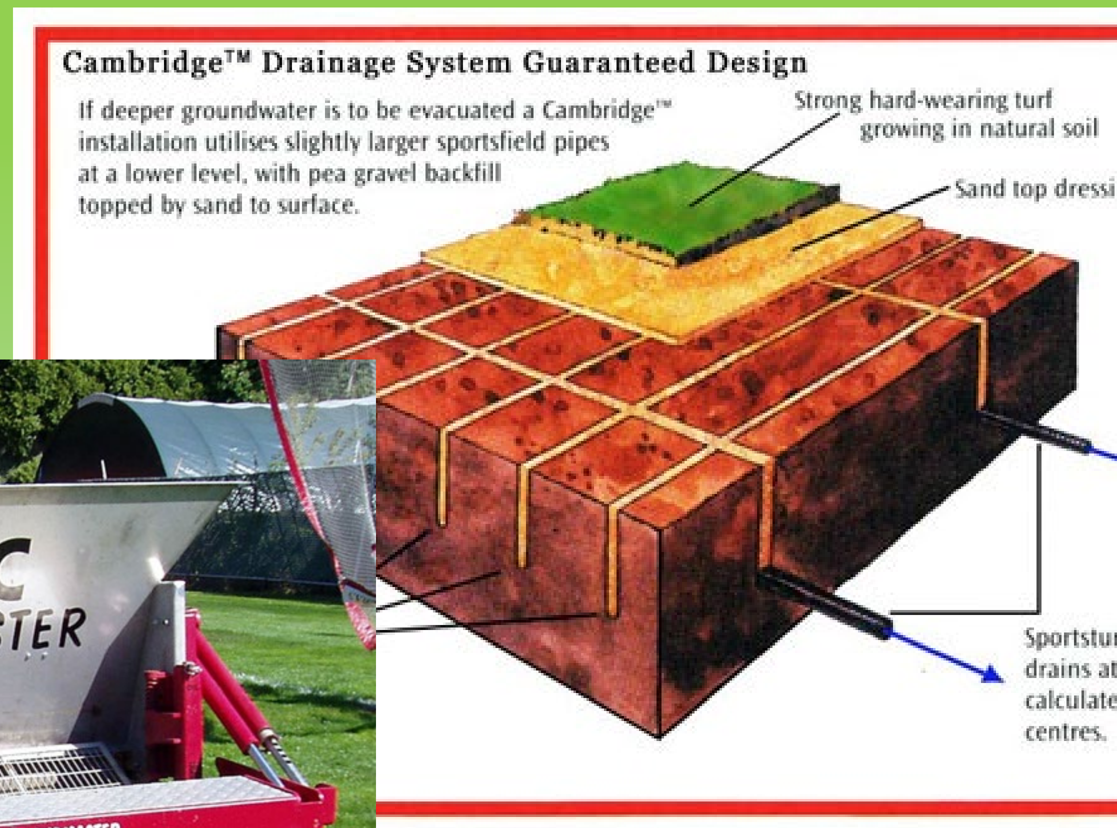
In order to have a significant number of events on a natural playing surface and provide reasonable playing conditions throughout the fall, regardless of weather conditions, the root-zone must be primarily sand-based. Unfortunately, the majority of high school athletic fields are constructed on native soil. These fields rely on surface drainage during periods of heavy rainfall, failing to provide adequate drainage of surplus water. Saturated field conditions substantially reduce soil cohesion if the native soil is high in silt and clay, adversely affecting traction and stability. Reduced stability in combination with heavy use in the typical fall athletic season results in turfgrass failure, decreased overall playability and diminished visual aesthetics.

1

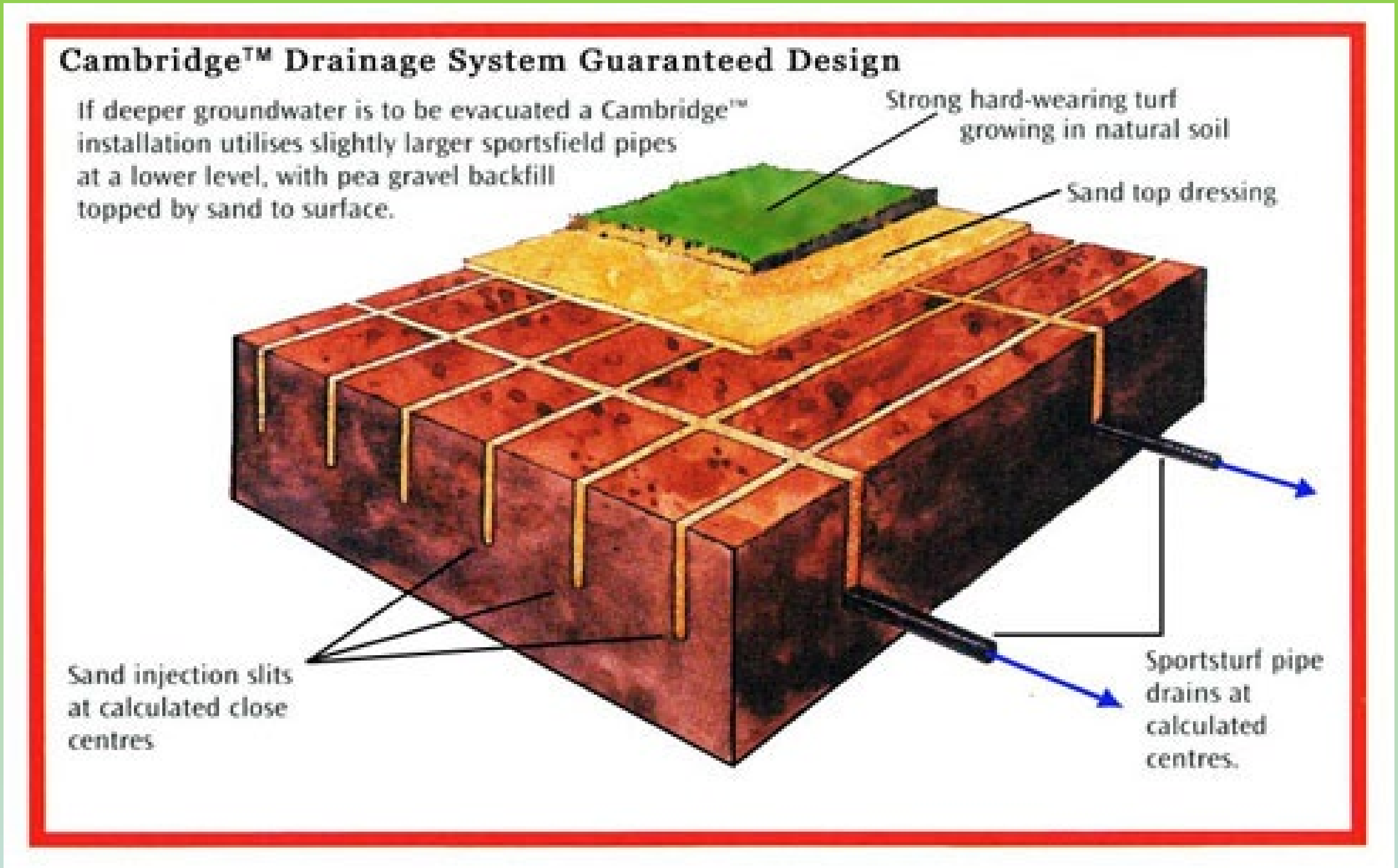


See this hand-out/reading

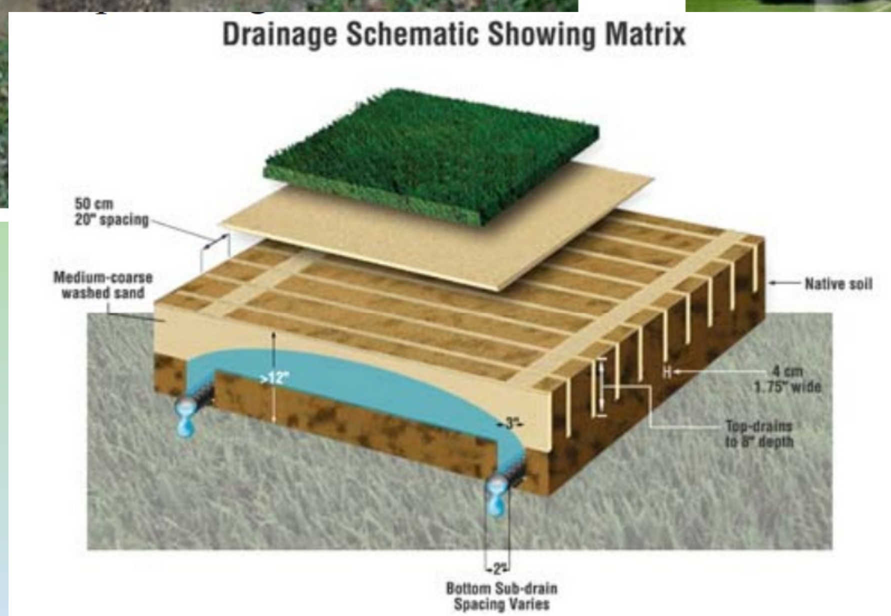
Sand-Slit/Sand ByPass Systems



Sand - Slit – Drainage Systems



QwikDrain Systems



Sand-Slit Athletic Fields

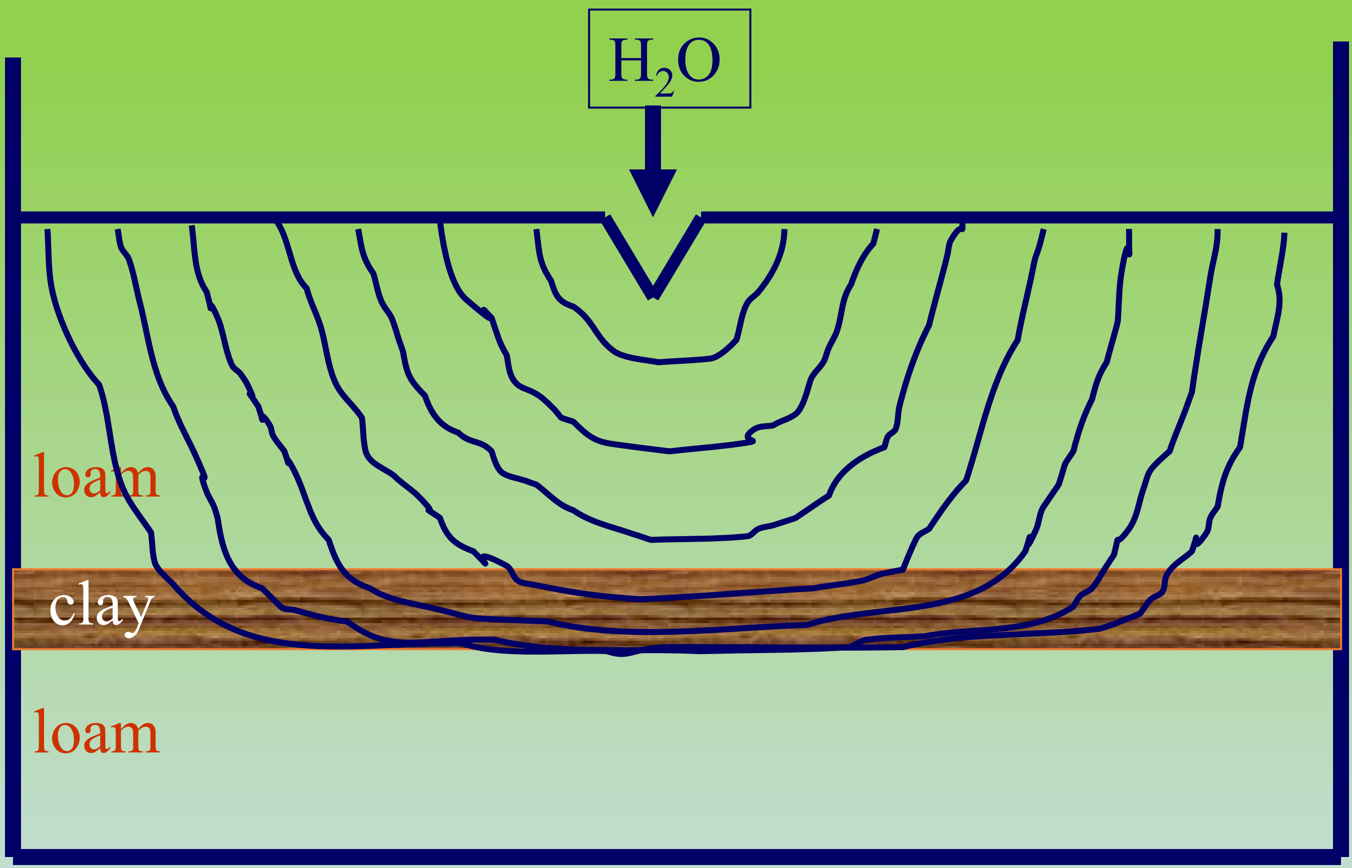


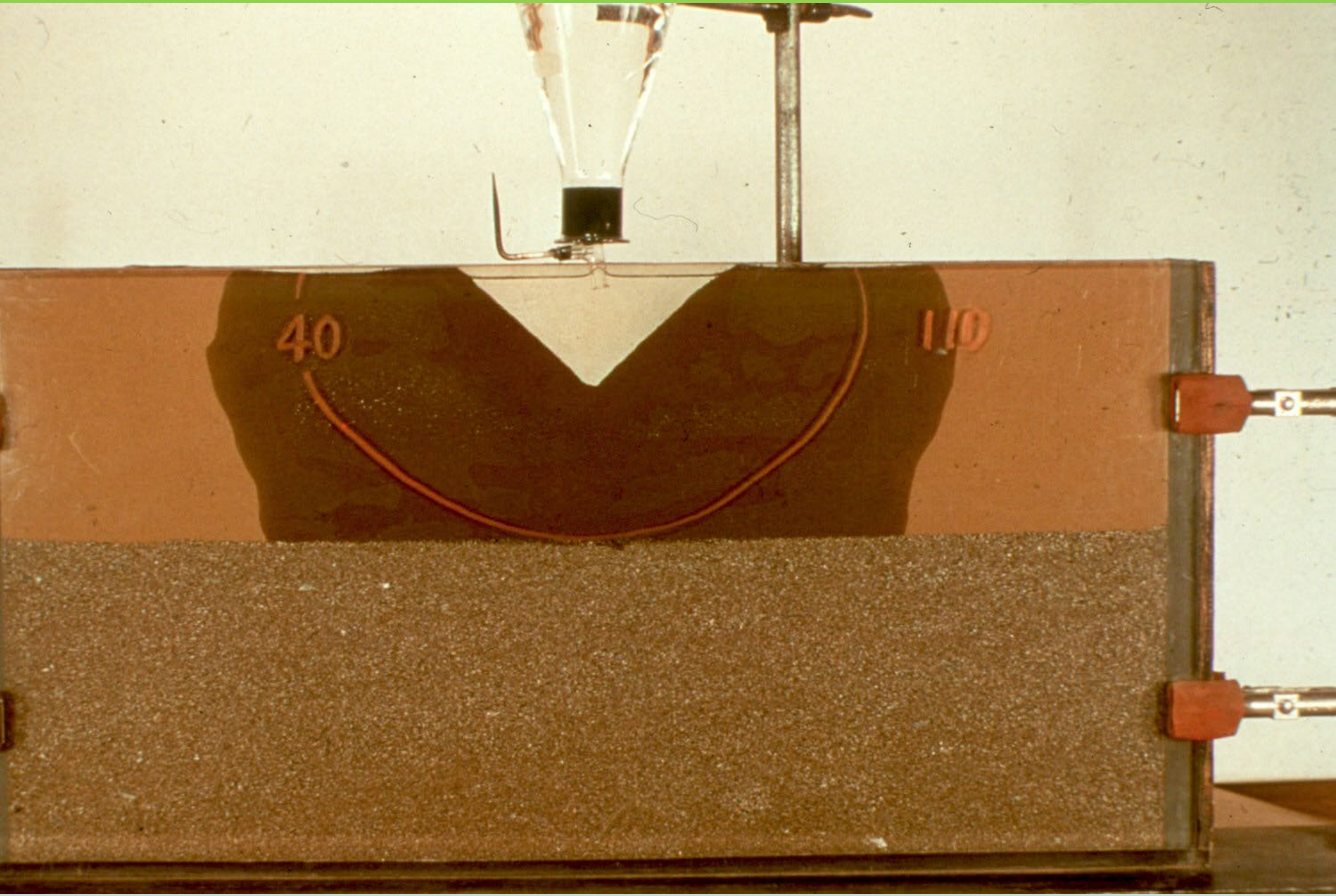
Thing 10

Layers?
What does my soil profile look like?

Layers are nice in cakes but not in high value rootzones

Movement of Water in Layered Soils:
Appearance of Wetting Fronts Over Time

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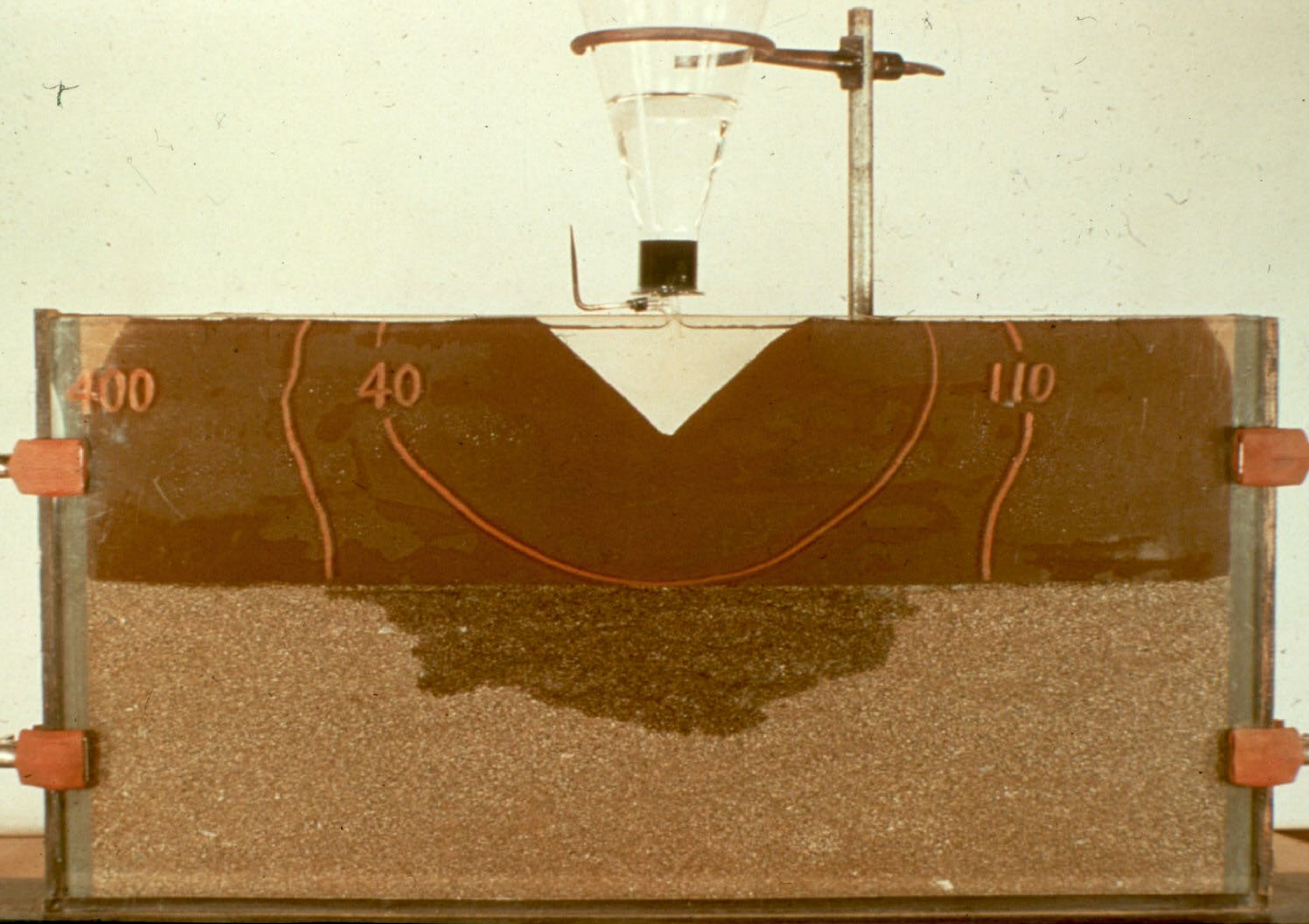
110



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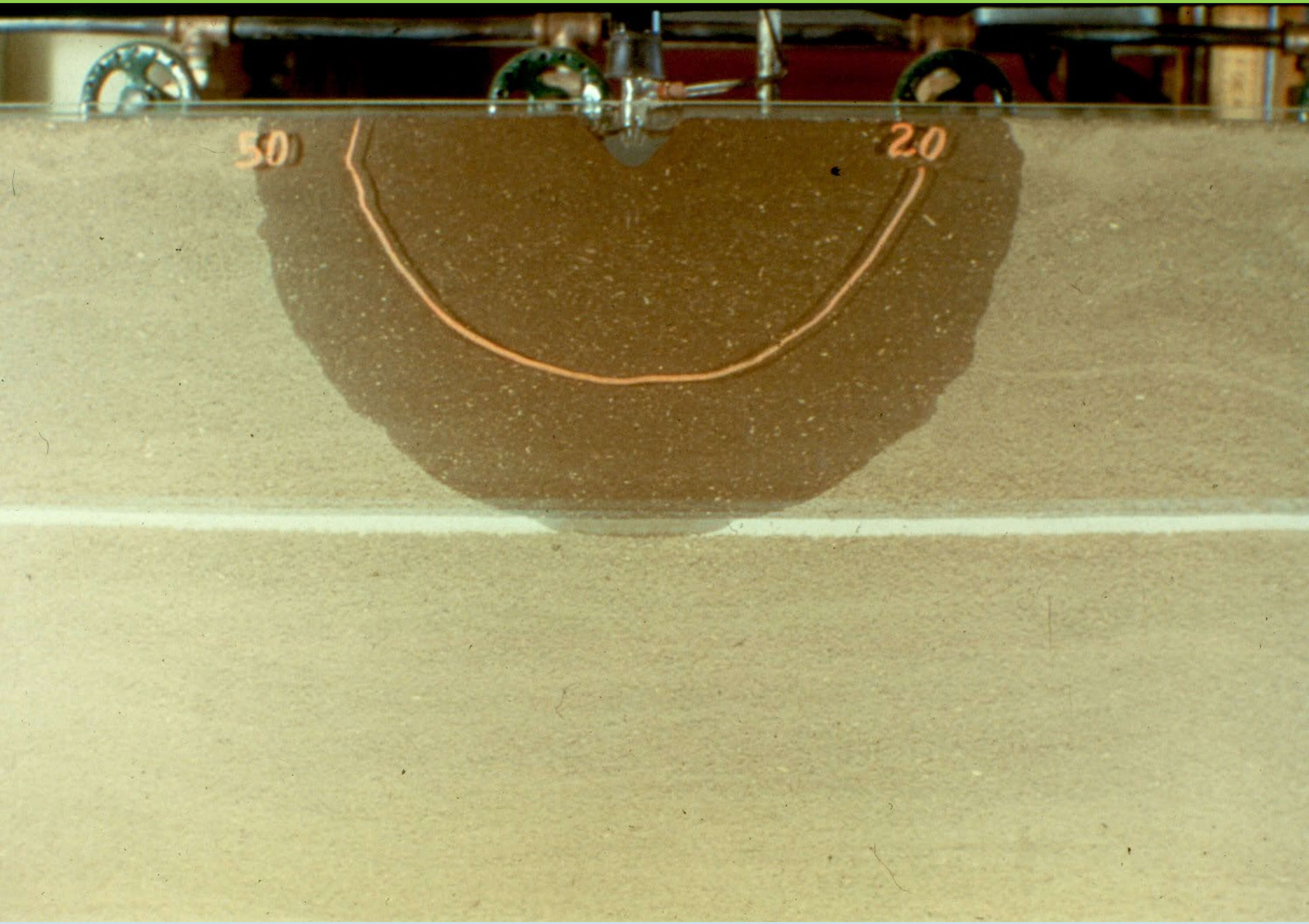
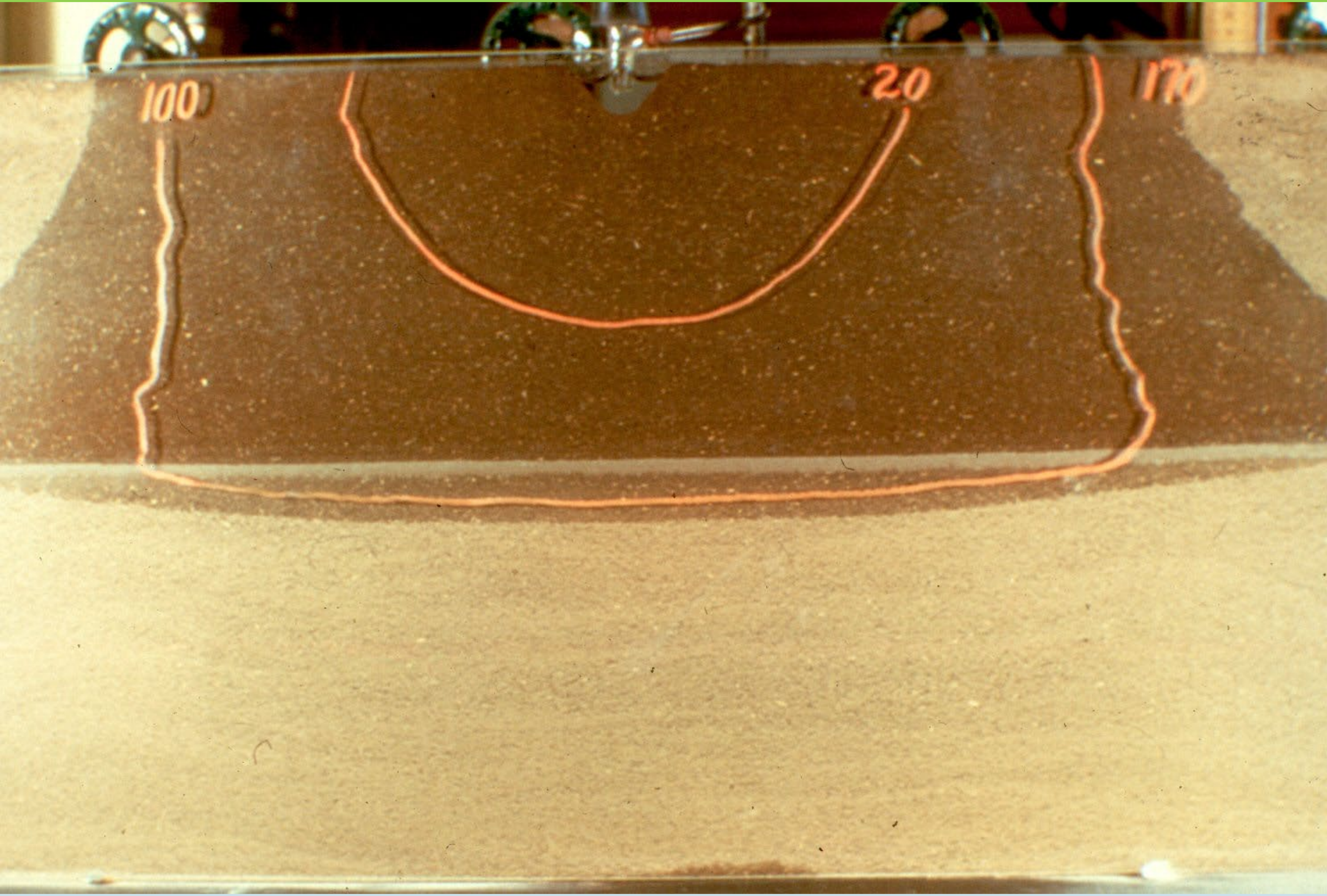

50
20


100
20
170

How do you overcome layering?

- Deep tine aerification.
- Other aerification that goes deep.
- If you are doing things correctly your drainage should improve.

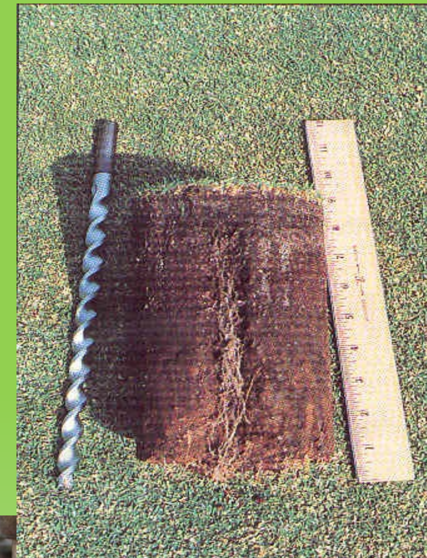
Alternative Cultivation Procedures

- Solid-tine/deep tine equipment
- Drill and Fill (Floyd McKay)
- Hydroject
- Dry-Ject
- Dethatching – Grooving
  - Graden Equipment

Cultivation Equipment
Solid Tine

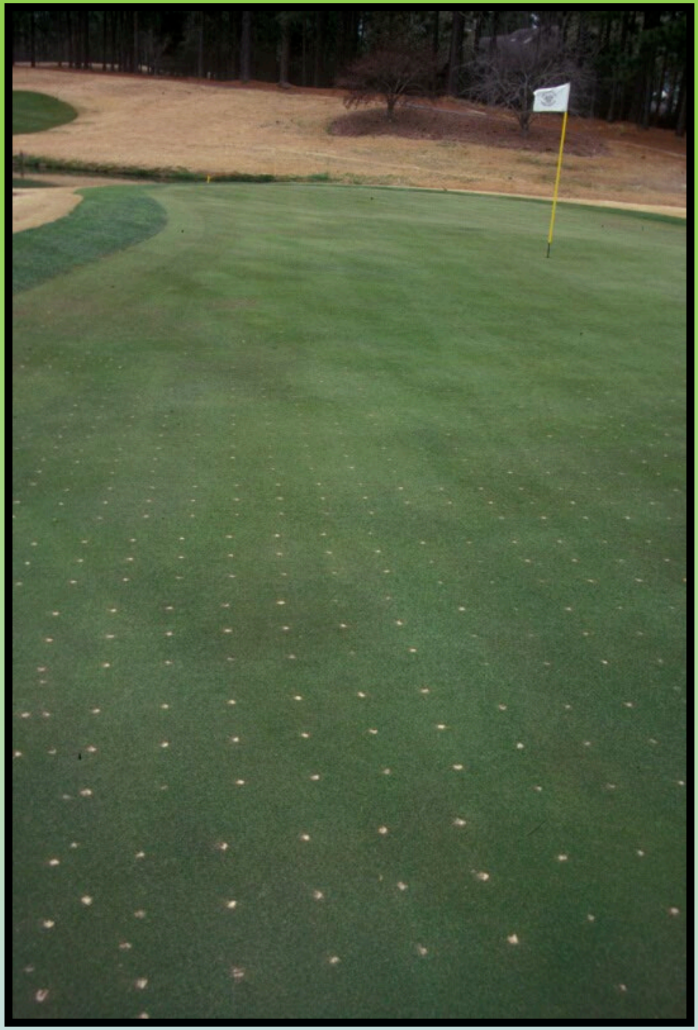
Deep Tine Cultivation in Autumn to Alleviate Compaction and Encourage Rooting

Drill and Fill



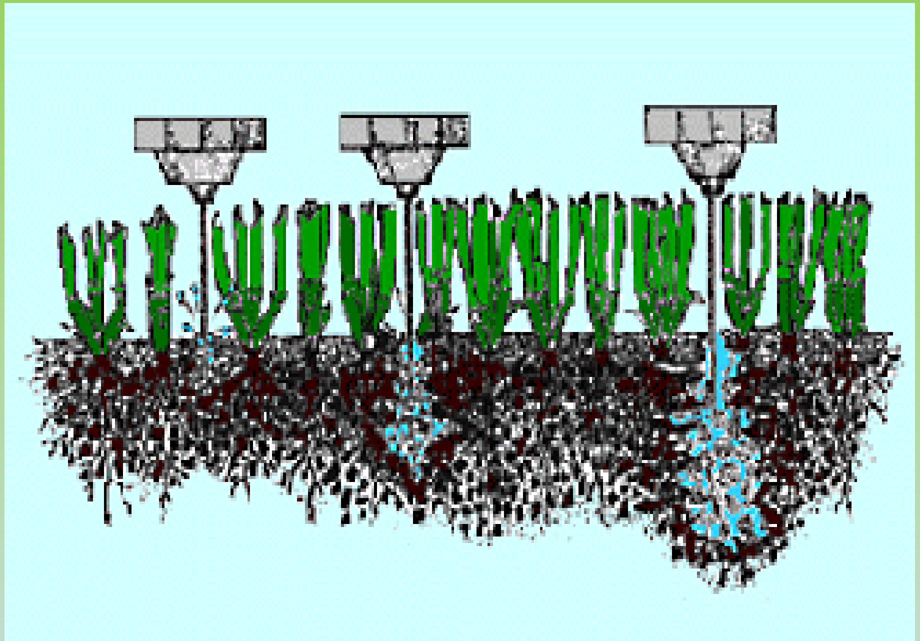
Drill and Fill

Drill and Fill



Large Channels = Large Impact on Soil Properties

Cultivation Equipment
Water Injection



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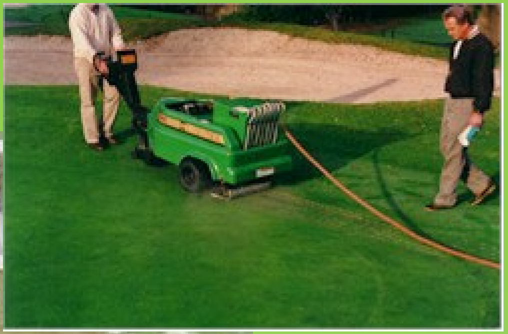
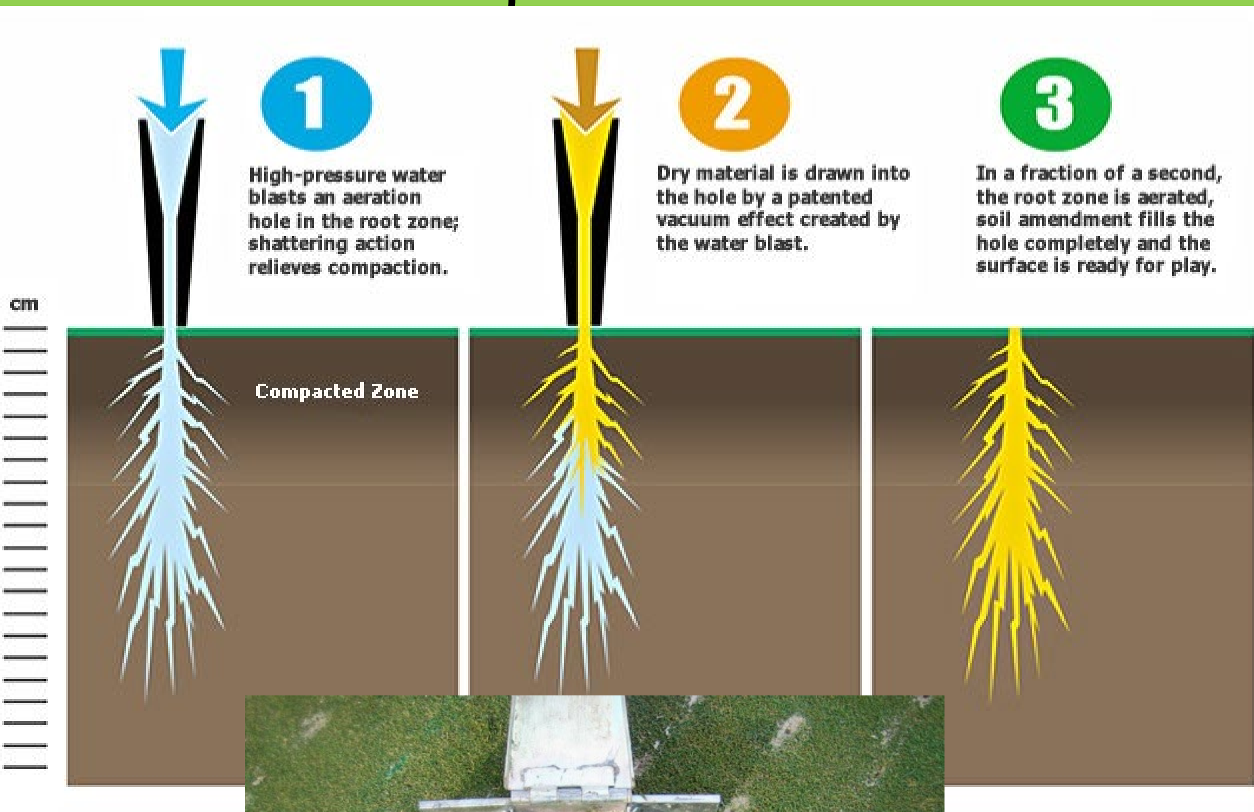


Sand Injection-Use and Utility?



Sand injection hole vs. traditional hole

www.super.friendlyhills.com

Air Injection Tools

Newest Equipment Technology
Soil Air-Injection Cultivation

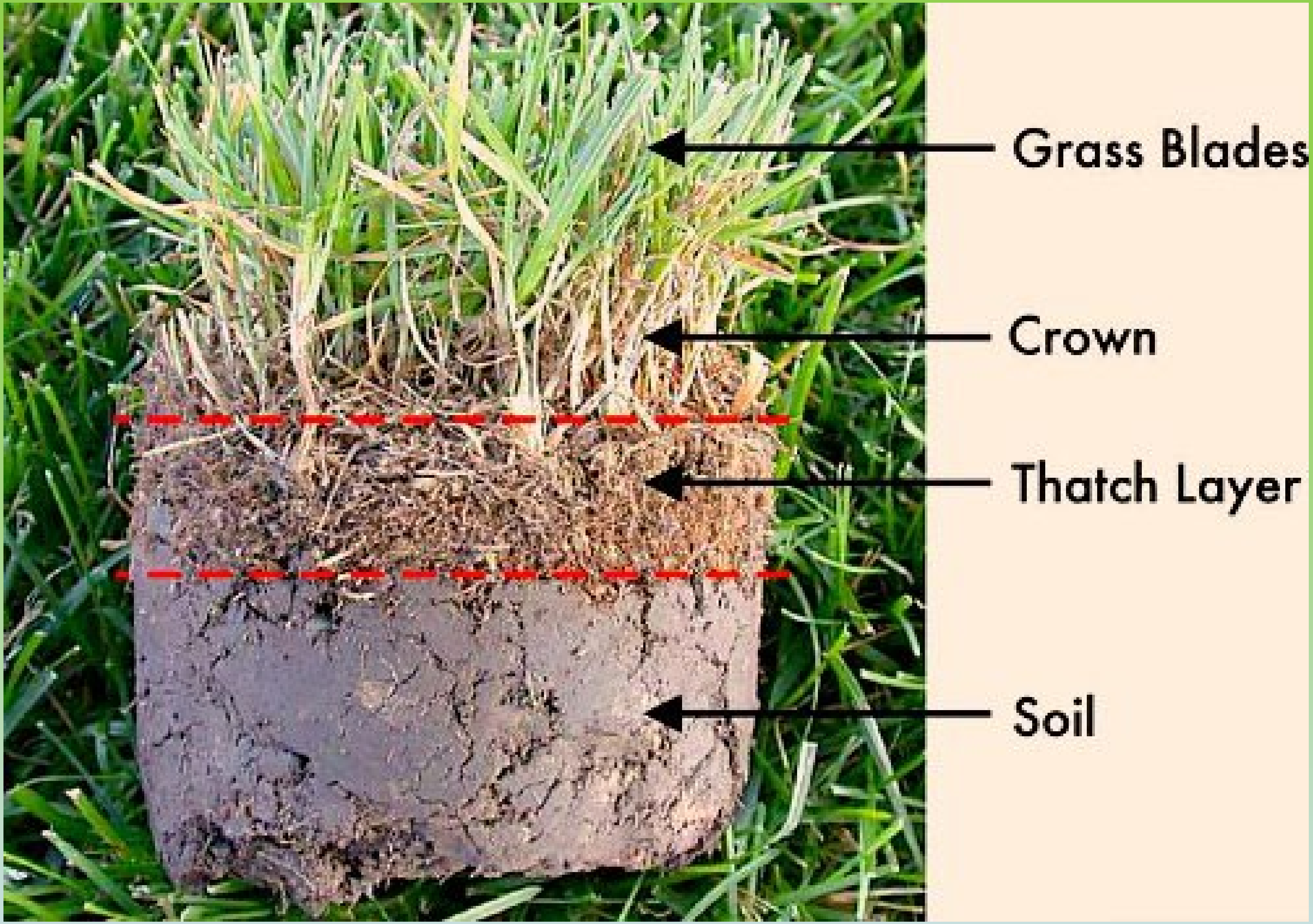
Advantages-Disadvantages to Water/Air-Injection and Dry-Ject Devices?

- Very little surface disruption
- Compaction relief
  - Surface and deep into soil
- Dry-Ject = Ability to infuse the soil/rootzone with sand = OM dilution?

- Is there a downside?
  - Cost? Time/labor costs?

Thing 10 b

Thatch Layer Thickness


Grass Blades
Crown
Thatch Layer
Soil

Athletic Field Rootzone Management

Image: Ken Siems

Thing 11

CEC Cation Exchange Capacity

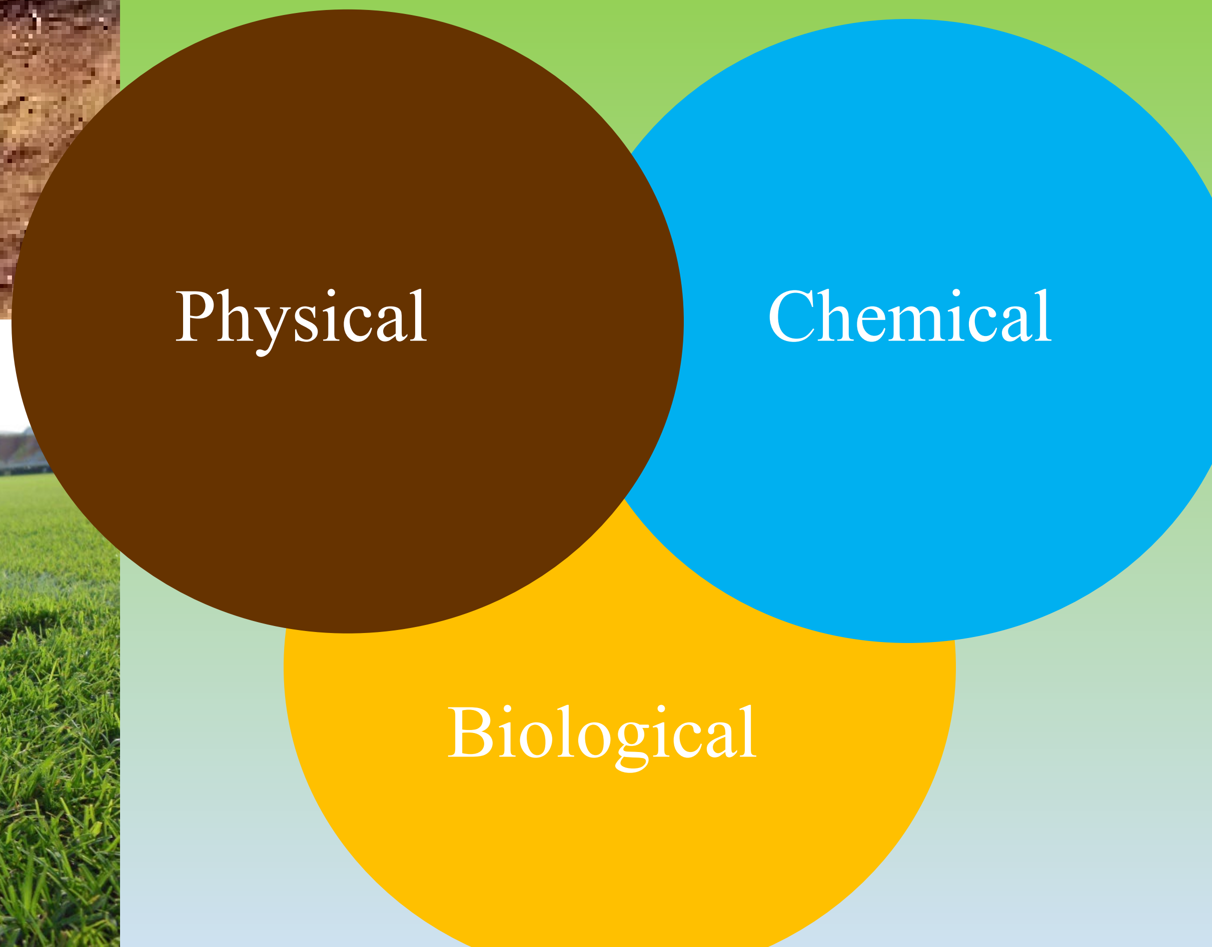
CEC Cation Exchange Capacity

- The higher the CEC the more ability of the rootzone to hold and supply essential mineral nutrients

- Often calculated by sum of cations from soil test.
- Dedicated CEC test using a double wash method would be more accurate – especially for sandy soils.
- Best way to manage would be to add organic matter such as compost or peat. These will increase CEC. I've never heard of someone trying to decrease CEC.

Sand size and mineralogy affect long term performance

Regardless of the Soil System-Quality Management Requires a "Systems Approach"



Thank YOU !!!

Soils 201: Athletic Field Soils and How to Manage Them

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Horticulture and Landscape Architecture Department
Purdue University

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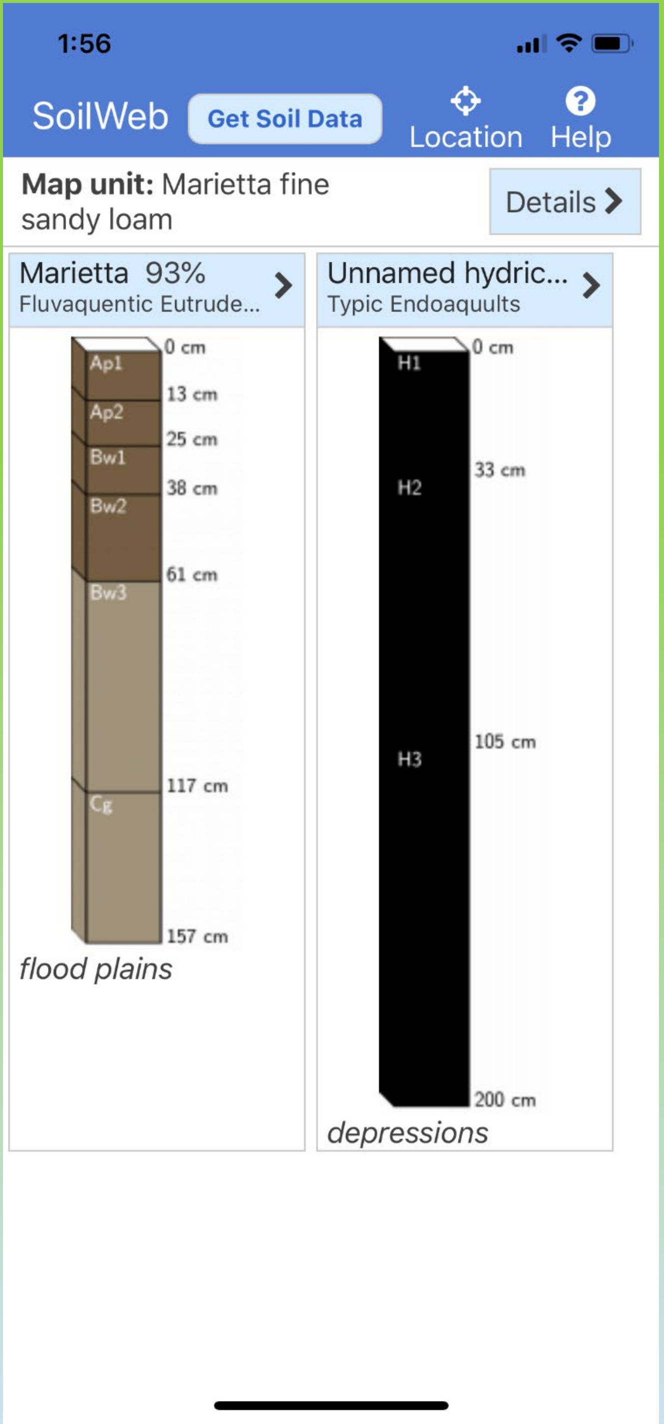
@BIGTurfKnowHow

Barry 2020 slides not used

A place to start Soil Web App


1:56
SoilWeb
Get Soil Data
Location
Help
Map unit: Marietta fine sandy loam
Details
Marietta 93%
Fluvaquentic Eutrude...
0 cm
Ap1
13 cm
Ap2
25 cm
Bw1
38 cm
Bw2
61 cm
Bw3
117 cm
Cg
157 cm
flood plains
Unnamed hydric...
Typic Endoaquults
0 cm
H1
33 cm
H2
105 cm
H3
200 cm
depressions

2:00

Back Marietta

LOCATION MARIETTA MS+AL AR TX

Established Series
Rev. JSH:WMK:RBH
03/2000

MARIETTA SERIES

The Marietta series consists of deep, moderately well drained soils on wide floodplains. Permeability is moderate. These are nearly level soils that formed in loamy alluvium along streams that drain areas of the Blackland Prairie and Southern Coastal Plain Major Land Resource Areas. Slopes range from 0 to 2 percent.

TAXONOMIC CLASS: Fine-loamy, siliceous, active, thermic Fluvaquentic Eutrudepts

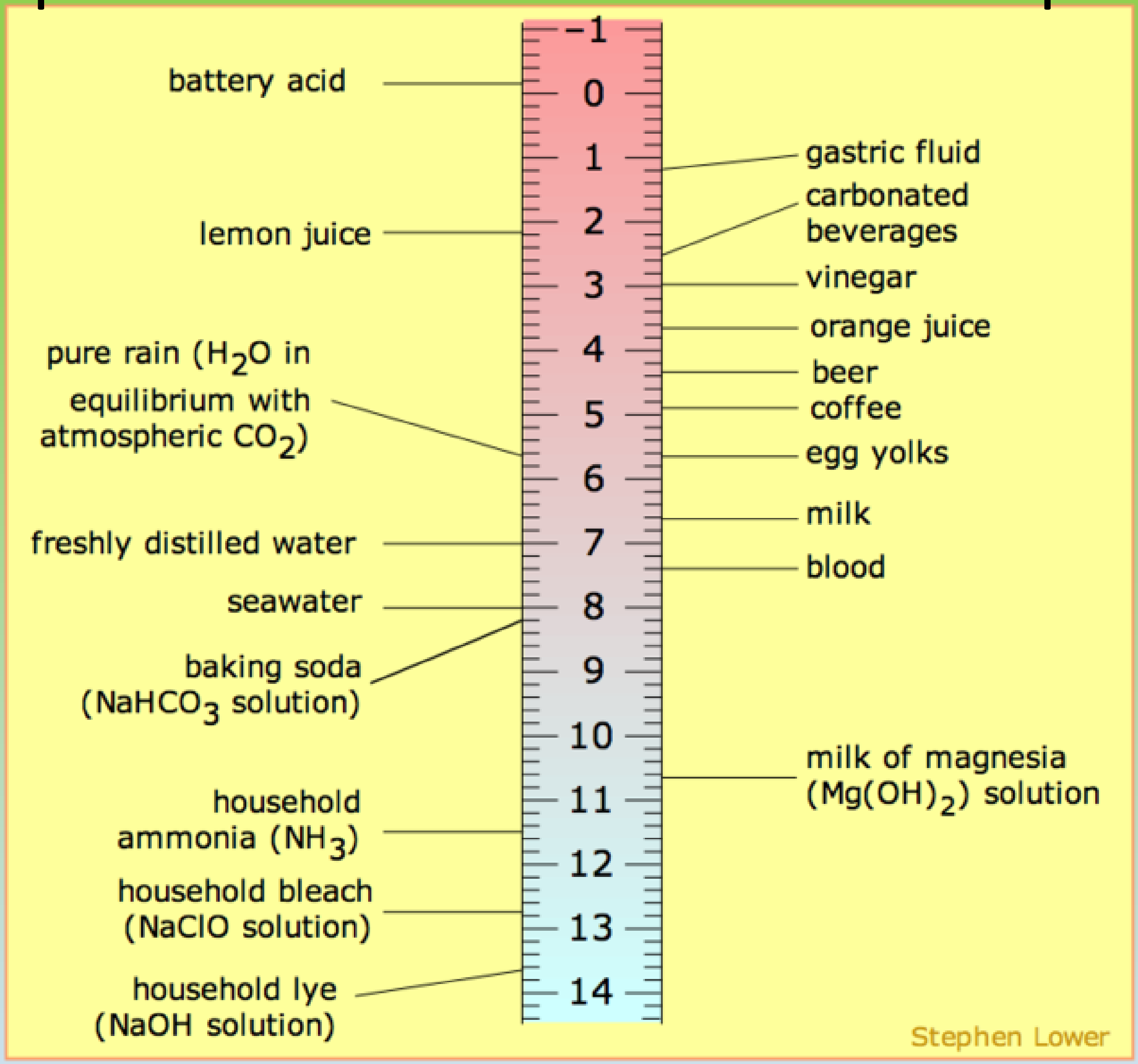
TYPICAL PEDON: Marietta loam - cultivated. (Colors are for moist soil unless otherwise stated.)

Ap1--0 to 5 inches; brown (10YR 4/3) loam; weak fine granular structure; very friable; many fine and medium roots; neutral; clear smooth boundary.

Ap2--5 to 10 inches; brown (10YR 4/3) silt loam; weak fine granular structure; friable; common fine roots; few gray and red root stains; neutral; abrupt smooth boundary. (Combined thickness of the A horizon is 4 to 16 inches thick)

DESCRIPTION DETAILS LINKS

The pH of some relatable liquids



Vital Soil Functions

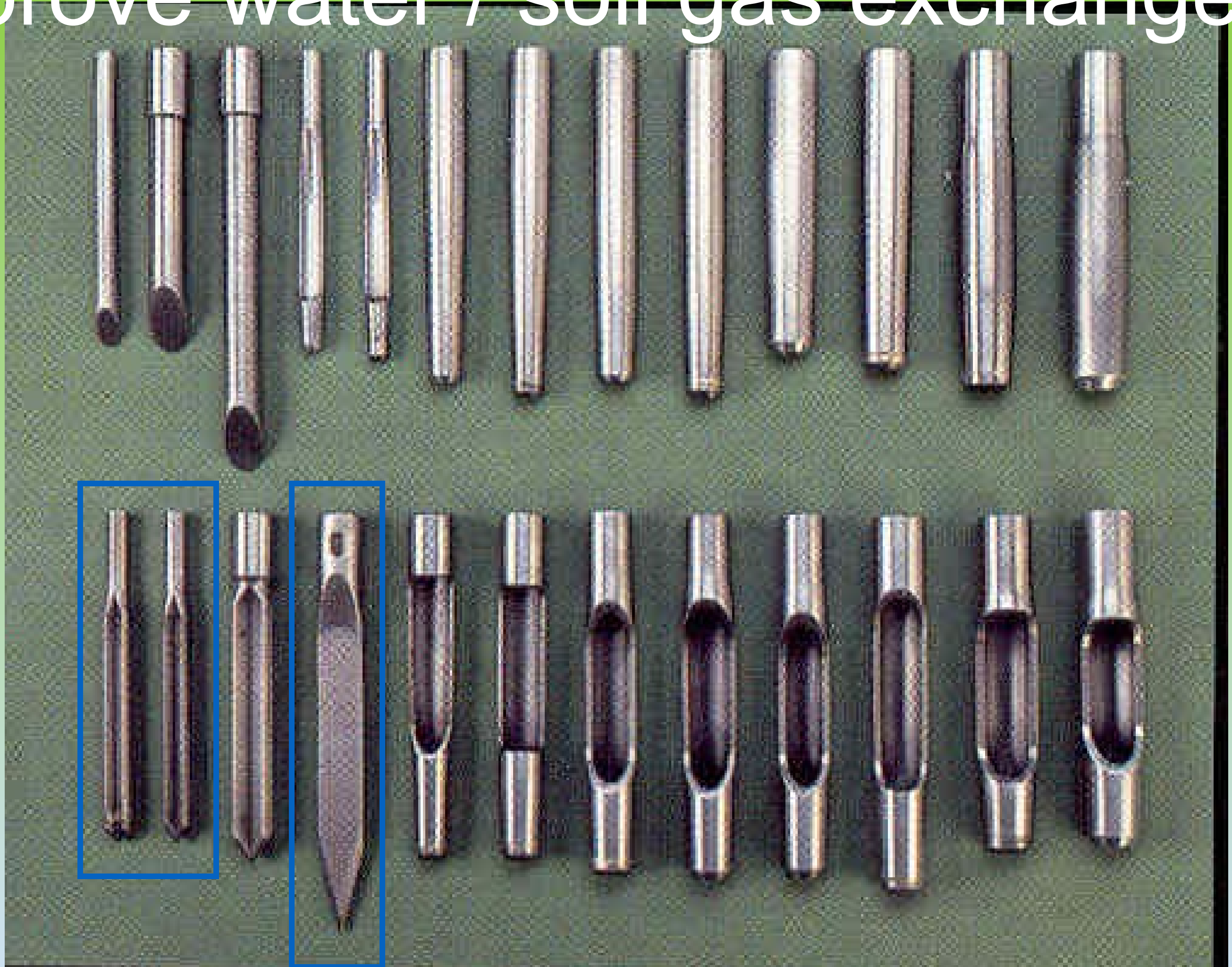
- Sustaining biological activity, diversity, and productivity
- Regulating and partitioning water and solute flow
- Altering, buffering, degrading, immobilizing, and detoxifying organic and inorganic materials including agricultural, industrial and municipal by-products and atmospheric deposition
- Storing and cycling nutrients and other elements with the Earth's biosphere
- Providing support of socioeconomic structures and protection of archeologic treasures associated with human habitation. *Karlen et al. 1997*

Cultivation Benefits

Solid Tines Work Well on Thin Greens During Summer

Venting Tines/Star Tines

Primary use = compaction relief and improve water / soil gas exchange



Cultivation Tines

Image: from ND Warren Golf Course maint. Dept.

Problematic Rootzones

What is limiting turf performance/health?

Vertical Mowing/ Dethatching/ or Grooving = very effective OM removal

Graden Response

Grooving (Graden) = Corduroy Stripes = Draws golfer complaints about surface smoothness issues