Soil Quality Assessment: Dig, Look, Feel, and Test

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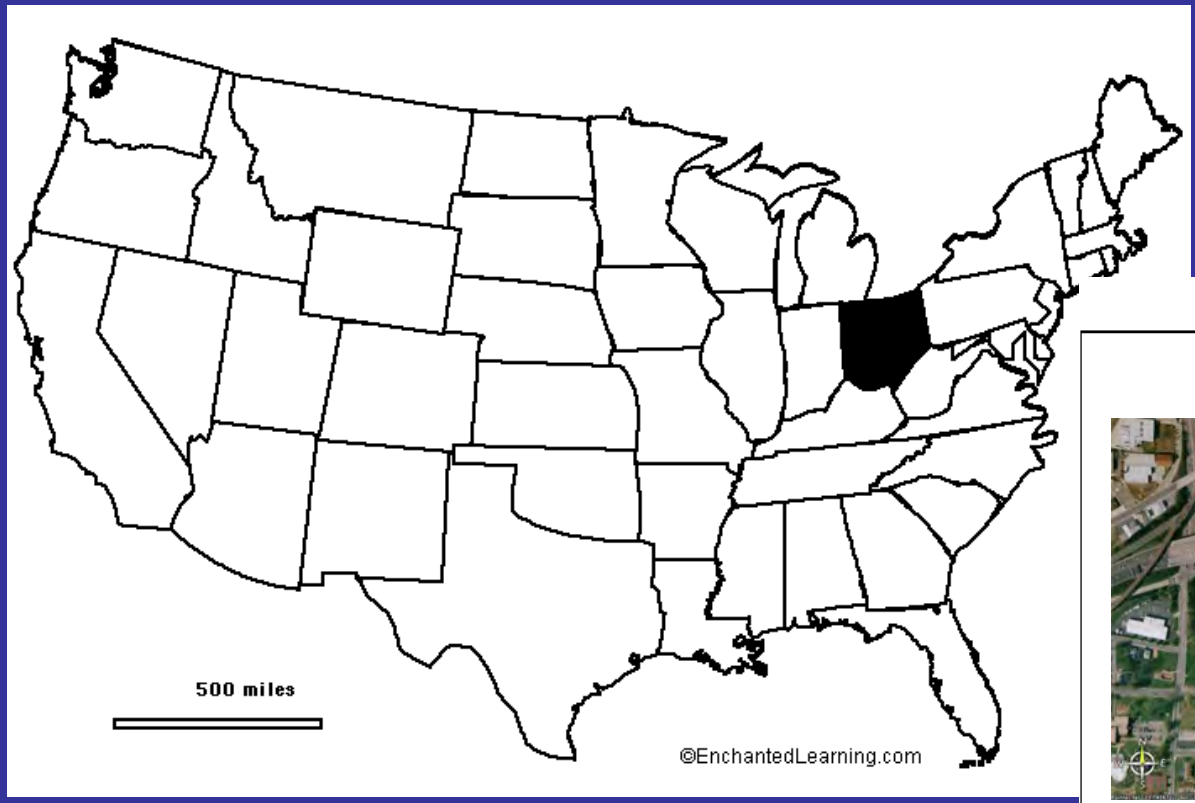
RUTGERS

New Jersey Agricultural Experiment Station

Paved Surface Deprives People of Soil Contact



116,534 sq. km impervious surface area within USA, equivalent in area to Ohio


“The earth lay rich and dark and fell apart lightly under the points of their toes” -P.S. Buck, The Good Earth

Historical References to Digging in Soils as a Restorative

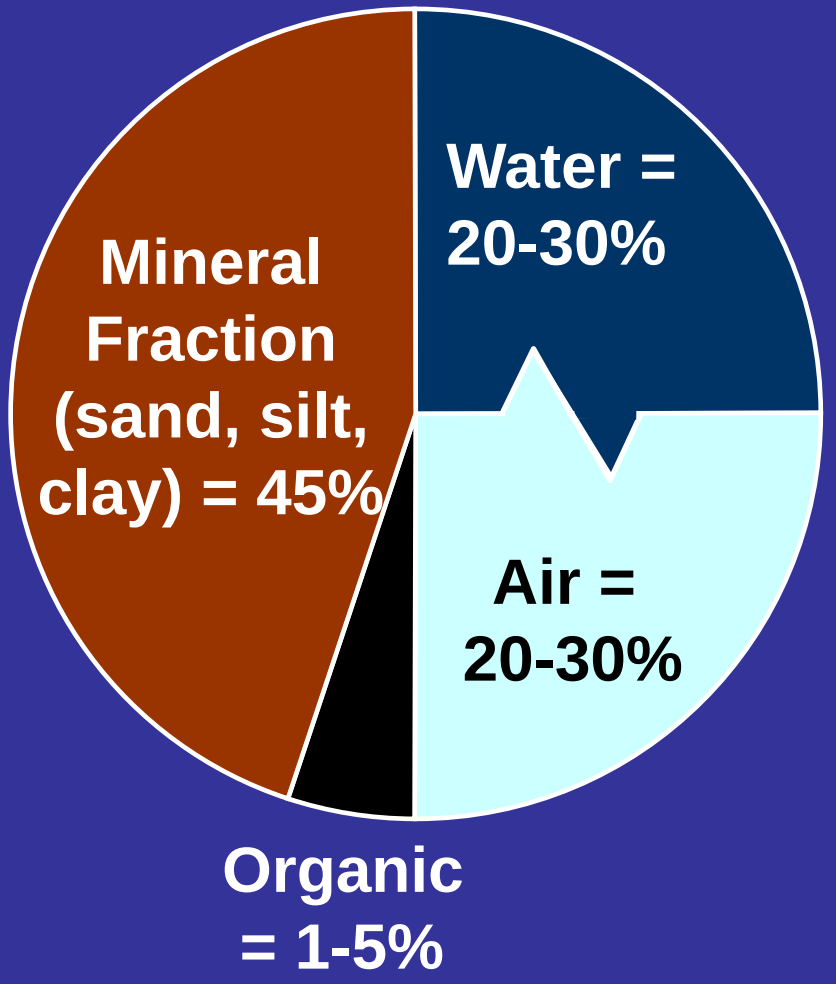
- 1699, the *English Gardener* advised “spare time in the garden, either digging, setting out, or weeding: there is no better way to improve your health.”
- 1700’s Dr. Benjamin Rush declared “digging in the soil has a curative effect on the mentally ill”
- 1870 Frederick Law Olmsted believed that nature reproduced in urban settings brings “tranquility and rest to the mind”
- 1940’s Carl Menninger led a horticulture therapy movement in Veterans Admin Hospital
- 1955 MSU awards grad degree in horticultural/occupational therapy
- 1971 KSU establishes horticultural therapy degree curriculum
-

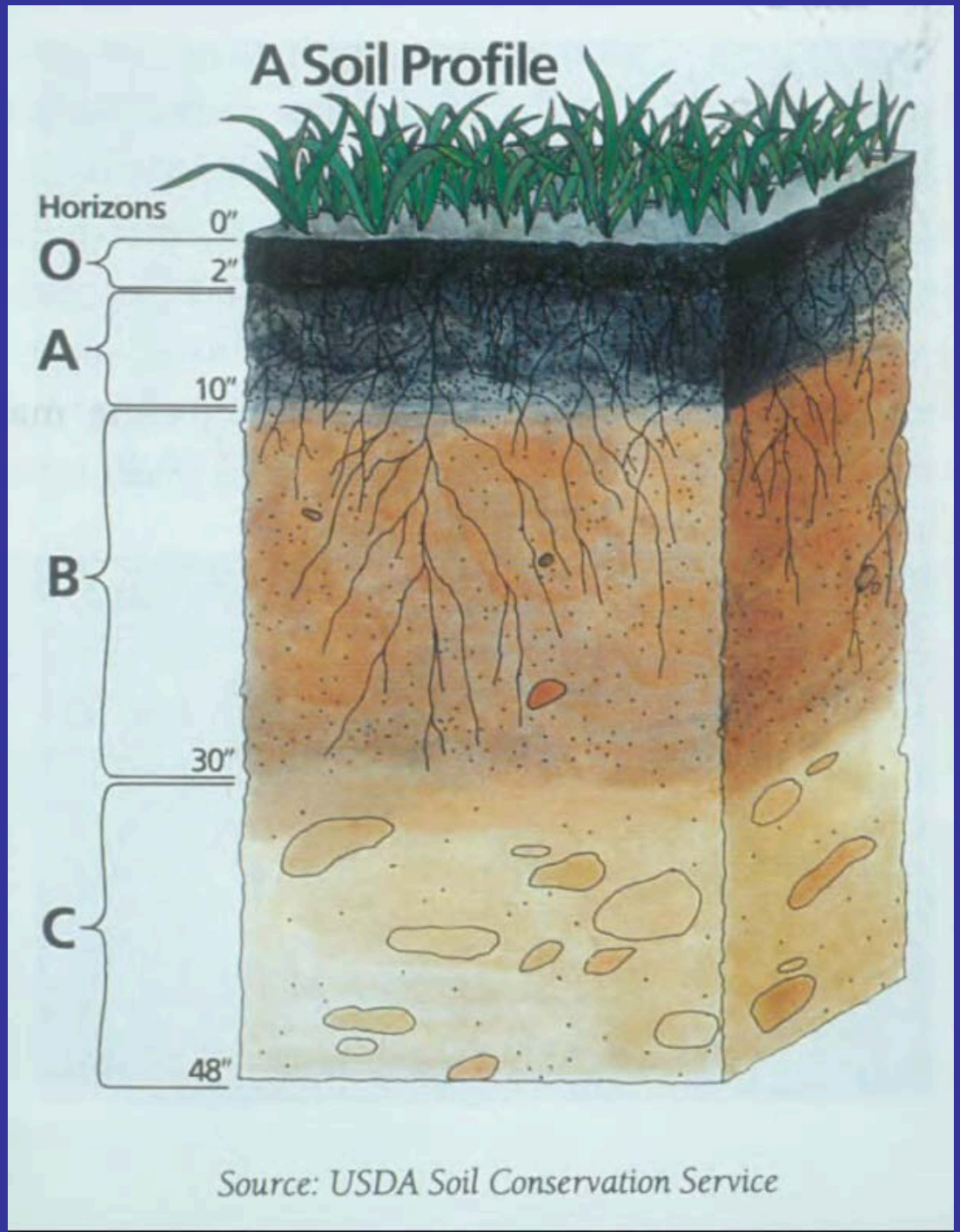
Contact with Soils

- A feeling for the organism
- Perception is multi-sensory
  - vision, smell, taste, touch, hearing

Composition of Soils

- Minerals
- Air
- Water
- Organic matter (humus)





Source: USDA Soil Conservation Service

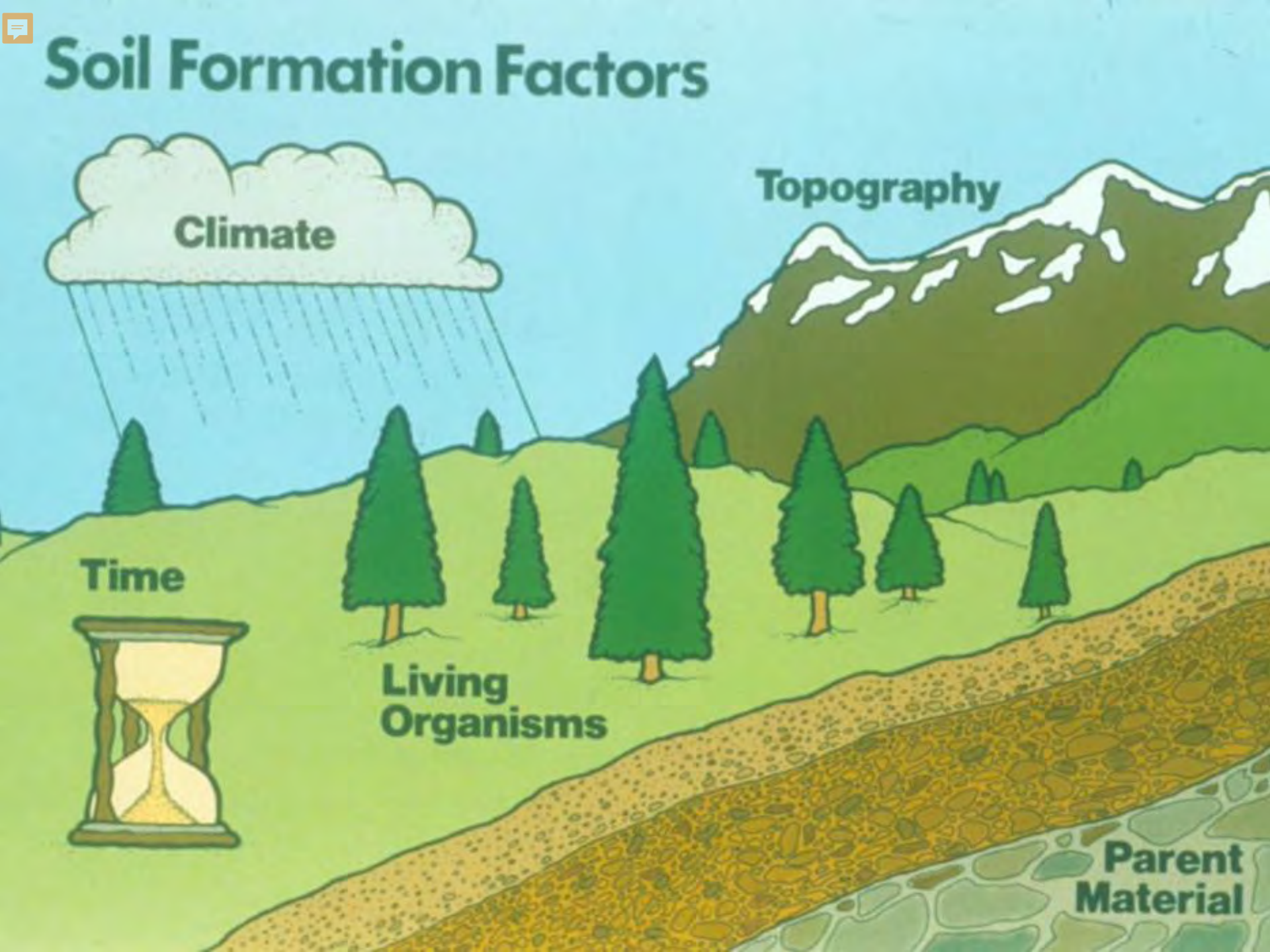
Compare Horizons

Shallow Bedrock

Reading the Landscape

USDA-NRCS Web Soil Survey

Soil Formation Factors



ULTISOLS

Ultisols - Soils that are in humid areas and have a clay-enriched subsoil that is low in nutrients. These soils are dominantly in the southeastern United States. With soil amendments they are productive for row crops.

Downer
State Soil of New Jersey

Landscape Beauty is a Living Expression of Soil Quality

Junk in Soils

Raised Beds

Raised Beds

Ag – Choice, Newton, NJ

Temperature/Oxygen Probe

Windrow Turning

Digging – Signs of Life- Soil Food Web

Soil PED Talks on Web

- Soil Health Diagnosed as You've Never Heard Before by Shannon Cappellazzi
- Focusing on Soil Health from Ground Up by Alex Flock
- Partnering to enhance soil Health by Barry Fisher
- You are Changing the World! by Jane Hardisty

Look and Feel Method – Soil Texture

The Mineral Material: sand, silt, and clay

Sand
.05 to 2mm
feels gritty

Silt
.002 to .05mm
feels smooth

Clay
less than .002mm
feels sticky

Determining Soil Texture by Feel

START

Does the soil form a ball? no → sand

yes

Does the soil form a ribbon? no → loamy sand

yes

How long is the ribbon?

(I) less than 2.5 cm long
- smooth and slippery → silt loam
- gritty → sandy loam
- neither smooth or gritty → loam

(II) 2.5 to 5 cm long
- smooth and slippery → silty clay loam
- gritty → sandy clay loam
- neither smooth or gritty → clay loam

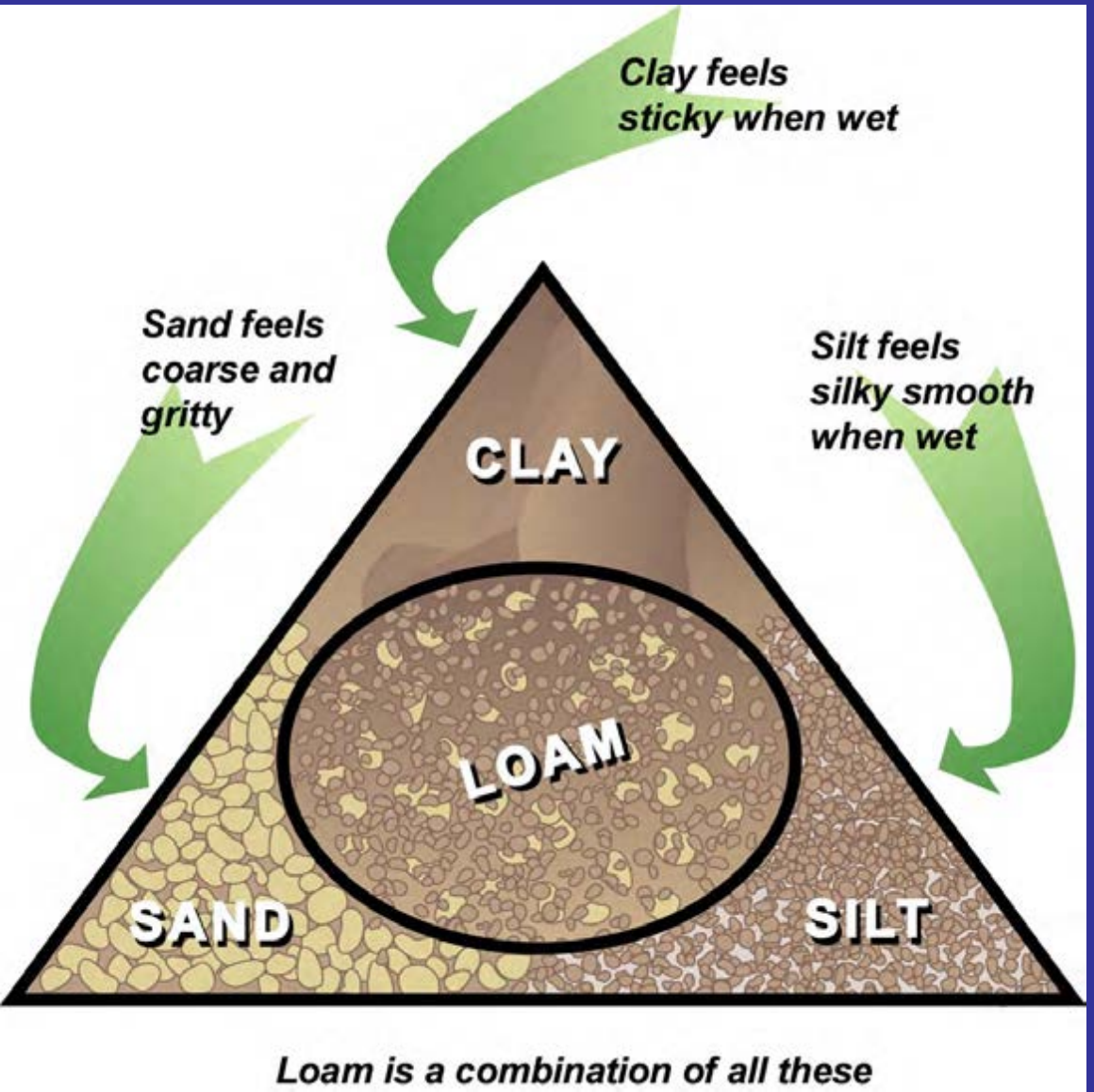
(III) more than 5 cm long
- smooth and slippery → silty clay
- gritty → sandy clay
- neither smooth or gritty → clay

FIG 10A
Sandy loam: a ribbon less than 2.5 cm long forms; individual grains are visible.

FIG 10B
Clay loam: a ribbon 2.5 to 5 cm will form; soil appears smoother.

FIG 10C
Clay: a ribbon greater than 5 cm can be formed; soil glistens somewhat.

Soil Texture



How does it feel in your hand?

Soil Organic Matter
Soil Texture

Texture	Organic Matter
	%
Sands	<1
Loams	2 – 3
Clays	4 – 5

Why determine soil texture?

- Soil texture influences:
  - Water intake rates
  - Water storage capacity
  - Ease of tillage
  - Amount of aeration
  - Soil fertility

Urban Compaction Deprives Millions of Contact with Quality Soil

“My soil is just clay.”
Bane of the urban gardener

Bad! Keep off Wet Soil

Wheel Traffic Leads to Soil Compaction

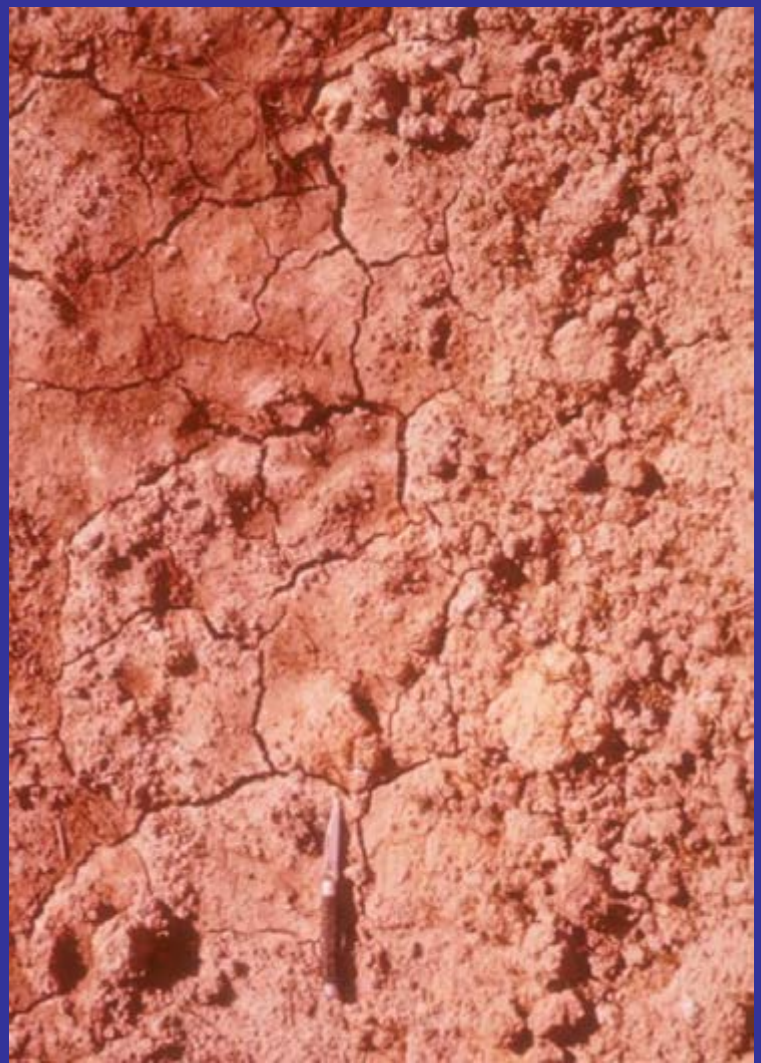
Soil Compaction/Earth Contraction

Wire Flag Test for Compaction

Water Infiltration Test

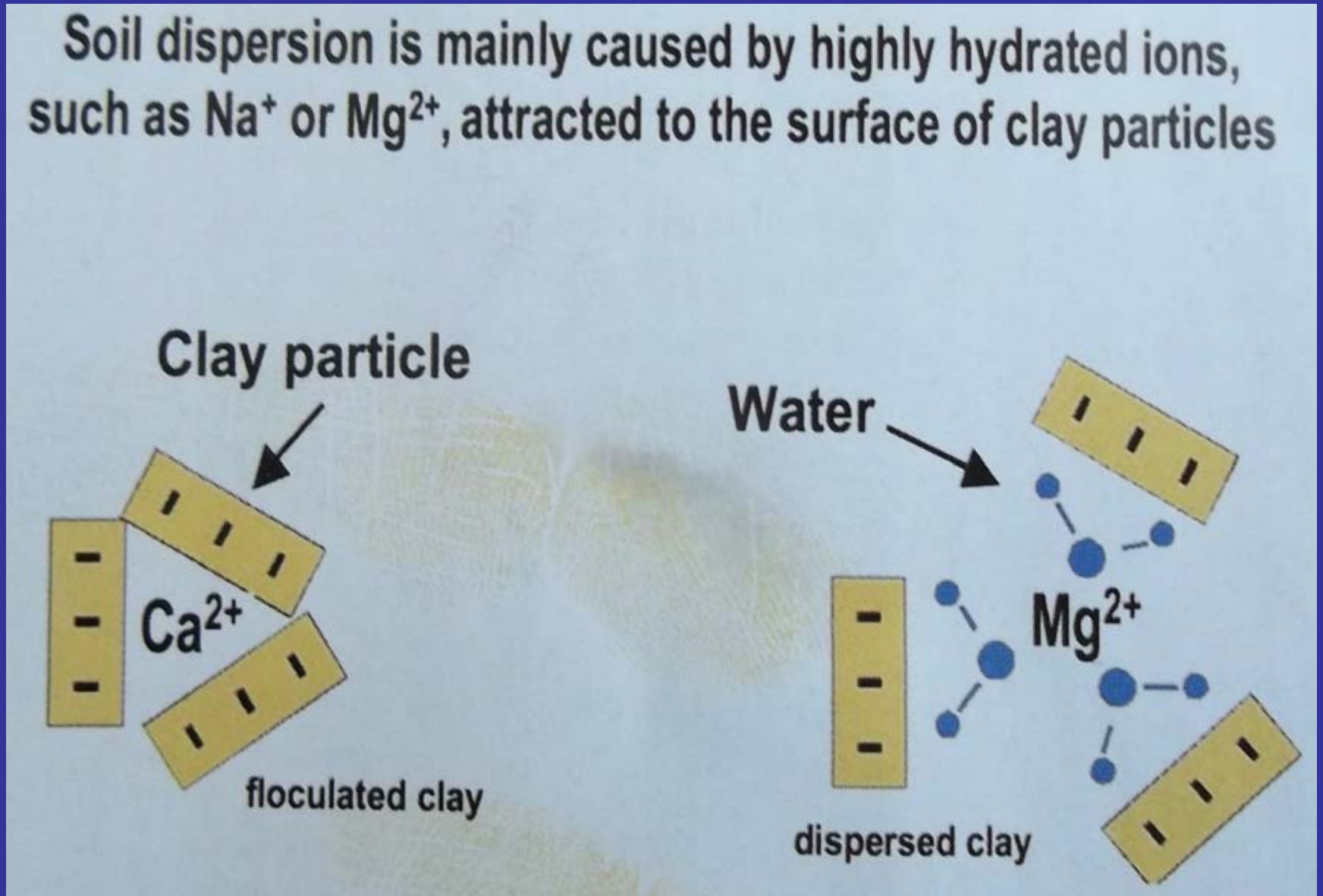
Soil Structure and Quality

Poor



Good

Calcium Improves Soil Structure



Lime Selection/Soil Test Level

- **Dolomitic lime (high Mg)**
  - **Use when soil test Mg level is low relative to Ca**
- **Calcitic lime (high Ca)**
  - **Use when soil test Ca level is low relative to Mg**
- **Gypsum (calcium sulfate)**
  - **Use when soil pH is high but Ca is needed**

- **Calcium rich soils are more friable and easily tilled**

Chemistry and Soil Color

Soil Mottles

- reddish spots within a blue-gray matrix that indicate the soil has experienced periods of poor aeration

Good quality soil has:

- Good aeration
- Good drainage
- Good tilth (they’re easy to work)
- Lots of organic matter
- Lots of organisms

Benefits of soil organic matter

- Increased water and nutrient-holding capacity
- Formation of soil into stable aggregates
- Reduced soil compaction
- Improved water infiltration

Horse Manure – Abundant Resource for Soil Improvement

RUTGERS
New Jersey Agricultural Experiment Station

Soil Testing Laboratory
Rutgers, The State University
ASB II
57 US Highway 1 South
New Brunswick, NJ 08901-8554

Soil Test Report
Lab #: 2011-9579

Name: George H. Cook
Address: 1 Sandy Lane
Westampton, NJ 08060
Phone:
Fax:
Email: georgehcook@rutgers.edu

Date Received: 2011-04-18
Date Reported: 2011-04-29
Serial #: BU-5171
Sample ID: L-1

Crop or Plant
Farm vegetable: mixed vegetable

Referred To: Rutgers Cooperative Ext. of Burlington County
(609)265-5050

Soil Tests and Interpretations

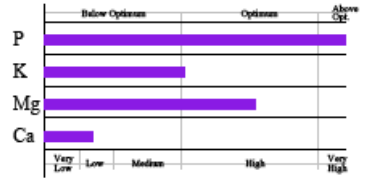
pH: 5.65 Moderately acidic

Lime Requirement Index: 7.80

The Lime Requirement Index (LRI) is a measure of the buffering capacity of the soil, its resistance to pH change, and is used to determine the appropriate amount of limestone, when necessary. LRI value near 8.0 indicates low buffering capacity of soil and a lower rate of limestone amendment compared to soil with high buffering capacity (LRI near 7.0).

Macronutrients (pounds per acre)

Phosphorous:	345	(Above Optimum)
Potassium:	147	(Optimum)
Magnesium:	225	(Optimum)
Calcium:	772	(Below Optimum)



by Mehlich 3 extraction

Micronutrients (parts per million)

Zinc(Zn)	Copper(Cu)	Manganese(Mn)	Boron(B)	Iron(Fe)
5.56 (Adequate)	1.86 (Adequate)	7.26 (Adequate)	0.18 (Low)	280.10 (High)

Estimated Cation Exchange Capacity and Basic Cation Saturation

CEC	Base Saturation	Calcium	Magnesium	Potassium
4.7 meq/100g		1.9 meq/100g	0.9 meq/100g	0.2 meq/100g
(100%)	66%	41%	20%	4%
Suggested Range of Cation Saturation:		65-76%	10-15%	4-7%

Special Tests Results

No special test data available

pH, Calcium, and Magnesium Recommendations

The soil pH is below the optimum range of 6.20 to 6.80 for the growth of most mixed vegetable.

To raise soil pH to target pH range, apply 900 pounds Calcium Carbonate Equivalent (CCE) per acre using calcitic limestone and till in to 8 in depth. Actual amount of limestone to be applied depends on CCE of the product used. For tillage depth other than 8", adjust the amount accordingly.
For new plantings this may be applied in a single operation spread uniformly on the surface, then mixed thoroughly to an 8 inch depth by tilling. Do not apply more than the recommended amount until the soil is tested again.

Fertilizer Recommendations

The agricultural agent of Rutgers Cooperative Extension will fill in a copy of this table to provide recommendations.

Plant nutrients recommended (pounds per acre)				When to apply	How to apply[1]	Notes
N	P_2O_5	K_2O	Mg[2]			

[1] Br=broadcast; PD=plowdown; DI=disk in; BP=band place; SD=sidedress; TD=topdress; Dr=drill
[2] When magnesium soil test value is low or very low and no limestone is needed to correct soil acidity, apply magnesium in fertilizer form to meet crop needs as shown.

Micronutrient Statements

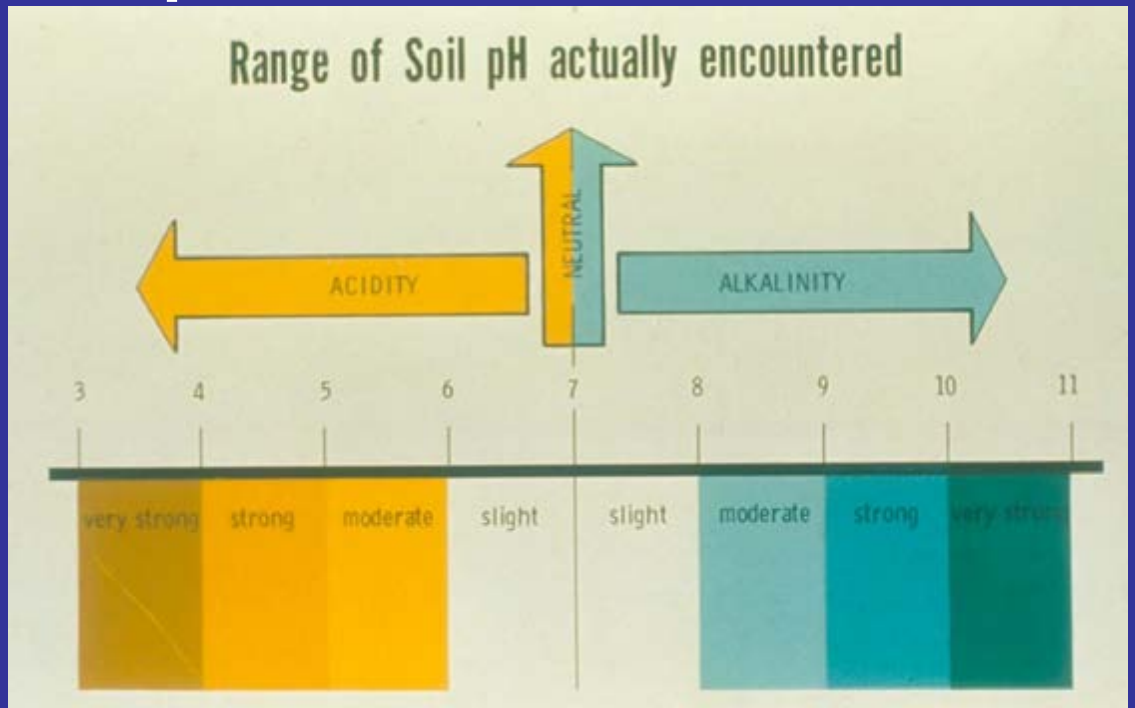
Zinc does not appear to be a limiting factor. For information about zinc in soil for plant nutrition, see FS721.

Copper does not appear to be a limiting factor. As with most other micronutrients, copper availability is related to soil pH. Do not over-lime. For more information about soil copper, see FS720.

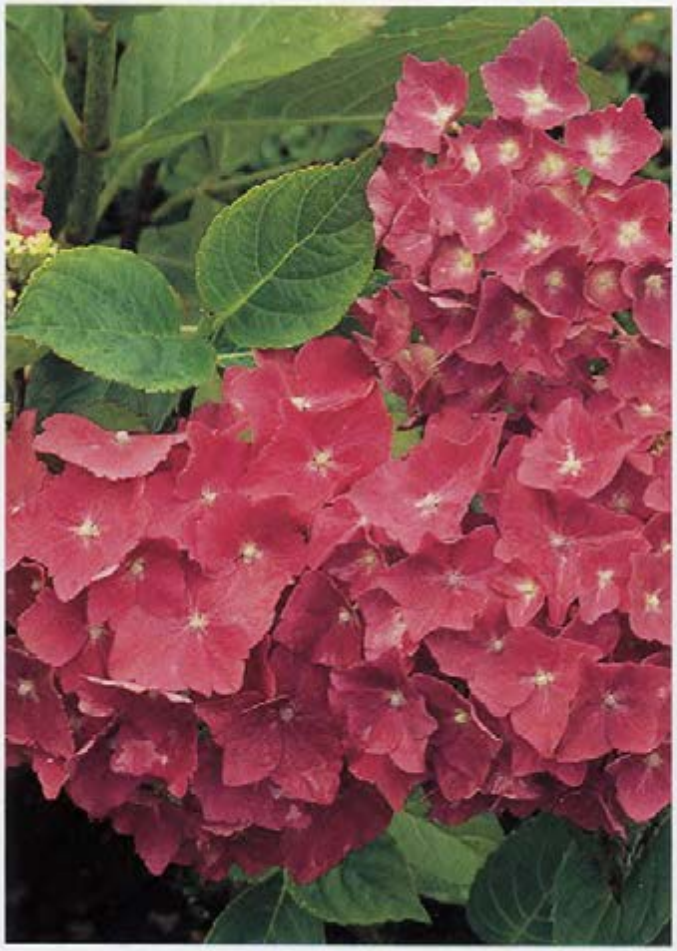
Manganese does not appear to be a limiting factor. Maintain soil pH in the optimum range, as directed in "Recommendations". See FS973 for more information about manganese in soil and plant nutrition.

Soil pH

- Defined as the negative logarithm of the hydrogen ion activity of the soil solution
- Soil pH values below 7 are “acid”
- Soil pH values above 7 are “alkaline”
- Soils at pH 7 are “neutral”



Soil pH Differences Influence Hydrangea Flower Color



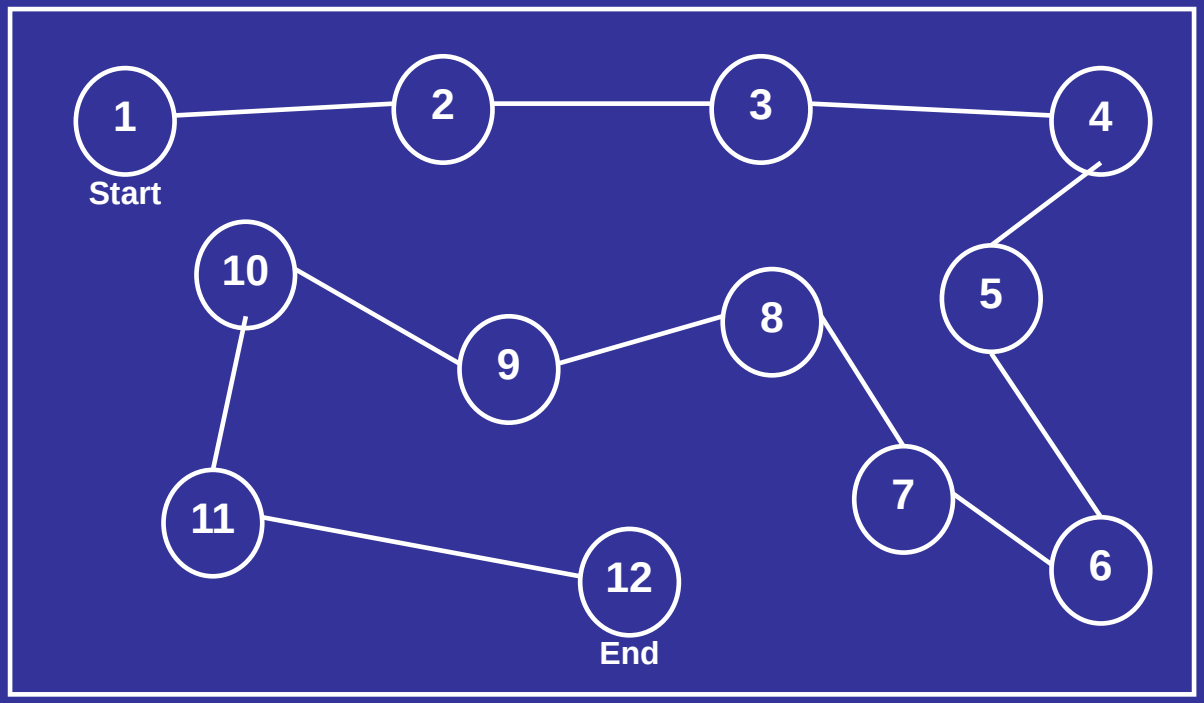
pH > 7

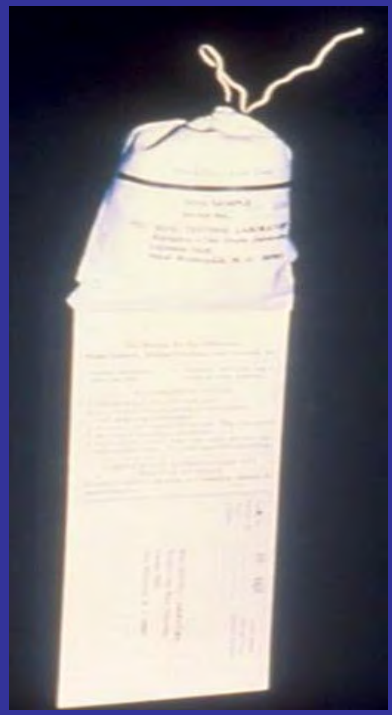
acidic soils

White Clover

First Things First – Take a Soil Sample

Soil Sampling Procedure





Reasons Soil Scientists Dig Pits

Soils can hold information about the history of a landscape

History of humans or the history of disturbance events that an area has experienced over time

History from a Soil Pit

https://soilsmatter.wordpress.com/2019/12/01/how-can-soil-scientists-tell-the-history-of-a-location-from-a-soil-pit/?_cldee=amhlY2ttYW5AbmphZXMucnV0Z2Vycy5lZHU%3d&recipientid=contact-28a07c118e33db1197e1001279d6310b-5636965de7e946ddbdfbc2ad9891039a&esid=203a4001-d216-ea11-810f-005056a7afa5

The soil profile of the pit described in this blog. (Grey lines to aid the reader) Under the grass is a loamy soil, with a fairly dark brown color, indicating organic matter content. The soil changes to a sandy loam, and then to a silty loam. The most dramatic finding was pieces of charcoal. Remnants of past civilization? Evidence of cryoturbation? Only further study will tell. The scientists marked each horizon with sticks. Credit: Ryan Schroeder.

How can I manage my soils to improve them?

- Avoid compaction by
  - Reducing tillage of wet soils
  - Reducing traffic on wet soils

- Increase the organic matter content by
  - Adding compost and manure
  - Growing and tilling in cover crops (green manure)

- Maintain cover with vegetation
- Encourage earthworms

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