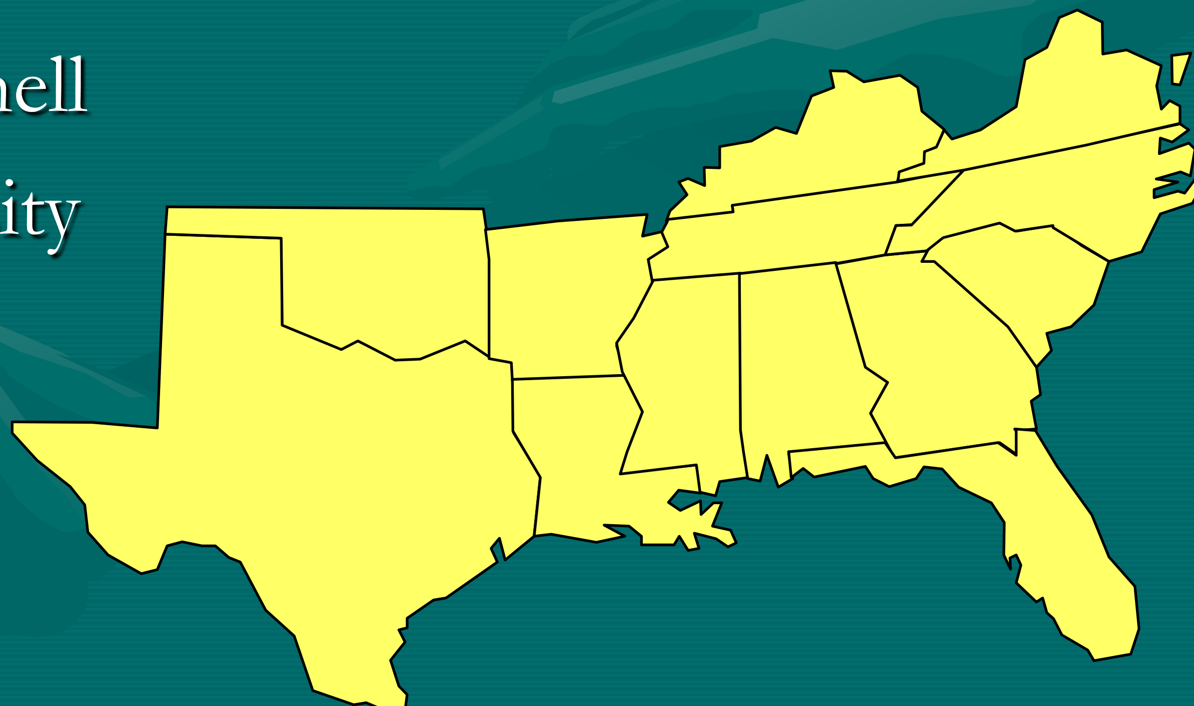
History of SERA-6
&
Soil Testing in the South

Charles C. Mitchell

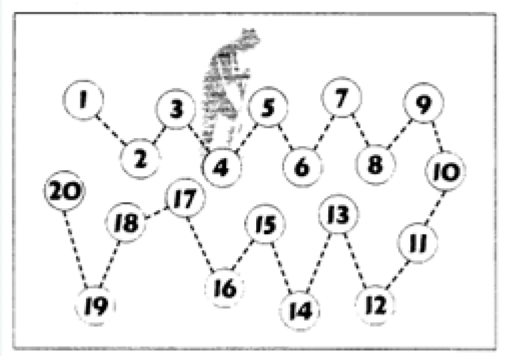
Auburn University



Joint meeting, State College, PA

July 18-20, 2016

Soil testing is. . .



"… by practitioners of the art." (Kurtz, 1978)

"… any chemical, physical, or biological measurement on a soil. (Peck, 1977)

"… the application of soil science research to the rapid chemical analyses to assess the available nutrient status of a soil." (Peck, 1990; SSSA Glossary, 1996))

Soil Testing History

- 1839. P identified as an essential plant nutrient (Liebig, Germany)
- 1843. Acidulated P process (Lawes & Gilbert, England)
- 1856. K identified as an essential plant nutrient (Salm-Horstmar)
- 1862. Morrill Act
- 1887. Concept of ionization (Arrhenius)
- 1888. Hatch Act

Soil Testing History

- 1894. Citric acid extraction for P (Dyer)
- Late 1800s. Total soil P analysis by gravimetric or volumetric phosphomolybdate complex
- 1909. pH scale proposed (Sorenson)
- 1914. Smith-Lever act
- 1919. AOAC suggested litmus paper to estimate soil reaction.
- Late 1920s. H electrode available.

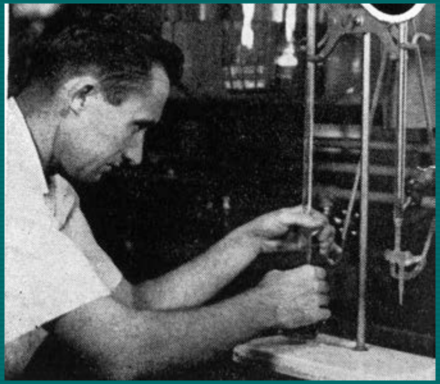
Soil Testing History

- 1929. "A Field Test for Available P" (Bray, IL)
- 1929. "A Test for Water-soluble P" (Spurway, MI)
- 1930. "Determination of readily available P" (Truog, WI)
- 1930s. pH meter and glass electrode developed.
- 1954. Public soil testing in all 48 states.

Soil Testing in the South

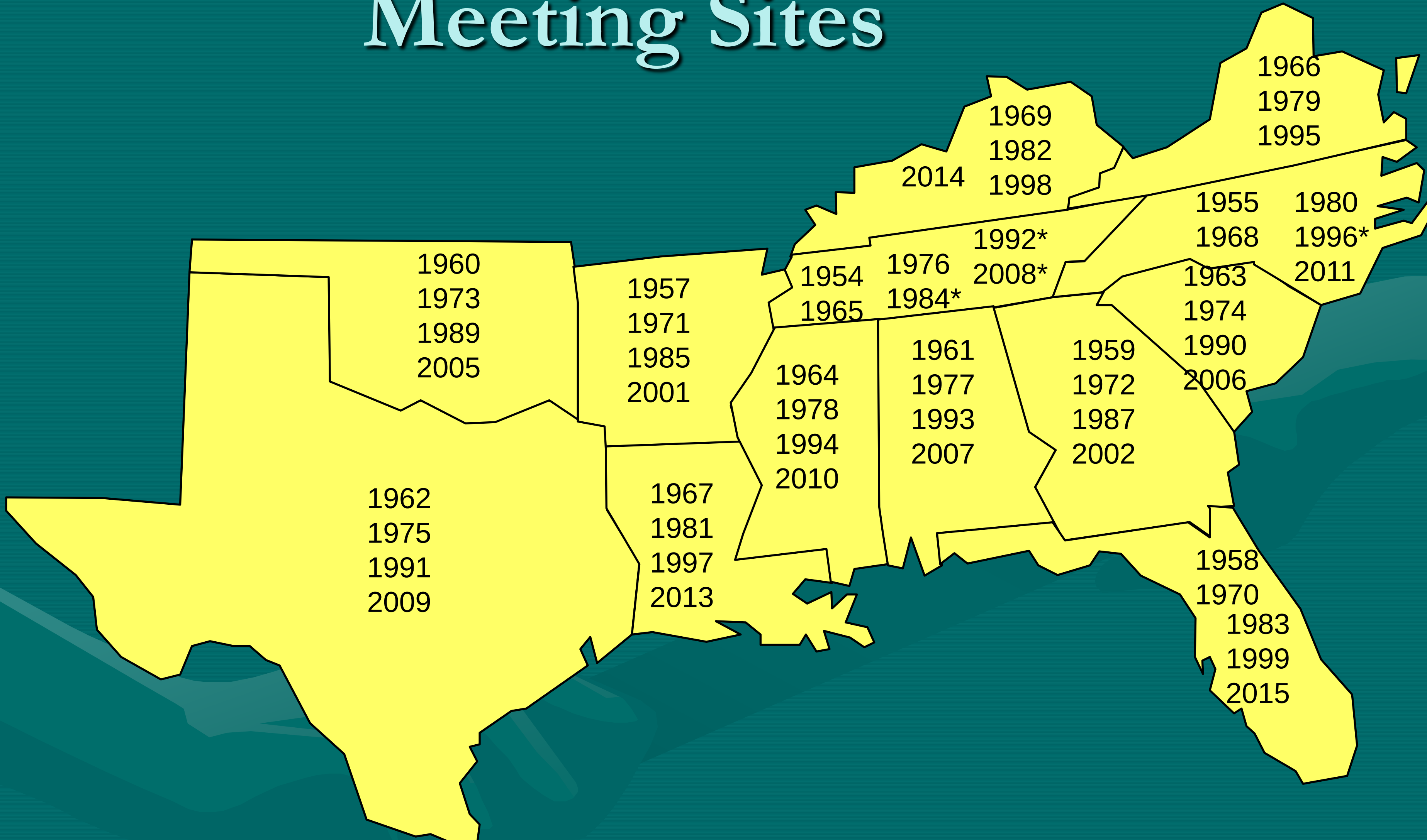
- 1928-29. South Carolina started testing soil pH on a limited scale using hydroquinone titrations.
- 1938. W.R. Paden set up the first state-supported soil testing service in the South at Clemson, SC.
- 1953. Adolph Mehlich (NC) published mimeo describing dilute, double-acid extraction for highly weathered soils.

Soil Testing in the South



- 1954. All states in the South had a public soil testing program.
- 1954. First meeting of "Soil Test Work Group" of the Southern Regional Research Committee.
  - 1962. S-52 Committee
  - 1983. SRIEG-18 Committee
  - 1991. SERA-6 Committee

Meeting Sites



* Joint meeting

Virgin Islands 1986
Puerto Rico 2003

Joint Meetings with North Central & Northeast Groups

- 1984 Memphis, TN
- 1988 St. Louis, MO
- 1992 Nashville, TN
- 1996 Raleigh, NC
- 2000 Mahoney State Park, NE
- 2004 Newark, DE
- 2008 Nashville, TN
- 2012 Madison, WI
- 2016 State College, PA

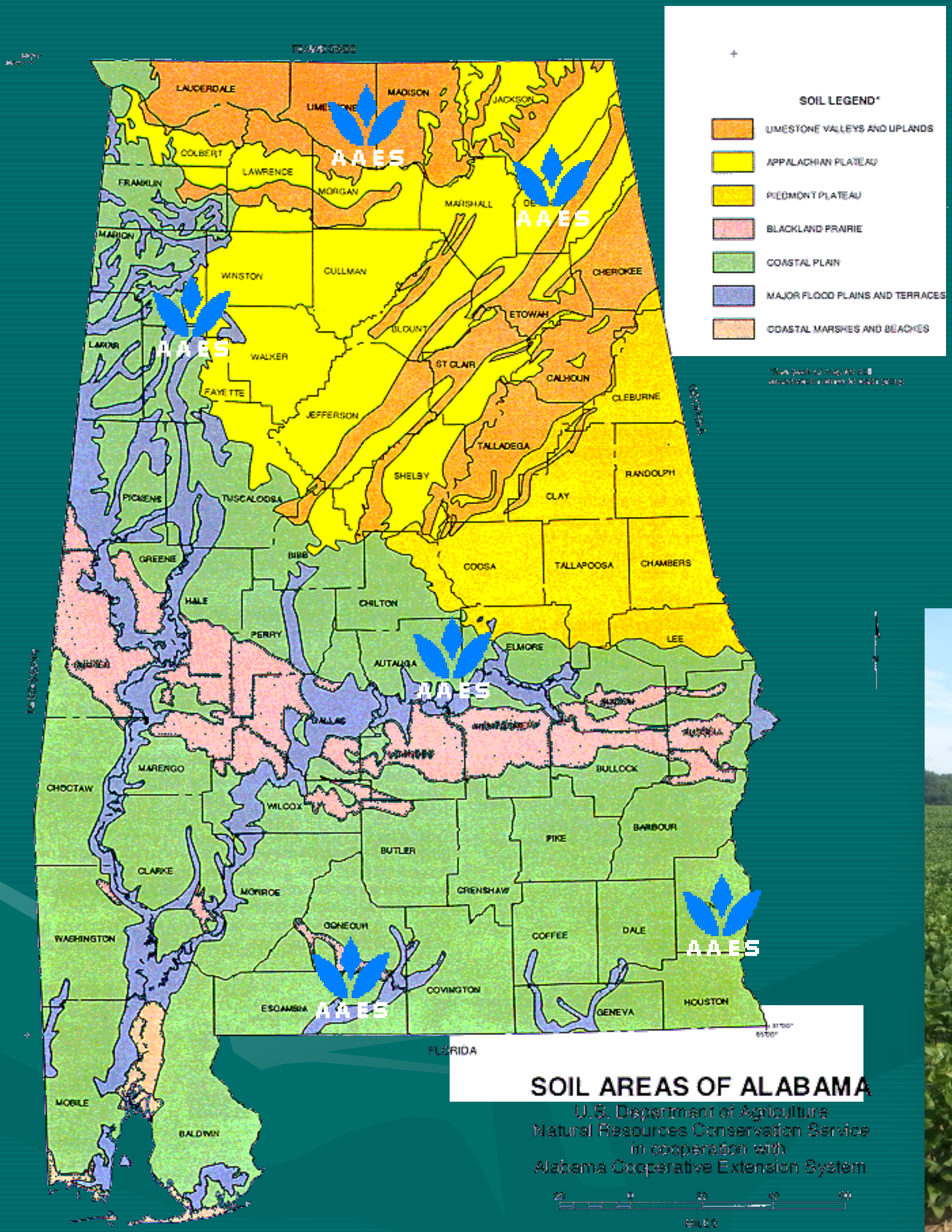
Notable Contributions by SERA-6 Participants

- 1953. R.D. Rouse (AL) published calibration data in "The Basis for Soil Testing in Alabama"

the BASIS for SOIL TESTING in ALABAMA

AGRICULTURAL EXPERIMENT STATION
of the ALABAMA POLYTECHNIC INSTITUTE
E. V. Smith, Director
Auburn, Alabama

R. D. Rouse



Two-Year Rotation (c. 1928)

Rates of NPK Test (c. 1954)

Notable Contributions by SERA-6 Participants

- 1953. R.D. Rouse (AL) published calibration data in "The Basis for Soil Testing in Alabama"
- Adolph Mehlich (NCDA) contributed (1) dilute double-acid extractant (Mehlich-1), 1953, (2) Mehlich-2 extractant, (3) Mehlich-3 which replaced M-2, and (4) Mehlich buffer for lime requirement.

Notable Contributions by SERA-6 Participants

- 1962. Adams-Evans (AL) lime requirement buffer published.
- 1965. Soil test interpretation and recommendations automated using computers (Cope, et al., Alabama)
- 1984. Mehlich-3 extracting procedure published (NCDA).

Notable Contributions by SERA-6 Participants

- 1970. J.D. Lancaster (MS) contributed acetic-malic-malonic acid extractant procedure (Mississippi/Lancaster) for fine-textured and calcareous soils (unpublished data). Conducted extensive soil test calibration research.

  - 1965. J.T. Cope, et al. (AL) initiated soil test computerization.

Soil Extractants Used in the South

Year	P extractants	K extractants	Lime methods
1950	13	10	?
1965	9	7	13?
1973	6	6	
1983	7	5	8
1992	5	5	8
2010	4	4	8
2016	3	4	8

Lime Requirement Methods 2016

Adams-Evans (FL)
Modified Adams-Evans (AL)
$Ca(OH)_2$ addition (GA, LA, PR)
pH and texture (AR, TX)
modified Woodruff (MS)
Mehlich (NC, VA)
Sikora (KY, OK)
Moore-Sikora (SC, TN)

P & K Methods 2010

Mehlich-1 AL, GA, SC, TN, VA

Mehlich-3 AR, FL, KY, LA, NC, OK, TX

Miss/Lancaster MS, AL

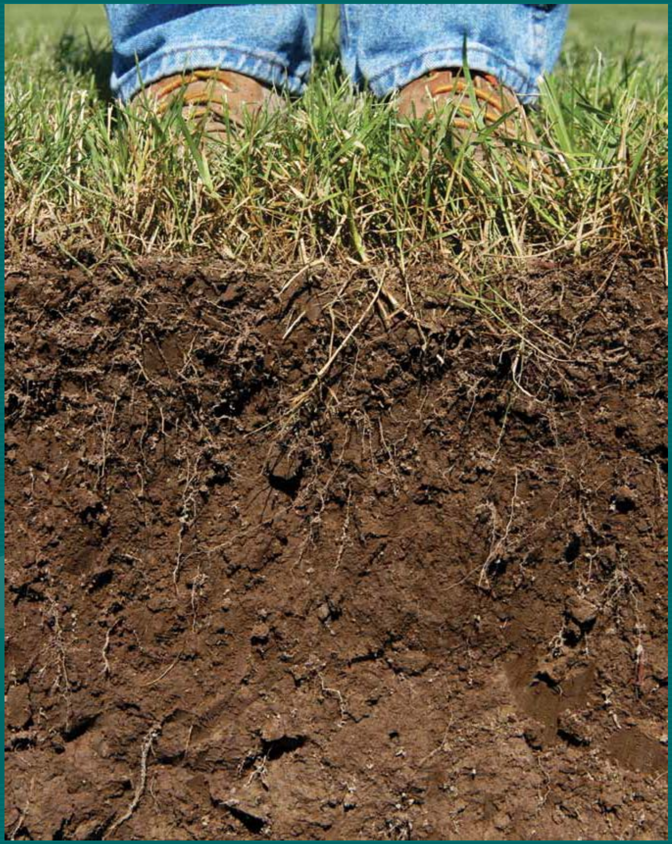
Bray-Kurtz P1/Olsen PR

"Soil tests won't help you create good soil. At best, they help you scrape by with really poor soil."

--Bill Finch
former Garden Editor, Mobile Press Register, and Director, Mobile Botanical Gardens
Blog on Jan. 23, 2013

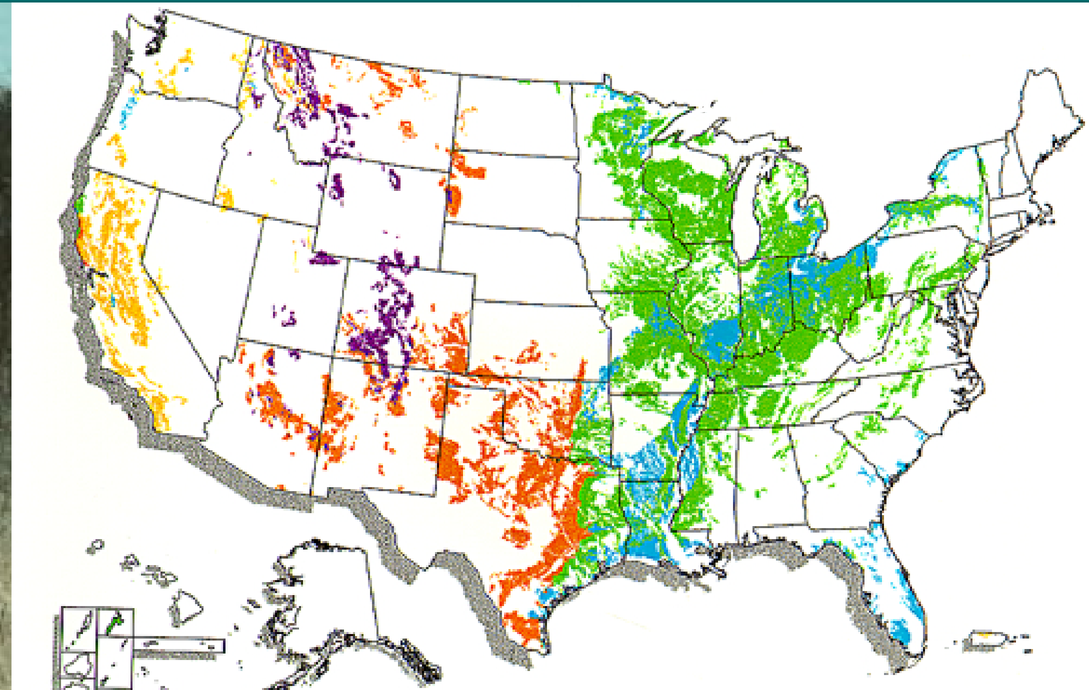
Measuring Soil Quality in Alabama

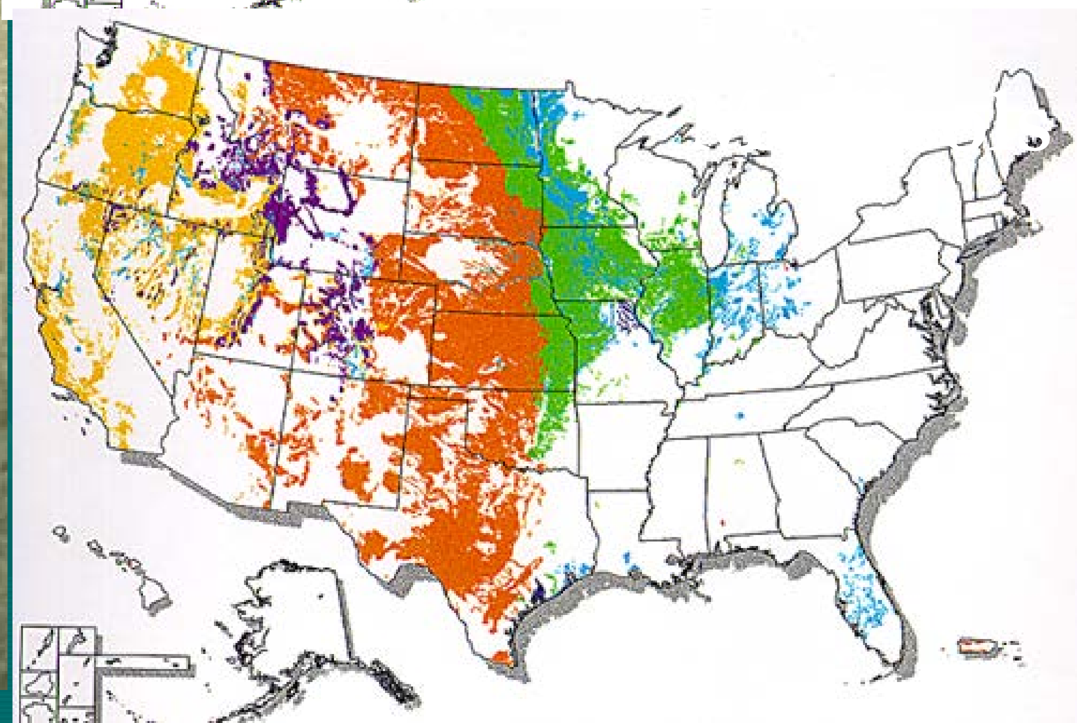
C.C. Mitchell and G. Huluka, Auburn University



Presented June 10, 2016, SWCSS, Auburn, AL

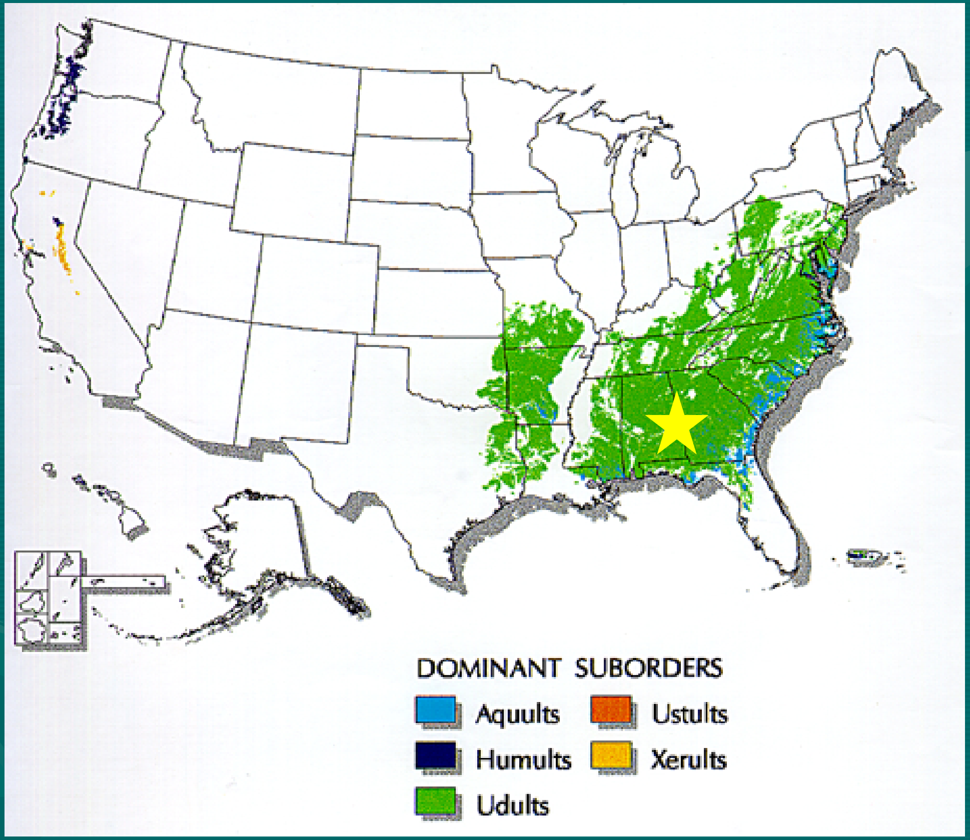

C
F
0
2
1
4
6
2
8
3
10
12
4
14
5

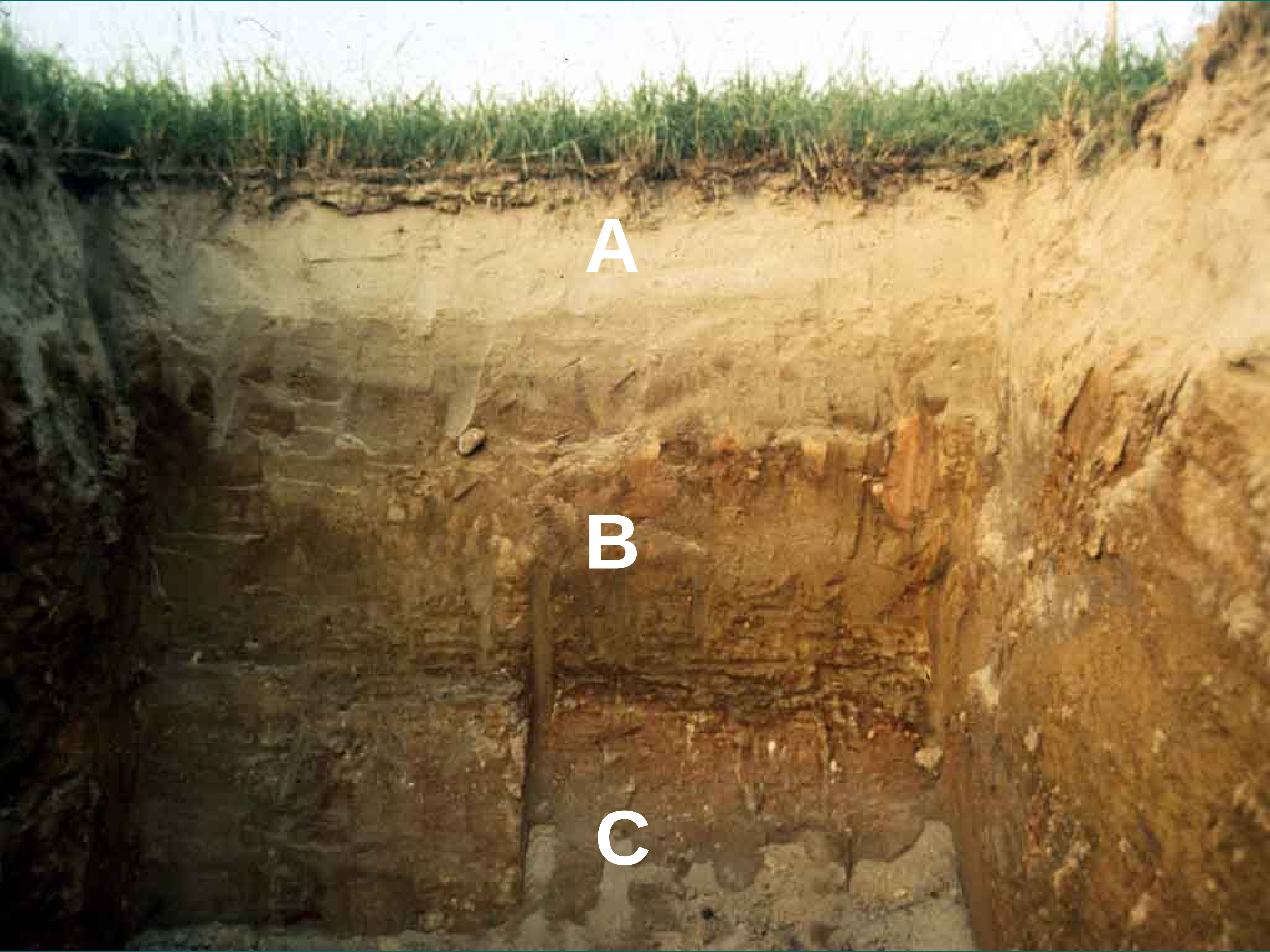




Ultisols


M
F
.2
1
.4
.6
2
.8
3
1


DOMINANT SUBORDERS
Aquults
Ustults
Humults
Xerults
Udults


A
B
C

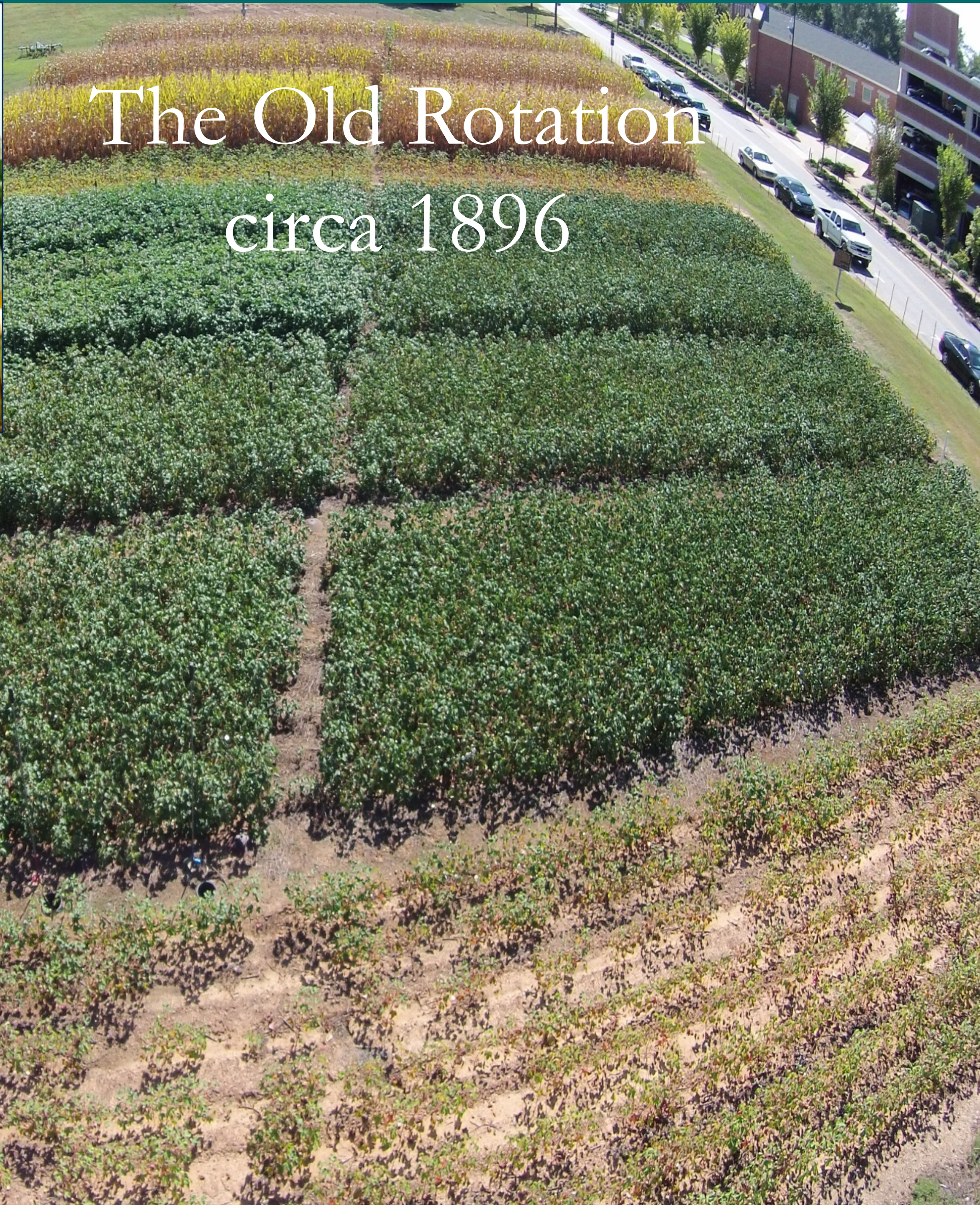
Most of these Ultisols in the southeastern US would be considered "poor quality" because. . .

- A history of severe erosion
- Low soil organic matter
- Excessive runoff
- Traffic pans or surface crusting/ soil compaction
- Steep slopes
- Shallow rooting of crops
- Lack of cover crops
- Soil borne diseases e.g. nematodes
- Low water holding capacity
- Low productivity

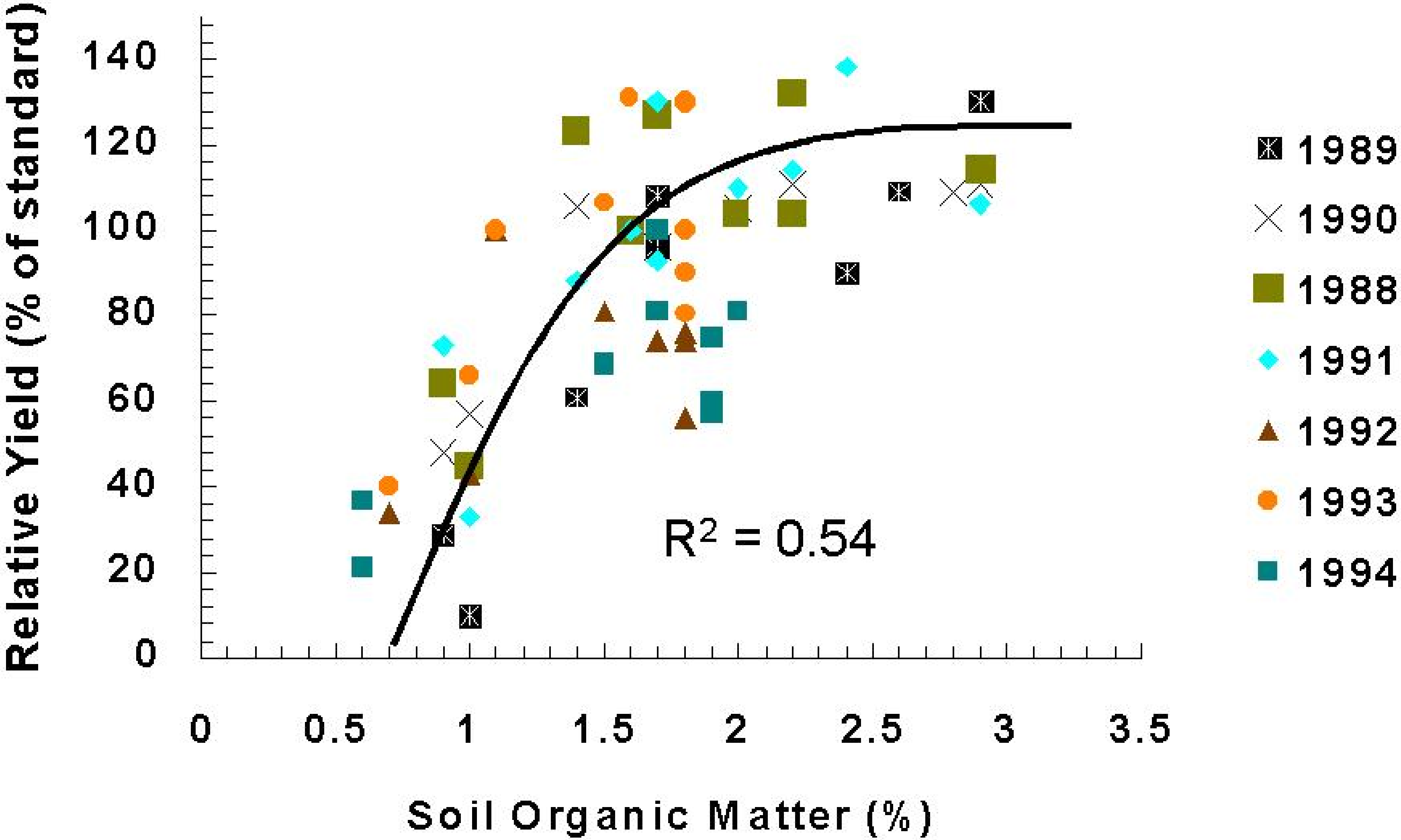
A 2001 survey of Central Alabama cotton fields showed. . .

- 63% had traffic pans within 12 inches of surface **in spite of in-row subsoiling**
- 55% had less than 0.4% soil organic matter in soil surface
- 85% WERE NOT using a cover crop
- 80-95% were doing a great job of fertilizing and liming according to soil test; soil pH and plant nutrients were in ideal range.

The Old Rotation circa 1896



As soil organic matter in the plow layer increases, yield potential goes up! (data from Alabama's Old Rotation Experiment (circa 1896))




Plot 7
Winter legume only
2015 yield = 2310 kg lint/ha
Plot 6
No N/no cover crop
2015 yield = 520 kg lint/ha
"The Old Rotation"
circa 1896
Auburn University, AL
July 28, 2015

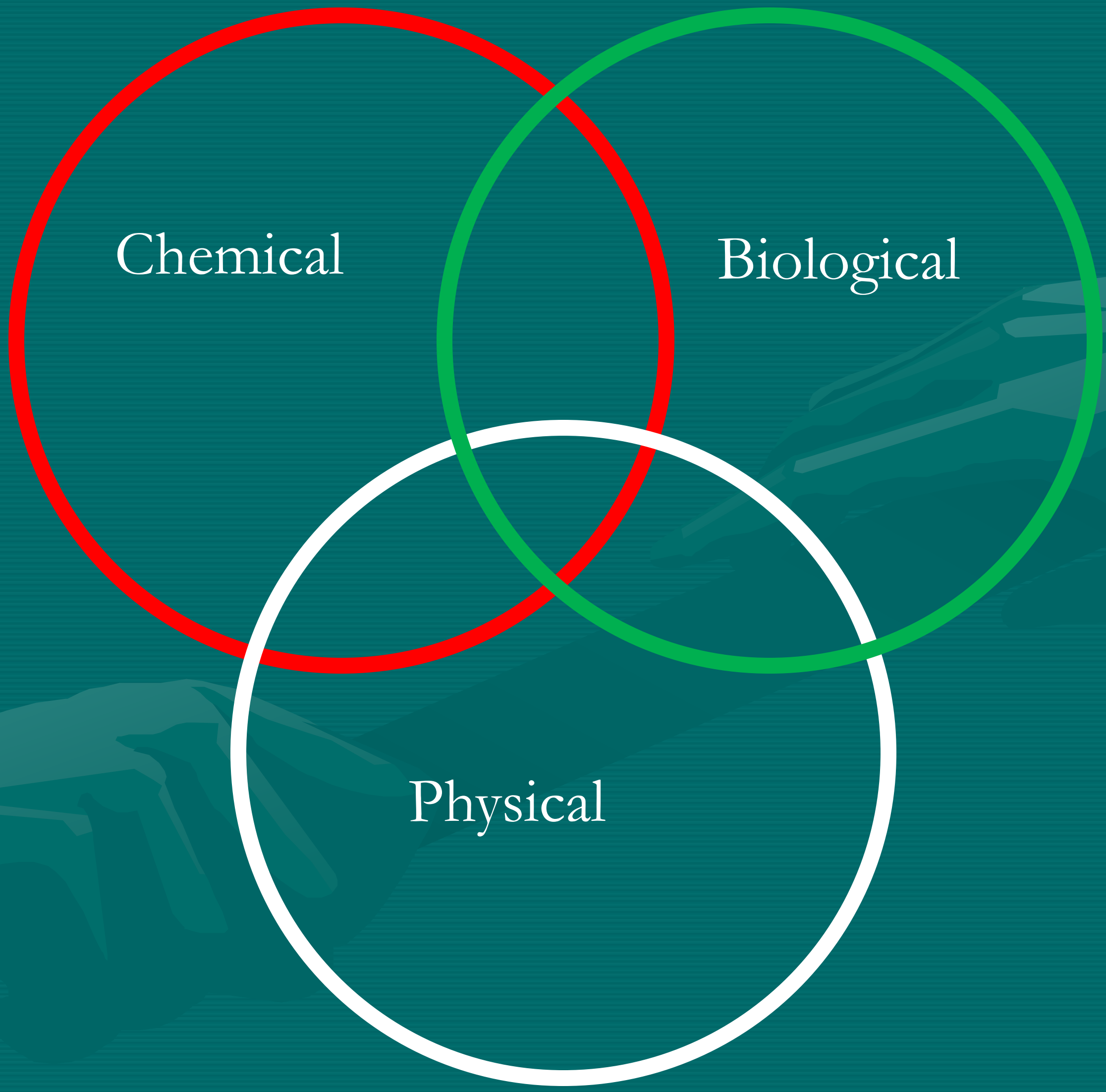
Can we measure soil quality?

In the lab?

In the field?

USDA-ARS Soil Quality Test Kit
Soil Quality Institute
August, 1999

Components of Soil Quality



In the lab?

- Routine soil test
- Soil cation exchange capacity
- Base saturation
- Electrical conductivity
- Heavy metal contamination
- Soil organic matter
- Respiration
- Mineralizable nitrogen
- Aggregate stability/slaking
- Soil Texture

Chemical

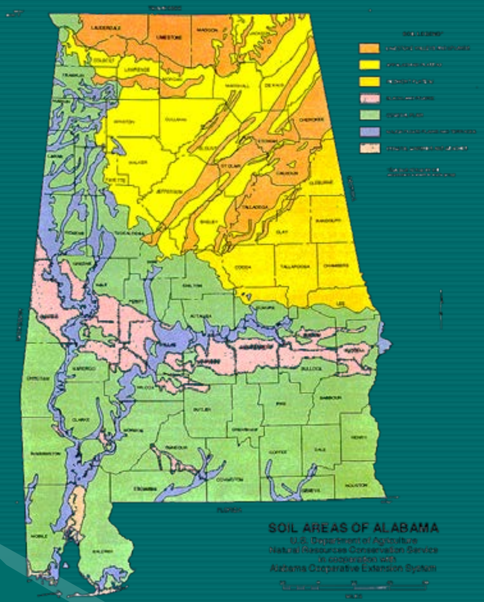
Biiological

Physical

In the field?

- Soil series/mapping unit
- History of site
- Slope
- Infiltration
- Traffic pans
- Soil compaction/bulk density
- Aggregate stability
- Slaking

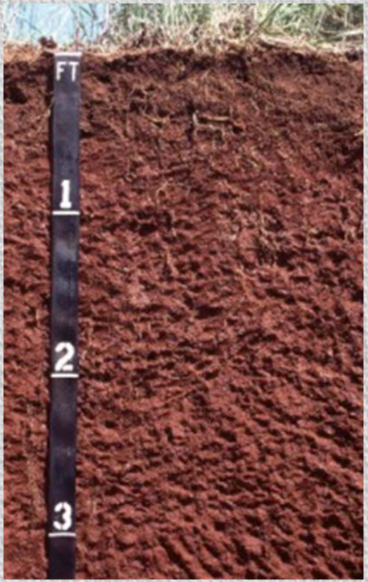
A Proposed Soil Quality Index for Alabama



- Should make farmers and gardeners aware of soil quality/soil health.
- Should suggest ways of improving soil quality/soil health.
- Must be adaptable to existing soil test methodologies.
- Must be relatively inexpensive to run on traditional soil samples.
- Must provide information in a simple, easy to understand manner.

Example of a SQI for a well managed, productive soil in the Tennessee Valley.

Factors	Values					Max. value	Your Score	BMP recommended
Soil CEC/soil group	<4.6 (Grp 1)	4.7-9.0 (Grp 2)	9.0- 15.0 (Grp.3)	>15,0 (Grp 4)				
	2	4	5	5		5	5	
Soil pH_w	<5.0	5.1-5.8	5.9-7.0	7.0-8.0	>8.0			
	0	10	15	10	5	15	15	
P RATING	VL/LOW	MEDIUM	HIGH	VERY HIGH	EXTREMELY HIGH			
	0	5	10	5	0	10	10	
K RATING	VL/LOW	MEDIUM	HIGH	VERY HIGH	EXTREMELY HIGH			
	0	5	10	8	5	10	10	
Base saturation	<10%	11-25%	26-50%	50-75%	>75%			
	0	3	6	10	8	10	10	
Soil O.M.(%)	<0.5	0.6-1.0	1.1-2.0	2.1-3.0	>3.0			
	0	5	10	15	20	20	15	
N mineralized (lb/a)	<10	11-20	21-30	31-50	>50			
	0	2	4	8	10	10	8	
Soil respiration	VeryLow	Low	Moderate	High	Very High			
	0	2	4	8	10	10	8	
Aggregate stability	No aggregates	Weak	Moderate	Good	Very strong aggregates			
	0	2	4	8	10	10	4	
Metals	Two or more metals "very high"		One metal is "very high"		All metals optimium			
	-10		-5		0	0	0	
TOTAL SOIL QUALITY INDEX						100	85	
Comments: Soil Quality Index is high. Continue with existing practices								



Example of a SQI for a eroded, sandy soil in South Alabama.

Factor	Values					Max. value	Your Score	BMP recommended
Soil CEC/soil group	<4.6 (Grp 1)	4.7-9.0 (Grp 2)	9.0- 15.0 (Grp.3)	>15,0 (Grp 4)				
	2	4	5	5		5	2	
Soil pH_w	<5.0	5.1-5.8	5.9-7.0	7.0-8.0	>8.0			Apply Ag. lime at recommended rates
	0	10	15	10	5	15	10	
P RATING	VL/LOW	MEDIUM	HIGH	VERY HIGH	EXTREME LY HIGH			
	0	5	10	5	0	10	10	
K RATING	VL/LOW	MEDIUM	HIGH	VERY HIGH	EXTREME LY HIGH			See soil test K recommendations
	0	5	10	8	5	10	5	
Base saturation	<10%	11-25%	26-50%	50-75%	>75%			
	0	3	6	10	8	10	6	
Soil O.M.(%)	<0.5	0.6-1.0	1.1-2.0	2.1-3.0	>3.0			PP2, PP3, SP3, SP7
	0	5	10	15	20	20	5	
N mineralize d (lb/a)	<10	11-20	21-30	31-50	>50			Building soil organic matter will help.
	0	2	4	8	10	10	2	
Soil respiration	VeryLow	Low	Moderate	High	Very High			Building soil organic matter will help.
	0	2	4	8	10	10	2	
Aggregate stability	No aggregat es	Weak	Moderate	Good	Very strong aggregate s			PP1, PP2, PP3, SP7, SP2
	0	2	4	8	10	10	2	
Metals	Two or more metals "very high"		One metal is "very high"		All metals optimum			
	-10		-5		0	0	0	
TOTAL SOIL QUALITY INDEX						100	44	See BMPs above

Comments: Your total soil quality index is low. Use one or more of the following primary practices to help improve the soil quality index. Re-test your soil in 3 years to determine if the practices are helping. You may be eligible for assistance from your local Soil and Water Conservation District Office or USDA-NRCS office.

Selected USDA-NRCS Practices to Improve SQI

Primary Practices (PP)

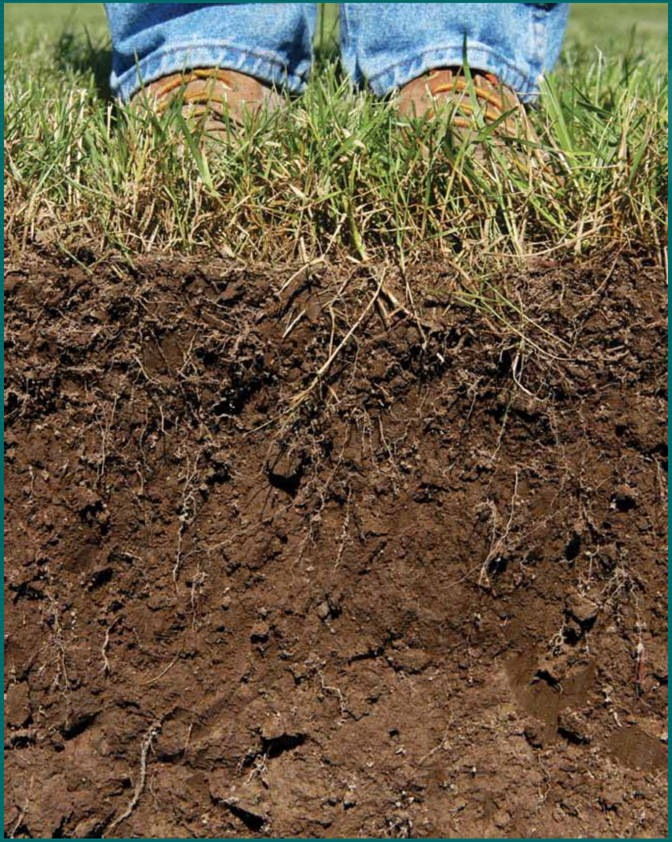
PP1. Conservation crop rotation (328)
PP2, Residue and Tillage Management "No-till/strip till" (329)
PP3. Cover crops (340
PP4. Nutrient management (590)
PP5. Integrated Pest Management (595)

Supporting Practices (SP)

SP1. Contour Farming (330)
SP2. Deep Tillage (324)
SP3. Forage and Biomass Planting (512) – for sod based rations
SP4. Irrigation water Management (449)
SP5. Contour Buffer Strips (332)
SP6. Filter Strips (393)
SP7. Mulching (345)
SP8. Terrace (600)

Complete list of conservation practices can be found at:
http://efotg.sc.egov.usda.gov/toc.aspx?CatID=321

“Soil tests can help you create really good soil.”

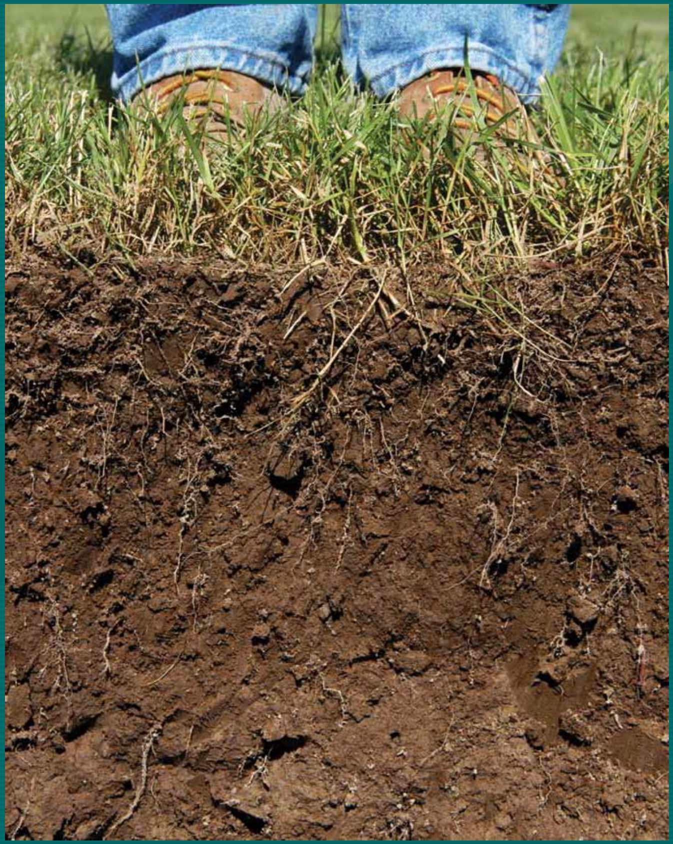


How to take a sample

- Same as routine soil sample
- Don't break up soil aggregates smaller than a marble because of slaking test
- Cost = $50 per sample

(50% discount due to commodity funding)

- Allow one week in lab because of additional tests.
- Report will include routine soil test, micronutrients, metals, and other results in addition to SQI table.
- Interpretation based on Alabama soils and not Midwestern soils.



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Presented June 10, 2016, SWCSS, Auburn, AL