West Virginia University

Soil Quality Assessment and Management

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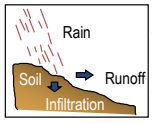
Soil Quality is…

- *The capacity of a specific kind of soil **to function**, within natural or managed ecosystem boundaries to sustain biological productivity, maintain environmental health, and promote plant and animal health.(e.g. cities).*

Soils Perform Vital Functions (General)

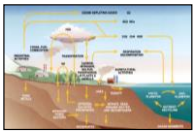
a) Sustaining plant and animal life below and above the surface. Support human health and habitation

b) Cycling and storing nutrients



c) Water retention & movement. Regulating and partitioning water and solute flow

d) Providing support to structures



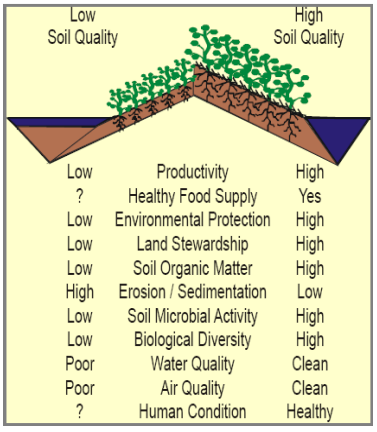
e) Filtering, buffering, degrading, immobilizing, and detoxifying

Soil Quality

- Soil quality integrates the *BIOLOGICAL, CHEMICAL, AND PHYSICAL COMPONENTS* and processes of a soil with its surroundings.
- *The concept that soil functions* within a larger system remains a key consideration in assessment of soil quality.

Soil functions related to plants

- Reservoir for plant nutrients and water
- Habitat for bacteria and fungi that break down organic matter
- Habitat for insects and other animals that mix the soil
- Medium for anchoring plant roots



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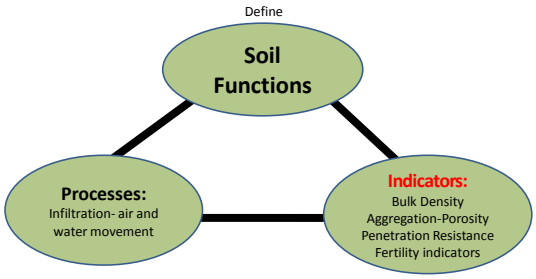
Soil Quality Link to Sustainability: Achieving Soil Quality Sustainability

1. SOIL QUALITY ASSESSMENT

Reasons for Evaluation or Testing Soil Quality

1. To determine the existing quality of soils
2. To evaluate the effects of management practices on the soil
3. To determine changes in soil quality over time

Assessment of Soil Quality



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Soil functions related to plants

Review

- Reservoir for plant nutrients and water
- Habitat for bacteria and fungi that break down organic matter
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- Medium for anchoring plant roots

Properties farmers consider important measures of soil quality

1. **Organic matter**
2. **Crop appearance**
3. **Earthworms**
4. **Erosion**
5. **Tillage ease**
6. **Drainage**
7. **Soil structure**
8. **Soil pH**
9. **Soil test P and K**
10. **Yield**

Assessing Soil Quality

- **Often subjective:**
  - Soil Health
  - Smell, feel, look, taste
  - Soil Quality Index
- **More quantitative:**
  - Chemical
    - pH, O.M., nutrients
  - Physical
    - Structure, bulk density
  - Biological
    - Respiration, microbial biomass
  - ***Integrate factors*** into an index

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Some Tests Used in Soil Quality

- Infiltration
- Soil 'Bulk' Density
- Aggregate Stability/Soil Slaking
- Soil Respiration
- Earthworms
- Electrical Conductivity
- Soil pH
- Soil Fertility/Soil test

WHY IS INFILTRATION IMPORTANT?

WHY IS SOIL 'BULK' DENSITY IMPORTANT?

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WHY IS AGGREGATE STABILITY/SLAKING IMPORTANT?

WHY IS SOIL RESPIRATION IMPORTANT?

Earthworms improve soil quality by

- increasing nutrient availability
- decomposing organic material
- enhancing soil porosity

WHY ARE EARTHWORMS IMPORTANT?

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WHY IS SOIL PH IMPORTANT?

WHY IS ELECTRICAL CONDUCTIVITY IMPORTANT?

To *assess plant available nutrient status*, salinity, elemental toxicity

Includes interpretations, evaluations, fertilizer and amendment recommendations

WHY ARE SOIL TESTS IMPORTANT?

Soil Quality Link to Sustainability: Achieving Soil Quality Sustainability

2. SOIL QUALITY MANAGEMENT

Sustainability

- **Sustainability** means that a given system will maintain its productivity "for ever";
  - and considering the human factor:
- Sustainable environmental management is "management that meets **current needs without** compromising the ability of the system to provide for **future needs**".

Avoid Degradation

- Manage soil properties to avoid degradation and as a consequence:
  - productivity loss
  - increased erosion
  - increased greenhouse gas production
  - increased probability of water quality degradation

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Soil Quality can be managed!

- **Soil Quality** can be improved (if it has been deteriorated) or maintained at a given level by:

1. _____

2. _____

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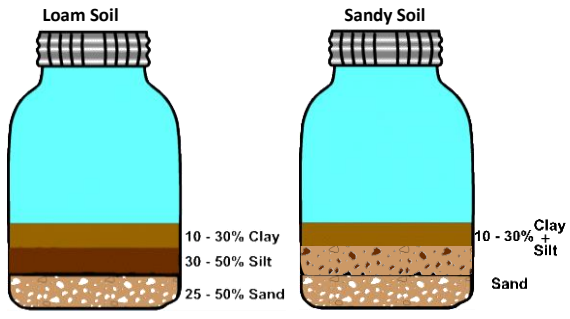
Inherent SQ:

Definition:

- Intrinsic properties (qualities) of soils determined by climate, topography, biota (biology), parent material, and time (e.g. Texture)

- **Used to**:
  - compare the capabilities of one soil against another
  - evaluate the suitability of soils for specific uses



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Dynamic SQ:

Definition:

- Properties determined by soil properties that are influenced by **human use and management decisions**. These properties are *use-dependent* properties and may be *temporal (dynamic)* of the soil.

- Examples:
  - Bulk density near the surface.
  - Organic matter content

Soil Quality Management: There is a limit to what we can do.

WHY?

Inherited ⇒ ***INTRINSIC SOIL QUALITY***:

Soil quality can be a consequence of inherent properties of soils.

Do you think you can change *Inherited Soil Quality*?

Some properties can not or are very difficult to be changed.

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Soil Quality Management: There is a limit to what we can do.

EXAMPLE:

A loam soil will have a higher water holding capacity than a sandy soil this implies that:

a) loam soil will have a higher inherent quality for storing water,

b) lower inherent quality for producing a freely drained condition.

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Soil Quality Management:

However:

Management ⇒ **Dynamic Soil Quality**

Dynamic quality is determined by soil properties that are influenced by human use and management decisions.

EXAMPLE:

a) Bulk density near the surface
b) organic matter content are

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Soil Quality Management: There is a limit to what we can do.

MANAGEMENT will either improve or reduce health of the soil.

This dynamic aspect of soil quality is the focal point of the concern for assessing the state (or quality) of the soil resource.

Soil Quality can be managed!

- **Soil Quality** can be improved (if it has been deteriorated) or maintained at a given level by:

1. _____

2. _____

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Adaptation!

Ask adaptability or suitability related questions:

- Are the soil properties favorable for establishing and maintaining crops, gardens, lawns, shrubs, and trees without extensive and expensive soil modifications?

Adaptation!

SOIL QUALITY AND ADAPTABILITY EVALUATION

- Soils are evaluated by the properties that may limit or prohibit a planned use.
  - "No" or "slight" limitations ⇒ creates favorable conditions (soil properties) for a specific landuse.
  - "Moderate", "severe" or "very severe", limitation ⇒ creates unfavorable conditions (less severe to more severe) which require its correction or a modification of the building plans.

Example
Soil Quality Assessment

SOIL TEST

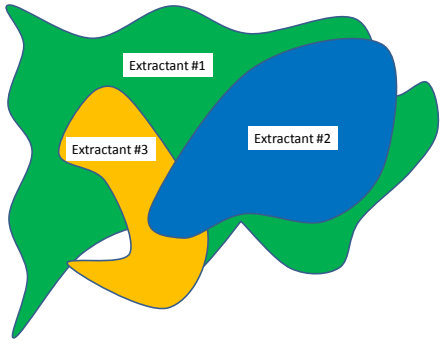
Soil Tests

- General Definition: any chemical or physical measurement made on a soil
- More Common Definition: **rapid** chemical analysis to *assess plant available nutrient status*, salinity, elemental toxicity
  - Includes interpretations, evaluations, fertilizer and amendment recommendations

WVU Soil Tests

- Primary Focus – P, Ca, Mg, K, pH & LR
  - Micronutrients if requested
  - Organic matter for specialty growers

Soil Test Extractants



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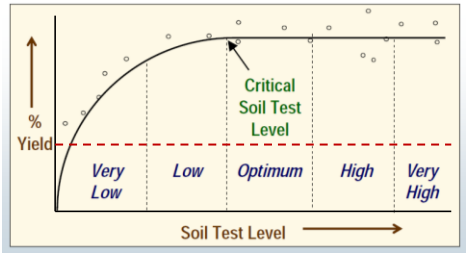
Soil Test Extractants

Extractant	States Using	Composition
Morgan	NY	Acetic acid
Modified Morgan	ME, MA	Acetic acid, ammonium hydroxide
Mehlich 1	FL, GA, SC, TN, VA, WV	Hydrochloric acid, sulfuric acid
Mehlich 3	AR, DE, KY, NC, NH, NJ, OK, PA	Acetic acid, nitric acid, ammonium nitrate, fluoride and EDTA

The Soil Test Extractant



Soil Test Reports

Table 1. West Virginia University Soil Testing Laboratory
Relative Availability or Sufficiency Levels for the Major Nutrients.

	P_2O_5	K_2O	Ca	Mg
	lb acre^{-1}			
Low (deficient)	0 – 25	0 – 60	0 – 1000	0 – 100
Medium	25 – 50	60 – 120	**1000 – 2500**	100 – 250
High (sufficient)	50 – 80	120 – 240	2500 – 4000	250 – 500
Excessive	80 +	240 +	4000 +	500+

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Example
Soil Quality Management

SOIL TEST

Soil Test Reports

West Virginia University Soil Testing Laboratory
Morgantown, WV 26506-6108
SOIL TEST REPORT 2011

WVU Lab No: 7942
County Name: MONONGALIA
Field Acres:
Tillage Method:

FSA Cost Sharing::
Previous Crop:
Soil Name:

County No.:
Sampling Date::
Soil Texture:

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SOIL TEST RESULTS

LBS/ACRE

pH	P		K		Ca		Mg		OM	Zn	Cu	Mn
4.9	57	HI	105	MED	1067	MED	105	MED				

****

L.M. MCDONALD
AG SCI BLDG
MORGANTOWN, WV
26506

* THIS SPACE FOR OFFICE USE					CEC
* AVAILABLE K	CA	MG	H		&BS
* meq/100g 0.1	2.7	0.2	20.0		23
* % SAT 1	12	1	87		14
* L.E. 10	LIMED IN LAST 12 MO? : NO				

****

Soil Test Reports

SOIL TEST RESULTS

LBS/ACRE

pH	P		K		Ca		Mg		OM	Zn	Cu	Mn
4.9	57	HI	105	MED	1067	MED	105	MED				

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* L.E. 10	LIMED IN LAST 12 MO? : NO				

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RECOMMENDATIONS TO LANDOWNER FOR AGLIME AND FERTILIZER
FOR TALLGRASS HAY OR PASTURE (LESS THAN 30% LEGUME)

AG LIME	NITROGEN	PHOSPHATE	POTASH
(DOLOMITIC 3 T/A DOLOMITIC LIME	(N) 50-0200 LBS/A	(P_2O_5) 40 LBS/A	(K_2O) 120 LBS/A

THE ABOVE RECOMMENDATIONS ARE FOR A YIELD GOAL OF 3 TO 4TONS/ACRE AND ASSUME A SOIL PH CORRECTED TO 6.5. **N NEEDS DEPEND ON DESIRED YIELD GOAL**. K APPLICATION SHOULD BE REDUCED IF MAGNESIUM (MG) IS LOW (LESS THAN 100 LBS/A).

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Dr. Louis McDonald

New Soil Test Reports

Part 1: ID

WEST VIRGINIA UNIVERSITY SOIL TESTING LABORATORY
P.O. Box 6108, MORGANTOWN, WV 26506-6108

SAMPLE DETAILS		Sample ID:	F-1/2
Sample Date	8/12/2012	Previous Crop	PASTURE
LAB ID	12-7143	Soil Name	
Limed in last 12Months	No	Soil Texture	
Area (Acre)		Tillage Method	

New Soil Test Reports

Part 2: Lab Results

Nutrients	Values	Rating			LOW	MEDIUM	HIGH	V HIGH
Soil pH	4.9	L.R.: 3						
P2O5(Lbs/A)	57	HIGH		P2O5				
K2O(Lbs/A)	105	MED		K2O				
Ca(Lbs/A)	1067	MED		Ca				
Mg(Lbs/A)	58	MED		Mg				

Nutrients	K	Ca	Mg	H	Total[CEC], BS(K+Ca+Mg)
MEQ/100	0.1	2.7	0.2	20	23
%Sat	1	12	1	87	14

Soil Test Reports

Part 3: Recommendations

Aglime	3 T/A GROUND LIME
Fertilizer - N (Lbs/Acre)	50 - 200
Fertilizer - P_2O_5 (Lbs/Acre)	40
Fertilizer - K_2O (Lbs/Acre)	120

SUGGESTIONS
The above recommendations are for a yield goal of 3 to 4 Tons/Acre and assume a soil pH corrected to 6.5.

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Dr. Louis McDonald

Compost and Manure Testing

State of West Virginia
DEPARTMENT OF AGRICULTURE
Gus R. Douglass, Commissioner

Janet L. Fisher, Deputy Commissioner
Bob Tabb, Deputy Commissioner
Steve Miller, AssistantCommissioner

LABORATORY ANALYSIS REPORT

WVDA Nutrient Management Lab
Moorefield Field Office
60B Industrial Park Road
Moorefield, WV 26836
304-538-2397

Date Received: May 31, 2012
Date Sampled: May 31, 2012
Date of Report: June 13, 2012

Submitted by: You

Producer: You

Sample ID Number: 05311201
Sample Description: turkey litter from house

Test Parameter	lbs/ton	%	Test date	Method	MDL
(N)Nitrogen (TKN)	61.49	3.07	6/12/2012	SM 4500-NH_3 C.	0.237
(P)Phosphate (P_2O_5)	38.73	1.94	6/12/2012	SM 4500-P E.	0.035
(K)Potash (K_2O)	40.08	2.00	6/13/2012	SW846 7000B.	0.006
*Moisture	-----	22.54	6/11/2012	SM 2540 B.	0.124
Ammonium	24.38	1.22	6/12/2012	SM 4500-NH_3 C.	0.009
**C:N Ratio	20.90	-----	6/12/2012	-----	----
Copper	0.566	0.0283	6/13/2012	SW846 7000B.	0.002
Calcium	20.88	1.04	6/13/2012	SW846 7000B.	0.006
Magnesium	5.68	0.28	6/13/2012	SW846 7000B.	0.002
pH		8.12	6/12/2012	SW-846 9045D	

*Calculations based on Total Solids measurement
**Not a certified method

When surface applied this sample will supply plant available:

Nitrogen (N) (Surface available)	30.74	lbs/ton
Nitrogen (N) (Incorporated)	40.49	lbs/ton
Phosphate (P_2O_5)	38.73	lbs/ton
Potash (K_2O)	40.08	lbs/ton

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