Soil Assessment

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Soil Assessments

• Field
  – WV Soil Quality Card
  – NRCS Soil Quality Test Kit

• Classification

• Lab
  – OSU list of labs
  – Sample Collection
  – Soil Quality Project
    • Compaction & History
    • Lab tests
Hand Texture Flowchart

At home, do your soil texture

The trick is to use just enough water, but not too much!

http://www.agriteach.com/members/soils/soil_texture_flowchart.gif
Fine clay has ~10,000 times as much surface area as the same weight of medium grain sand!
Coarse textured soils **larger pores**

Fine textured soils **greater total pore space**

Sand

Clay
<table>
<thead>
<tr>
<th></th>
<th>Sand</th>
<th>Silt</th>
<th>Clay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water-holding capacity</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Aeration</td>
<td>Good</td>
<td>Medium</td>
<td>Poor</td>
</tr>
<tr>
<td>Drainage</td>
<td>High</td>
<td>Slow</td>
<td>Very slow</td>
</tr>
<tr>
<td>Nutrient retention</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
</tbody>
</table>
WV Soil Quality Card

OSU Willamette Valley Soil Quality Card and Guide available online

Willamette Valley Soil Quality Card (EM 8711)

Willamette Valley Soil Quality Card Guide (EM 8710)
NRCS SQ Test Kit

Infiltration
Lab Assessments

- OSU Extension lab list
- Sample collection is VERY IMPORTANT!
What a Soil Test Tells You:

- Relative levels of nutrients in your soil
- Fertilizer recommendation
- Standard soil test: P, K, Ca, Mg, B, pH, lime
- No good soil test exists for nitrogen requirement
Soil Quality

• Sustain biological productivity
• Maintain environmental quality
• Promote plant, animal and human health
Soil Health => Understanding soil processes

- Physical support for plants
- Aeration
- Soil water storage and movement
- Resistance to soil erosion
- Physical root proliferation and organism movement

- Pest suppression
- N mineralization
- OM decomposition
- Support of microbial community

- Nutrient storage and release
- Soil reactions
- Energy (C) storage
Why Evaluate SQ?

- Informed management decisions
- Lower production costs
- Build soil capital
- Reduce environmental impacts
Soil Quality Project

Mission Statement

provide farmers with an assessment package that describes on-farm soil quality to guide future management decisions
Management and Soil Quality

Organic Matter → Soil Organisms

Vegetation → Soil Quality

Soil Structure → Soil Quality

Water Infiltration → Soil Quality
Soil Classification and Mapping

- 2010
  - 7 farms
- 2011
  - 3 farms
Soil Mapping and Classification
Lab Assessments: Answer is in the BAG!
Sample for Soil Quality

10 compaction readings
10 shovels of soil = composite sample
### Soil Quality Assessment Report

<table>
<thead>
<tr>
<th>Name of Farmer</th>
<th>Farm name</th>
<th>Sample ID#</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>23</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Farm Location</th>
<th>Sampling Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Field ID per farmer</th>
<th>GPS Coordinates</th>
<th>Field Agent</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Last Crops Grown</th>
<th>Field Soil Texture</th>
</tr>
</thead>
<tbody>
<tr>
<td>weeds and bare soil</td>
<td>sandy loam</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Management</th>
<th>follow</th>
</tr>
</thead>
</table>

#### Indicators

<table>
<thead>
<tr>
<th>Physical</th>
<th>Value</th>
<th>Units</th>
<th>Range for SQP soils</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Textural Class</td>
<td>73</td>
<td>% sand</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>sandy loam</td>
<td>16</td>
<td>% silt</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>% clay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aggregate Stability</td>
<td>10</td>
<td>%</td>
<td>5.89</td>
<td>aeration, infiltration, rooting, crusting</td>
</tr>
<tr>
<td>Surface Hardness</td>
<td>545</td>
<td>psi</td>
<td>9.57-24</td>
<td>root growth, water transmission</td>
</tr>
<tr>
<td>Subsurface Hardness</td>
<td>628</td>
<td>psi</td>
<td>55-628</td>
<td>rooting at depth</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Biological</th>
<th>Value</th>
<th>Units</th>
<th>Range for SQP soils</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic Matter</td>
<td>1.1</td>
<td>%</td>
<td>1.0-1.5</td>
<td>energy, C storage, water and nutrient holding</td>
</tr>
<tr>
<td>Active Carbon</td>
<td>145</td>
<td>mg/kg soil (ppm)</td>
<td>99-901</td>
<td>organic material to support biological functions</td>
</tr>
<tr>
<td>Potentially Mineralizable Nitrogen</td>
<td>0.0</td>
<td>ppm N per day at 22°C</td>
<td>0.04 - 0.66</td>
<td>ability to supply N</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Value</th>
<th>Units</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extractable Phosphorus</td>
<td>17</td>
<td>ppm</td>
<td>4.2-42</td>
</tr>
<tr>
<td>Extractable Potassium</td>
<td>129</td>
<td>ppm</td>
<td>102-1070</td>
</tr>
<tr>
<td>Extractable Calcium</td>
<td>1400</td>
<td>ppm</td>
<td>1400-4739</td>
</tr>
<tr>
<td>Extractable Magnesium</td>
<td>391</td>
<td>ppm</td>
<td>123-674</td>
</tr>
<tr>
<td>pH</td>
<td>6.7</td>
<td></td>
<td>4.8-7.4</td>
</tr>
</tbody>
</table>

- for fee basis
- cost share opportunities
Structure = Aggregates

- Held together by:
  - Fungal hyphae
  - Bacterial “glues”
  - Organic Matter

- Allows for:
  - Water infiltration
  - Healthy soil biology
  - Enough pore space
  - “Happy” roots
Hands-on FUN!!!

1. Place a ped of two soils, Soil A and Soil B, each on a petri dish or plastic lid.

2. Add enough drops of water to make a pool around the peds.

3. Observe the results.
Aggregate Stability

- 0.25 mm – 2 mm aggregates
- 5 min of simulated rainfall
- Measure weight of stable aggregates to calculate % water stable aggregates
Ag St vs. Texture vs. Manage

Aggregate Stability

Aggregate Stability (%)

Coarse-Textured
Medium-Textured
Fine-Textured
Effect of tillage & roots on stability
Water Infiltration

1. Reduces erosion
2. Minimizes water pollution
3. Increases irrigation efficiency
4. Prevents flooding
5. Is cost effective
Compaction

Pore spaces are where plants get air, water, and nutrients.

Soil compaction decreases valuable pore space between soil particles.

Uncompacted soil

Compacted

Adapted from Sulzman and Frey, 2003
SOIL PHYSICAL PROPERTIES:

Compaction

Dickey-john compaction tester

0-6 inches
6-18 inches
18-24 inches

Results impacted by:
• Soil moisture content
• Equipment training
SOIL PHYSICAL PROPERTIES:

**Surface Hardness**

- Good = 62%
- Poor = 23%

Low organic inputs; High disturbance

High organic inputs
Compaction Results

- Farmer awareness varied.
- Recommend decimal format for geolocation data.
- Importance of equipment training.
SOIL BIOLOGICAL PROPERTIES:

Organic Matter

OM > 4.3% - History of organic amendments or grass production (pasture, grass seed, or baseline)

OM < 2% - Intensive chemical and cultivation weed management or fallow

>9% = 2010 samples
Impact of soil organic matter on soil water

Soil Water Content (Volume)

Soil Organic Matter by Weight (%)

Field Capacity

Available Water

Wilting coefficient
Healthy soils maintain a diverse and active community of soil organisms that:

- Suppress plant disease, & insect and weed pests
- Form beneficial symbiotic associations with plant roots
- Recycle essential plant nutrients
- Improve soil structure for better water and nutrient retention

Ultimately, healthy soils increase grower profits and protect the environment
Active Carbon

- Potassium Permanganate (KMnO₄)

- Color change reaction = biologically available Carbon
Chemical composition of plant matter

• Sugars, starches, simple proteins
• Crude proteins
• Hemicellulose
• Cellulose
• Fats, waxes
• Lignin
Total organic C,
Comparing conventional till (CT) and no-till (NT)

Active C (KMnO$_4$-oxidizable C) more clearly responds to management than total organic C

KMnO$_4$-oxidizable C (“active C”),
Comparing conventional till (CT) and no-till (NT)