SOIL QUALITY MONITORING FOR AGRICULTURAL SUSTAINABILITY

Review of Concepts, Indicators, and Management Strategies
What is Soil Quality?

Soil quality refers to the capacity of soil to function.

Larson and Pierce, 1991
What functions do soils provide?

- Sustain biological productivity
- Regulate water flow
- Cycle nutrients
- Regulate atmospheric quality
- Filter/Buffer/Transform chemicals
- Habitat for soil organisms
Improving soil quality...

...means optimizing multiple soil functions, not focusing on a single soil function.
Monitoring Soil Quality…

- ...is scale dependent.
- ...uses quantifiable indicators.
- ...is best done over time.

- 45 kg/ha
- 0.23 dS/m
- 1.15 g/cm³
Common Indicators of Soil Quality

Soil Physical Properties

- Topsoil depth
- Soil bulk density
- Infiltration rate
- Water holding capacity
- Soil compaction
- Soil structural stability
Common Indicators of Soil Quality

Soil Chemical Properties

- Nutrient availability (N, P, K, S)
- Electrical conductivity
- Soil pH
- Soil organic carbon
- Total nitrogen
Common Indicators of Soil Quality

Soil Biological Properties

- Soil respiration
- Microbial biomass
- Mineralizable nutrients
- Earthworm abundance
Common Indicators of Soil Quality

Plant/Crop Characteristics

- Yield
- Growth rate
- Root depth/health
- Residue cover
## Guidelines for Monitoring Selected Soil Quality Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Sampling Frequency</th>
<th>Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infiltration rate</td>
<td>Variable</td>
<td>After rain or irrigation; Not too soon after tillage.</td>
</tr>
<tr>
<td>Soil pH</td>
<td>Annual</td>
<td>Same time each year.</td>
</tr>
<tr>
<td>Available nutrients</td>
<td>Variable</td>
<td>Spring/early summer for crop availability; fall for potential loss by leaching.</td>
</tr>
<tr>
<td>Soil organic matter</td>
<td>Every 3-5 yr</td>
<td>Spring; Prior to tillage.</td>
</tr>
<tr>
<td>Earthworms</td>
<td>Annual</td>
<td>Spring; Prior to tillage.</td>
</tr>
</tbody>
</table>

* It is important to tailor monitoring to local climates, soil types, and management systems.

Sarrantonio et al., 1996
Management Strategies for Improving Soil Quality

- Conserve soil organic matter
- Minimize soil erosion
- Balance production with environment
- Use renewable resources

Doran et al., 1996
Strategies to improve soil quality equate to management practices that…

- … increase cropping intensity and diversity.
- … reduce soil disturbance.
- … recycle plant and animal manure.

Doran and Zeiss, 2001

