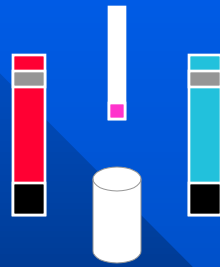
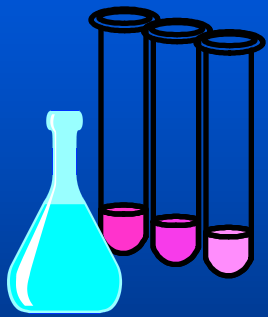


SOIL QUALITY MONITORING FOR AGRICULTURAL SUSTAINABILITY



Review of Concepts, Indicators, and
Management Strategies

What is Soil Quality?

Soil quality refers to the capacity of soil to function.

What functions do soils provide?

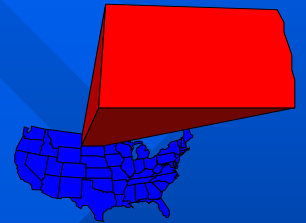
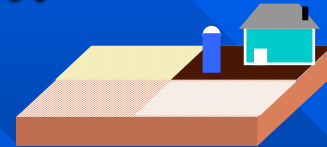
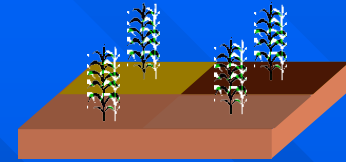
- Sustain biological productivity
- Regulate water flow
- Cycle nutrients
- Regulate atmospheric quality
- Filter/Buffer/Transform chemicals
- Habitat for soil organisms

Improving soil quality...

...means optimizing multiple soil functions, not focusing on a single soil function.

Monitoring Soil Quality...

- ...is scale dependent.

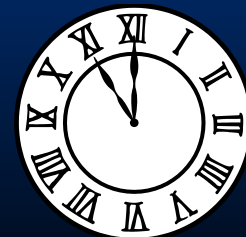


- ...uses quantifiable indicators. **45 kg/ha**

0.23 dS/m

- ...is best done over time.

1.15 g/cm³



Common Indicators of Soil Quality

Soil Physical Properties

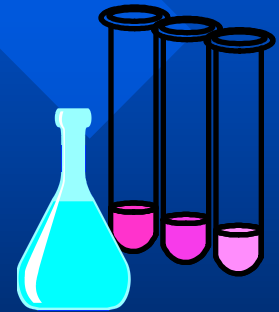
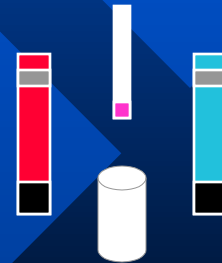
- Topsoil depth
- Soil bulk density
- Infiltration rate
- Water holding capacity
- Soil compaction
- Soil structural stability



Common Indicators of Soil Quality

Soil Chemical Properties

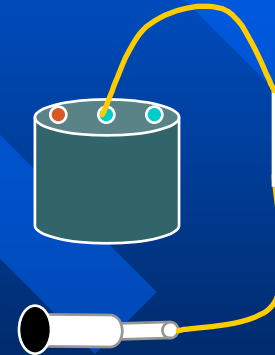
- Nutrient availability (N, P, K, S)
- Electrical conductivity
- Soil pH
- Soil organic carbon
- Total nitrogen



Common Indicators of Soil Quality

Soil Biological Properties

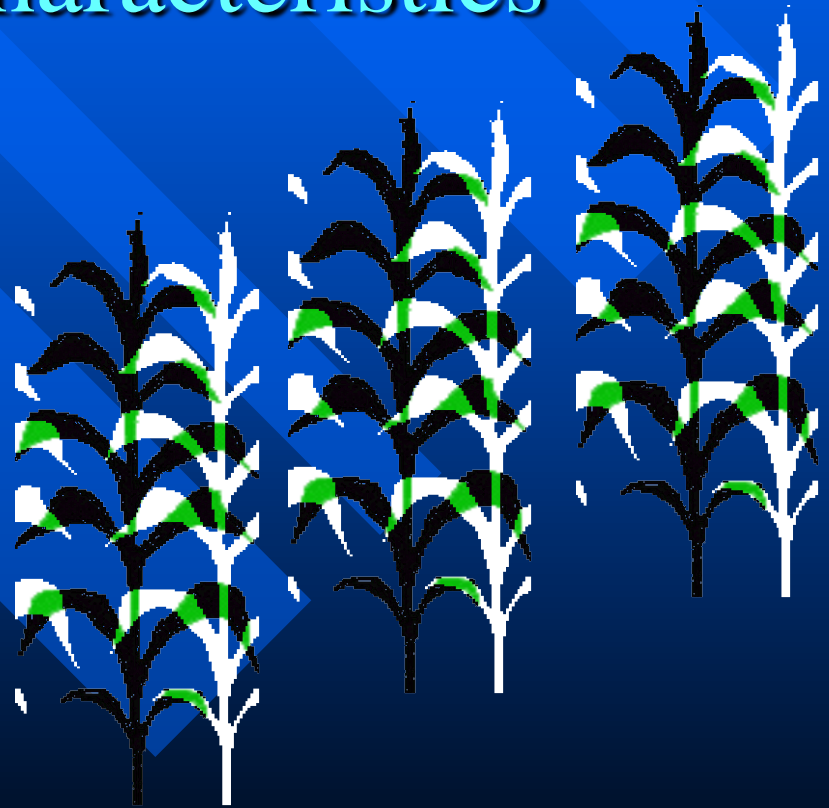
- Soil respiration
- Microbial biomass
- Mineralizable nutrients
- Earthworm abundance



Common Indicators of Soil Quality

Plant/Crop Characteristics

- Yield
- Growth rate
- Root depth/health
- Residue cover



Guidelines for Monitoring Selected Soil Quality Indicators

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

* 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

Strategies to improve soil quality equate to management practices that...

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

References

Doran, J.W., and M.R. Zeiss. 2000. Soil health and sustainability: managing the biotic component of soil quality. *Agric. Ecosys. Environ.* 15(1):3-11.

Doran, J.W., M. Sarrantonio, and M.A. Liebig. 1996. Soil health and sustainability. *Advances in Agronomy.* 56:1-54.

Larson, W.E., and F.J. Pierce. 1991. Conservation and enhancement of soil quality. *In* Evaluation for sustainable land management in the developing world. Vol. 2. IBSRAM Proc. 12(2). Bangkok, Thailand. Int. Board for Soil Res. and Management.

Sarrantonio, M., J.W. Doran, M.A. Liebig, and J.J. Halvorson. 1996. On-farm assessment of soil quality and health. p. 83-105. *In* J.W. Doran and A.J. Jones (ed.) Methods for assessing soil quality. Soil Science Society of America Special Publication 49. SSSA, Madison, WI.