

Soil Survey and Soil Health

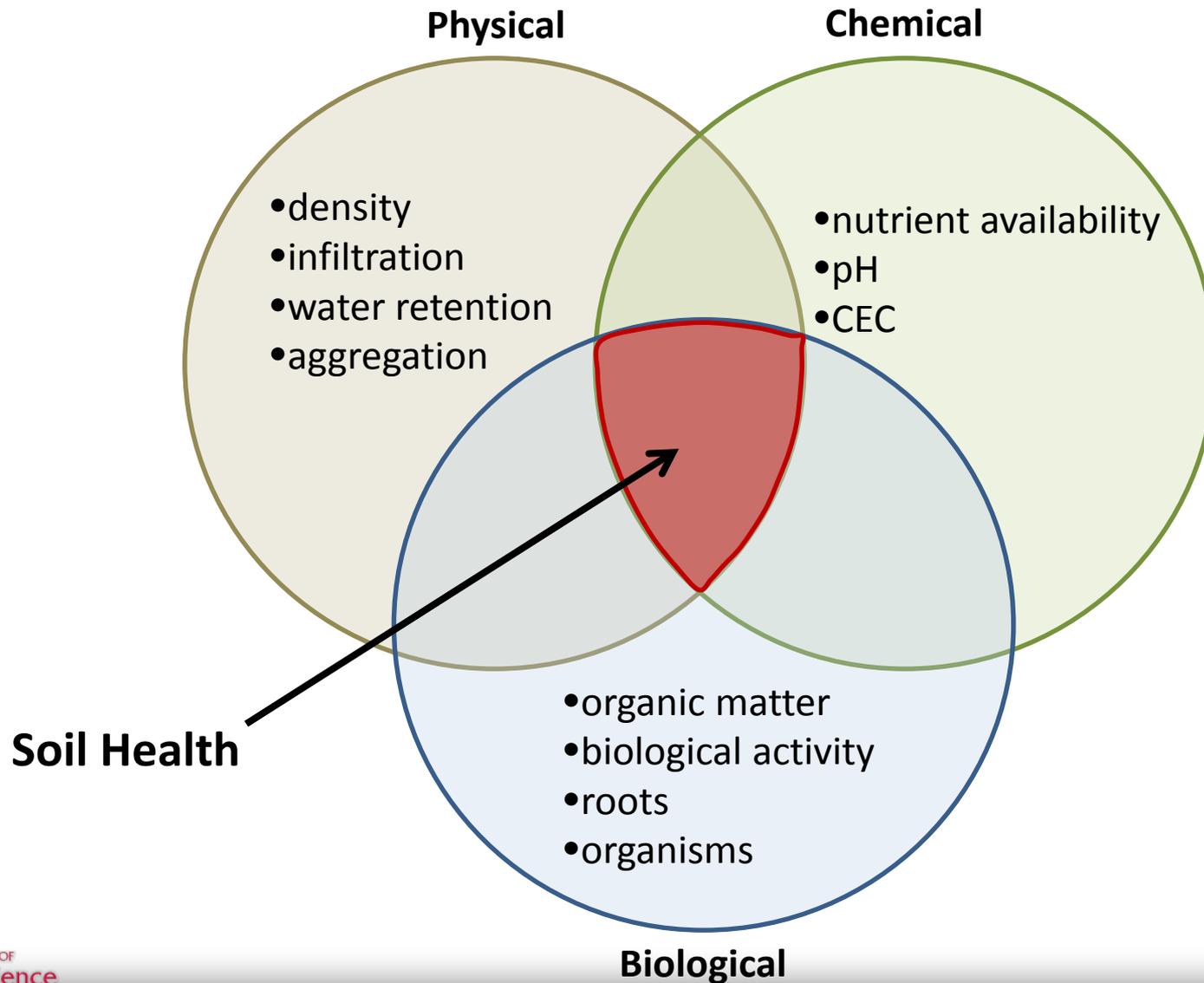
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Cooperative Soil Survey Planning Workshop
November 10, 2015

What is Soil Health?

- Ability of a soil to function in a way that benefits both humans and the environment
- This assumes there is a baseline (i.e. maximum potential) for different soils

Soil Health Indicators (or Soil Properties that Influence Productivity)



Soil Quality Indicators & Their Impact

| Measurement | Process Affected |
|---------------------|---|
| Organic matter | Nutrient cycling, pesticide and water retention, soil structure |
| Infiltration | Runoff and leaching potential, plant water use efficiency, erosion potential |
| Aggregation | Soil structure, erosion resistance, crop emergence, infiltration |
| pH | Nutrient availability, pesticide absorption and mobility |
| Microbial biomass | Biological activity, nutrient cycling, capacity to degrade pesticides |
| Forms of N | Availability to plants, leaching potential, mineralization and immobilization rates |
| Bulk density | Root penetration, water/air filled pores, biological activity |
| Topsoil depth | Rooting volume, water and nutrient availability |
| Available nutrients | Capacity to support plant growth, environmental hazard |

(Karlen et al. SSSAJ , 1997)

CT

Roto-tilled

NT



Organic matter oxidation

Conc. H₂O₂

NT

Roto-tilled

CT



Aggregate stability

Slake test

photos: F. Arriaga, Soil Science

Water Infiltration

Field Day August 2013

Conventional



No-tillage



photos: Roger Schmidt, NPM Program

Assessing Soil Health

1. SUBJECTIVE:

- Soil Health?
- Smell, feel, look, taste?
- Soil Quality Rating

2. QUANTITATIVE:

- Chemical
 - pH, O.M., nutrients
- Physical
 - Structure, bulk density
- Biological
 - Respiration, microbial biomass
- Integrate factors into an index



Soil Health Score Card Example

Field Notes

Current field management
(tillage, fertilizer, irrigation, crop rotation, other)

*soil test showed need
for potassium*

Ideas for changes in field management

*1. add potassium fertilizer
2. ?????*



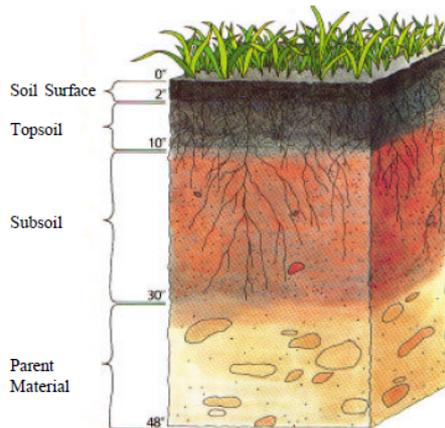
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Nebraska

Soil Quality Card



Developed by:

- ♦Nebraska Farmers
- ♦Natural Resources Districts (NRD)
- ♦Nebraska Cooperative Extension
- ♦Soils Staff of the Natural Resources Conservation Service (NRCS)

The soil quality assessment card was developed by farmers in collaboration with the Natural Resources Conservation Service (NRCS), Natural Resources Districts (NRD), and the University Nebraska Lincoln. It has been locally adapted by Nebraska NRCS as a field tool for Nebraska farmers, educators, and agricultural support professionals such as soil conservationists, Cooperative Extension educators, or agriculture industry personnel.

Regular use will allow you to assess current soil quality conditions, record changes

in soil quality, and compare fields and management practices. The card is most effective when filled out by the same person over time. It provides you with a qualitative assessment of the soil. Evaluation scores do not represent absolute measures or values. Use the card in more than one spot on your field to obtain a more representative assessment.

For help in using this card or if you have any questions regarding it, please contact your local NRCS Office:

Telephone # _____
Fax # _____

Suggested Assessment Calendar

| | |
|-----------------------------|--|
| 1. Soil Structure | After rainfall events or irrigation |
| 2. Biological Activity | At planting |
| 3. Erosion | After harvest and during highwind periods or after heavy rain. Also assess after planting. |
| 4. Soil Test Organic Matter | After reviewing soil test data. Assess in fall or spring. |
| 5. Soil compaction | Spring to when plants are about 10" tall. |
| 6. Plant Health | Summer to late summer. |
| 7. Residue | Post harvest, pre plant, growing season |
| 8. Infiltration | After rainfall events. |
| 9. Water Holding Capacity | After soil is at field moisture capacity. Assess during growing season. |
| 10. Other | |
| 11. Other | |

Soil Health Score Card Example (cont.)

NRCS Soil Quality Card

Date: Sept 25, 2014

Crop: wheat

Field location: somewhere in Wisconsin

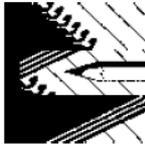
Year of planting: 2013

Soil moisture: Good for planting
 Too dry for planting
 Too wet for planting

| Indicator | Preferred | | | | | | | | | | Observations | Rating the indicator | | | |
|-----------------------------|---|---|---|---|---|---|---|---|---|----|--------------|--|--|--|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | 1 | 5 | 10 | |
| 1. Soil Structure | | | | | | X | | | | | | Hard with no surface residue. Powder when dry, crust easily after a hard rain. Large, hard clods, very hard to prepare seed bed. | Crumbles with pressure. Some residue and organic matter. Crust only in areas such as wheel tracks. | Very crumbly. No crusting, residue prevents surface hardening. Mellow, ready to plant. | |
| 2. Biological Activity | | | | | | | X | | | | | | Very old residue that doesn't decompose; no sign of soil life (insects, worms, etc.) | Moderate decomposition of residue; few soil organisms (insects or worms) | Rapid decomposition of residue; many soil organism and diverse population |
| 3. Erosion | | | | | | | X | | | | | | Signs of severe wind stress or gullies throughout field | Adequate control after windy period or hard rain | Excellent control after hard wind or hard rain. |
| 4. Soil Test Organic Matter | | | | | | | | | X | | | | Downward trend <0.6% organic matter | Static trend 0.8% to 1.2% organic matter | Upward trend 2.0% or above organic matter |
| 5. Soil Compaction | | | | | | X | | | | | | | Hard pan stops roots, roots grow laterally | Few roots grow through, some grow laterally | Roots grow straight down |
| 6. Plant Health | | | | | | | | | | | | <i>not applicable</i> | Yellow, thin stalks | Yellow-green, medium stalks | Dark green, thick stalks |
| 7. Residue | | | | | | | | | X | | | | Little or no surface residue Few roots in subsoil | Moderate surface residue, moderate roots | Heavy surface residue Dense roots, tunnels of decomposed roots |
| 8. Infiltration | | | | | | | X | | | | | | Ponding visible | Some ponding - visible after 12-24 hrs. | No ponding |
| 9. Water Holding Capacity | | | | | | | X | | | | | | Crops wilt quickly after water events | Crops curl or wilt but come back quickly | Crops tolerate droughty conditions |
| Other | <i>cover crop planted; slightly denser soil layer detected between 6-8" of depth.</i> | | | | | | | | | | | | | | |

How to use the card

1 Enter date, location crop, and soil moisture level in the assessed field.



2 Use a shovel or a soil probe to probe the soil. Rate each indicator on a scale from 1 to 10. Refer to the rating guide to determine the score for each indicator.



3 Record your observations. Review and evaluate your scoring.



4 On the back page, write down current management practices. Record ideas for changes in management that you will implement as a result of your assessment.





Cornell Soil Health Assessment 2014

Cornell Nutrient Analysis Lab (CNAL), G01 Bradfield Hall, Ithaca, NY 14853 (607) 255-4540

Soil Health Lab Coordinator Bob Schindelbeck (607) 227-6055, rs3@cornell.edu

E-mail: soilhealth@cornell.edu

Website: http://soilhealth.cals.cornell.edu



Please provide the SOIL NAME. For soil maps and soil names visit <http://websoilsurvey.nrcs.usda.gov/app/>

★ Remember: 8 cups of soil (2 QUARTS) are needed! ★

| | | |
|--|--|--|
| Grower Name: _____ Address: _____ Phone: _____ Email: _____ | Note: All personal information is kept confidential <i>Wisconsin</i> COUNTY: _____ | Agricultural Service Provider Name: <i>Rico Ag Services</i> Address: _____ Phone: _____ Email: <i>rico@agservices.com</i> |
|--|--|--|

| | |
|---|---|
| Soil Health Assessment Package* \$85 \$ <u>85</u> | <input type="checkbox"/> Check enclosed (to: CORNELL UNIV.) |
| NEW FOR 2014 The set of tests that make up the Soil Health Assessment has been changed: Two tests have been added and one has been removed. See back of sheet or Website for more details | <input type="checkbox"/> Paid Agent (name): |
| Add-on Soluble Salts \$7.50 \$ <u>X</u> | <input type="checkbox"/> Bill Me for charges using account: |
| Add-on Metals Screening \$17 \$ <u>X</u> | <input type="checkbox"/> Bill Me for charges using credit card (\$50 minimum): (you will be called to provide info.) |
| Add-on Hot water-soluble Boron \$15 \$ <u>X</u> | \$85 :Total |

| SOIL INFORMATION | | |
|-----------------------|-------------------------------|------------------|
| LAB ID (Lab Use Only) | Field Identification | Date Sampled |
| | <i>Soil quality sample #1</i> | <i>18Sept'14</i> |

| | | | |
|--|---|--|--|
| GPS Coordinates for Field or Sample | | Latitude: _____ | Longitude: _____ |
| SOIL NAME (REQUIRED) (ex. LIMA silt loam) <i>Antigo silt loam</i> | Tillage Depth 2012 2013 2014 <i>1 1 1</i> 1 = no till, 2 = 1-7 inch, 3 = 7-9 inch, 4 = >9 inch | Artificial Drainage <i>1</i> 1 = none, 2 = Inadequate, 3 = Adequate, 4 = Excellent | Manure / Organic Additions Type/ Animal Amount/ Acre [] 2012 [] 2013 [] 2014 <i>unknown</i> |

| CROP INFORMATION (see back of this sheet for Crop Codes) | | | | | | | | |
|---|--|----------|-----------------|-------------------|----------------|--------------|-------------------|----------------|
| % Legume Last Year | Cover Crop | | Past Year Crops | | | Future Crops | | |
| <i>1</i> 1 = 0%, 2 = 1-25%, 3 = 26-50%, 4 = 51-100% | <i>1</i> 1 = Before next crop, 2 = Before 2nd years crop, 3 = Before 3rd years crop, 4 = Before all years crop | <i>1</i> | 3 yrs ago | 2 yrs ago | Last yr | This yr | Next yr | Third yr |
| | | | <i>wheat</i> | <i>corn grain</i> | <i>soybean</i> | <i>wheat</i> | <i>corn grain</i> | <i>soybean</i> |

| FIELD PENETROMETER DATA COLLECTION (use SMALL 1/2" tip) | | | | | | | | | | | |
|---|------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|--|
| PENETRATION RESISTANCE | location 1 | | location 2 | | location 3 | | location 4 | | location 5 | | Depth to Hardpan or a Restrictive Layer (inches): <i>slight restriction 6-8" of depth</i> |
| | 0-6 INCH Maximum | push 1 | push 2 | push 3 | push 4 | push 5 | push 6 | push 7 | push 8 | push 9 | |
| 6-18 INCH Maximum | <i>200</i> | <i>200</i> | <i>250</i> | <i>175</i> | <i>200</i> | <i>175</i> | <i>225</i> | <i>250</i> | <i>300</i> | <i>225</i> | |

Record the highest resistance value encountered in each depth range. NOTE: A field penetrometer is available to borrow. Contact Bob Schindelbeck (at top of page) and it can be sent to you through the mail.

222

220



Cornell Soil Health Assessment

Sample ID:
 Field/Treatment:
 WI
 Tillage:
 Crops Crown:
 Date Sampled:
 Given Soil Type:
 Given Soil Texture:
 Coordinates:

Measured Soil Textural Class: Silt Loam

Sand: 4% Silt: 75% Clay: 21%

Test Report

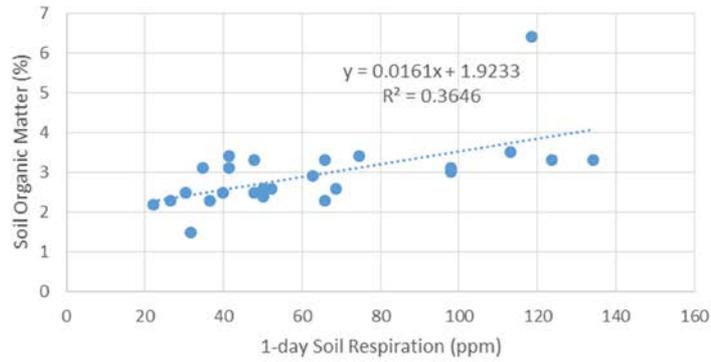
| | Indicator | Value | Rating | Constraint |
|------------|---|-------|--------|---|
| Physical | Available Water Capacity | 0.18 | 64 | |
| | Surface Hardness | 222 | 29 | Rooting, Water Transmission |
| | Subsurface Hardness | 220 | 77 | |
| | Aggregate Stability | 45.4 | 71 | |
| Biological | Organic Matter | 3.4 | 48 | |
| | ACE Soil Protein Index | 5.0 | 23 | Organic Matter Quality, Organic N Storage, N Mineralization |
| | Root Pathogen Pressure | 4.5 | 56 | |
| | Respiration | 0.45 | 0 | Soil Microbial Abundance and Activity |
| | Active Carbon | 752 | 77 | |
| Chemical | pH | 6.5 | 100 | |
| | Phosphorus | 6.7 | 100 | |
| | Potassium | 153.9 | 100 | |
| | Minor Elements Mg: 762 Fe: 0.9 Mn: 4.7 Zn: 1.2 | | 100 | |

Overall Quality Score

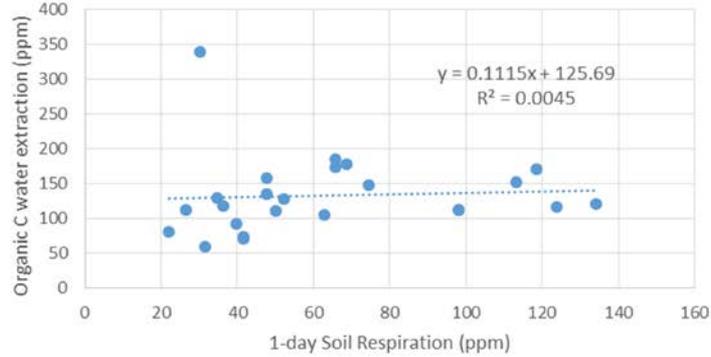
65

Medium

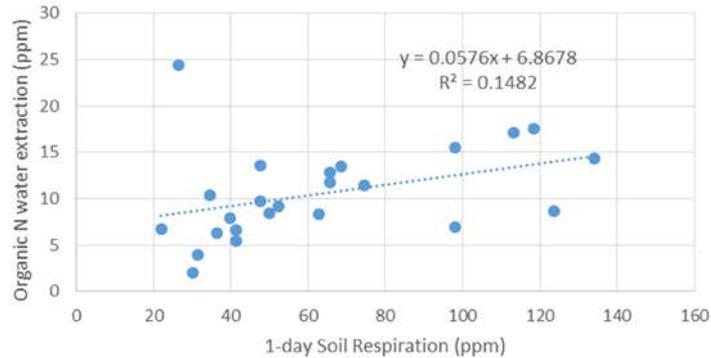
1-day CO₂ versus SOM



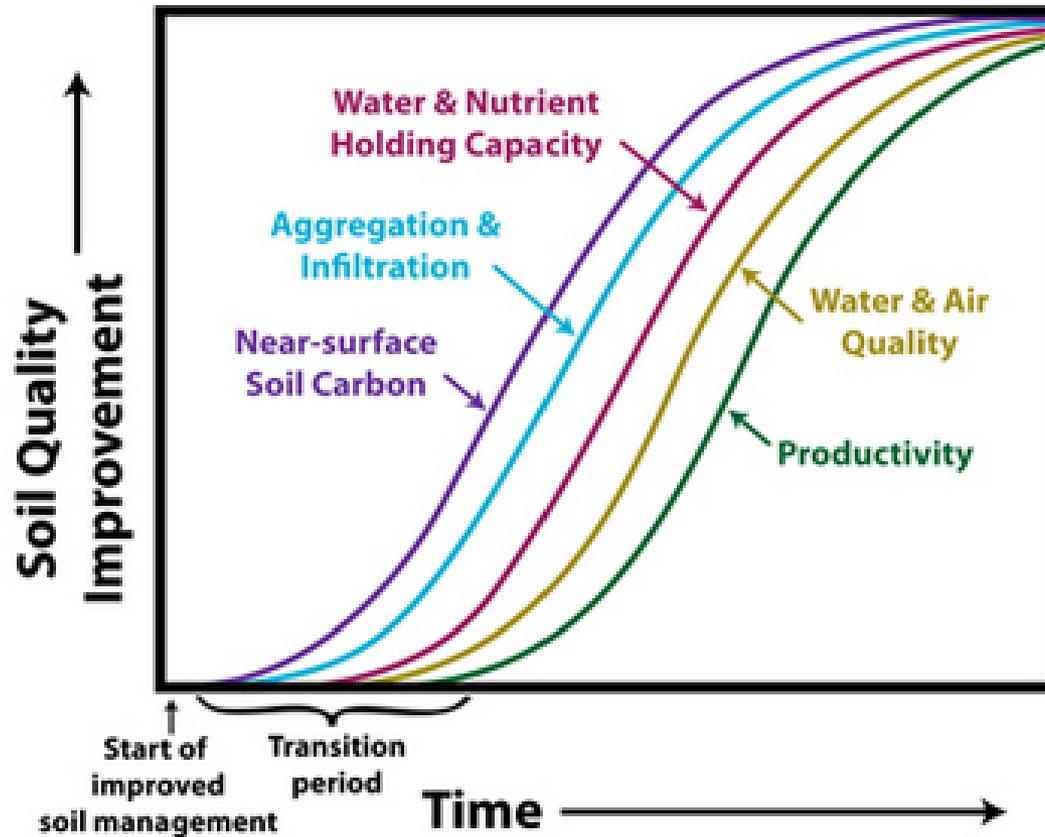
1-day CO₂ versus organic C



1-day CO₂ versus organic N



Management Effects Over Time



Possibilities for Soil Health in SS

- Add measurements on SH parameters, but also include soil management information.
- Incorporate a SH potential index into database.
- Other???

Photo: F. Arriaga



Old woods

Kewaunee B horizon

Hay (2009-12); Corn (2013)

Corn silage-2 years

Corn silage-2 years

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