Measuring and Managing Changes in Soil Health

PA DEP’s Ag Advisory Board
April 15th, 2015
DEP South-Central Regional Office, Susquehanna Room A, Harrisburg, PA

Dan Dostie
USDA NRCS
Presentation Topics

• NRCS Assistance for Improving Soil Health

• How does Soil Health relate to DEP Regs?

• What is different about this approach to Ag?
NRCS Assistance for Soil Health

- Long Range Soil and Water Conservation District Soil Health Program Development
- Planning Assistance
- Practice Application Assistance through NRCS programs
Many Pennsylvania Partners

Second Annual
PA No-Till Alliance Soil Health Field Days
July 29, 30 & 31
Three locations - Same program & speakers at all!
More info at www.panotill.org or (717) 635-2320

July 29  Oregon View Farm - Jay Landis, host
         1270 E. Oregon Road, Lititz, PA 17543

July 30  M & A Farms - Mark Rohrbach, host
         57 Howglen Lane, Catawissa, PA 17820

July 31  Fabin Brothers Farms - Scott Reinhart, host
         231 Bethel Church Road, Indiana, PA 15701

Join us for the 24th Annual
FARMING FOR THE FUTURE CONFERENCE

WE’RE PLEASED TO ANNOUNCE OUR MAIN SPEAKERS

Saturdays Morning Main Speaker
Ray Archuleta is a Conservation Agronomist at the
NRCS’s Eastern National Technical Center in North Carolina. Known as ‘The Soil Guy’, Ray shares his infectious enthusiasm for soil health and the principles of agroecology as he travels around the country. His biological approach looks to the more than 3 billion years of evolutionary knowledge embedded in nature to guide the organic grower’s practice. He has 25 years of experience with the Natural Resources Conservation Service.
No-till and Soil Health Support

This program is intended to support farm profitability and soil health with peer-to-peer and technical support for no-till systems and other soil health best management practices. Read more...

Grass Roots
Prescribed Grazing for the 21st Century

Prescribed Grazing is an interactive planning method, done with the operator based on individual goals and needs which can include intensive rotational, rotational, and continuous grazing. Read more...

Park The Plow for Profit

Through the Park the Plow program, Capital RC&D promotes no-till farming as a more profitable and environmentally-friendly alternative to traditional farming methods. Read more...
# Upcoming Soil Health Workshops

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Location</th>
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<tbody>
<tr>
<td>March 17</td>
<td>Connect Soils to Profits</td>
<td>USDA Service Center, Mill Hall, PA</td>
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<tr>
<td>March 18</td>
<td>Connect Soils to Profits</td>
<td>Pine Barn Inn, Danville, PA</td>
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<td>March 19</td>
<td>Connect Soils to Profits</td>
<td>Wysox Fire Hall, Towanda, PA</td>
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<td>July 27-29</td>
<td>PA No-Till Alliance Field Day</td>
<td>Elizabethtown, PA</td>
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<td>August 18-20</td>
<td>Ag Progress Days Soils Exhibit</td>
<td>Rock Springs, PA</td>
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<td>End of August</td>
<td>Advanced Soil Health Technical Discussion</td>
<td>Ag Progress Days Site, Rock Springs, PA</td>
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<td>September</td>
<td>Grazing Pasture Soil Health Field Day</td>
<td>Wilson Farm, Forest County</td>
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<tr>
<td>October 14-16</td>
<td>The Precarious Alliance: Land and its Uses</td>
<td>Del Val College</td>
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</table>
Is selling corn residue worth harming soil?

Futurity

After the corn harvest, farmers still have plant material, called corn residue, left behind. Farmers considering selling that corn residue to produce cellulosic ethanol should consider carefully, according to new research. Mahdi Al-Kaisi, a professor of agronomy at Iowa State University, is urging farmers to consider variables such as topography, tillage system, nitrogen application and the amount of organic matter present in their soil to determine how much corn residue they should part with.

Share this article:  
READ MORE

Cover Crops That Pay™
Advanced genetics, proven by research
NRCS Program Assistance

CTA – Haney Test Field Trials with ARS

Soil Health Nutrient Tool
Cropland Data Collection Form

1. Lab ID: __________
2. Field Acres: __3239__
3. Soil Texture (predominant topsoil texture): (circle one)
   - Sand
   - Loamy Sand
   - Silt loam
   - Loam
   - Silty Clay
   - Clay loam

<table>
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<tr>
<th>Sample ID</th>
<th>N lbs per acre</th>
<th>P2O5 lbs per acre</th>
<th>K2O lbs per acre</th>
<th>Nutrient value per acre</th>
<th>Crop</th>
<th>Yield Goal</th>
<th>lbs N needed</th>
<th>lbs P2O5 needed</th>
<th>lbs K2O needed</th>
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<td>69.89</td>
<td>137.80</td>
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<td>Wheat</td>
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<td>MC02</td>
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<td>MC03</td>
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<td>86.56</td>
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<td>61.04</td>
<td>51.18</td>
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</table>

Pounds of plant available Nitrogen per acre in your soil
Pounds of plant available P2O5 per acre in your soil
Pounds of plant available K2O per acre in your soil
Dollar value of nutrients in your soil based on fertilizer prices.

Type in your Yield Goal
Type in your Crop
- Wheat
- Corn
- Sorghum
- Oats
- Soybeans
- Sunflowers
- Grass
- Cotton

bulk per acre
NRCS Program Assistance

EQIP Practice Scenarios (No Till, Cover Crops, etc.)

<table>
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<tr>
<th>EQIP</th>
<th>Practice Description</th>
<th>Rotation Description</th>
<th>Acres</th>
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<td>Standard Rotation</td>
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<td>HU-Standard Rotation</td>
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<td>Specialty Crops Rotation</td>
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<td>HU-Specialty Crops Rotation</td>
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<td>Organic Standard Rotation</td>
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<td>HU-Organic Standard Rotation</td>
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<td>Organic Specialty Crops Rotation</td>
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<td>HU-Organic Specialty Crops Rotation</td>
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<td>No-Till/Strip-Till</td>
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<td>Residue and Tillage Management - No-Till</td>
<td>HU-No-Till/Strip-Till</td>
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<td>Organic No-Till/Strip-Till</td>
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<td>Residue and Tillage Management - No-Till</td>
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<td>No Till Adaptive Management</td>
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<tr>
<td>340</td>
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<td>HU-Small grain or legume</td>
<td>70</td>
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<td>Aerial Seeding</td>
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<td>340</td>
<td>EQIP Cover Crop</td>
<td>HU-Organic Mix</td>
<td>130</td>
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</table>
NRCS Program Assistance

CSP Enhancements:

SQL18—Soil health crop rotation
SQL15 - Utilize the soil health nutrient tool to assess soil nutrient pools
ENR10 – Using nitrogen provided by legumes, animal manure and compost to supply 90 to 100 percent of the nitrogen needs
ENR12 – Use of legume cover crops as a nitrogen source
PLT20 – High residue cover crop or mixtures for weed suppression
SOE05 – Intensive no-till (organic or non-organic systems)
SQL08 – Intercropping to improve soil quality and increase biodiversity
SQL12 – Intensive cover cropping for annual crops
SQL16 - High species diversity grazing land
Planning Assistance: Measuring Soil Property Indicators of Quality

**Biological Health**
- Community Populations
- Species Diversity

**Chemical Properties**
- Nutrient Availability
- pH & CEC

**Physical Structure**
- Rainfall Infiltration & Runoff
- Aggregate Stability & Slaking
http://mapmaker.millersville.edu/PAmaps/Soils/

Soil Orders

- Alfisol
  - High Nutrients
  - Young Soils
- Ultisol
  - Low Nutrients
  - New Soils
- Inceptisol

Credits

Data source for Populated Places: Esri, Inc.
Map and webpage created by: Dr. Geiger, 2012.
Key principles to improve soil health

- Minimize soil disturbance
- Keep the soil covered
- Grow a living root year round
- Diversify the kinds of plants
- Integrate animals where possible

Productivity  Health  Resiliency
Field Scale Rainfall Simulator
Infiltration & Runoff Demonstration
Demonstrating Infiltration Properties

A one inch layer of water is added to a six inch diameter ring to measure infiltration rate.
Diagnosing Soil Compaction

Figure 1.1-5. Topsoil compaction is caused by contact pressure, whereas lower subsoil compaction is caused by axle load.
Key #1: Limit Soil Disturbance

- Agricultural disturbance destroys soil organic matter
- Destroys habitat for soil organisms and creates a hostile environment
- Types of disturbance
  - Physical (tillage)
  - Chemical (over application)
  - Biological (over grazing)
How does Soil Health relate to DEP?

Regs?
Chapter 102.4(a)?
Chapter 102.4(b)?
Chapter 91?

... None of the above ... More a Growing Greener
What is different about this approach?

Holistic Functioning

Stewardship

Principles not Practices

“As to methods, there maybe a million and then some, but principles are few. The man who grasps principles can successfully select his own method”
- Ralph Waldo Emerson
What is different about this approach?
Principles More than Practices

- Integrate Diversity Of Animals
- Reduce Chemical, Biological, and Physical Stress
- Understand Your Social & Ecological Context
- Cover The Soil at all times
- Synergize with Diversity: Crop Rotations and Cover Crops
- Grow a Living Root 24/7
What is a Healthy Soil?
A holistic portrait of the soil integrating physical, chemical, biological properties to grow desired plants.
A Healthy Soil Works (functions) for You, All
(So You don’t have to work for dirt! Or muddy your neighbors . . . )

• Provide physical support to plants
• Create structural habitat, space for soil life (house)
• Regulate water flow
• Regulate air flow below ground
• Release and recycle nutrients (food)
• Filter and adsorb toxins
• Buffer against extreme changes
Desired Soil Qualities to Grow Plants

• Good soil tilth, sufficient depth for roots
• Good soil drainage
• Large population of beneficial organisms
• Small population of pathogens, weed & insect pests
• Sufficient, but not excessive, nutrient supply
• No chemicals or toxins that may harm the crop
• Resilience to degradation and unfavorable conditions
Benefits of Soils Working Well

Soil health matters because:

1. Healthy soils are high-performing, productive soils.
2. Healthy soils reduce production costs—and improve profits.
3. Healthy soils protect natural resources on and off the farm.
4. Franklin Roosevelt’s statement, “The nation that destroys its soil destroys itself,” is as true today as it was 75 years ago.
5. Healthy soils can reduce nutrient loading and sediment runoff, increase efficiencies, and sustain wildlife habitat.

What are the benefits of healthy soil?

1. Healthy soil holds more water (by binding it to organic matter), and loses less water to runoff and evaporation.
2. Organic matter builds as tillage declines and plants and residue cover the soil. Organic matter holds 18-20 times its weight in water and recycles nutrients for plants to use.
3. One percent of organic matter in the top six inches of soil would hold approximately 27,000 gallons of water per acre!
4. Most farmers can increase their soil organic matter in three to 10 years if they are motivated about adopting conservation practices to achieve this goal.
Soil Biology Respiration Measures

NEW TECHNOLOGY FOR MEASURING SOIL C AND N MINERALIZATION POTENTIAL

Solvita® - Innovative rapid test for 24 hour CO₂ burst.

- No extra lab equipment
- No wet chemistry
- Streamline tests
- High volume per day
- Reduce costs
- Field and lab use

Soil studies have shown the utility of testing CO₂ respiration as a means to gauge active soil carbon and potential release of nitrogen. Recent research shows that the CO₂ burst from short-term drying-rewetting accurately predicts N+P mineralization, and is superior to current estimates of N-Min potential from soil organic matter. The Solvita® procedure combines these findings with modern technology in a reliable, simple-to-use process which can be performed fairly rapidly at a significantly reduced cost compared to traditional lab respirometry.

Simple, accurate procedure:

1. Weigh in dry soil
2. Place in jar
3. Add H₂O
4. Insert CO₂ sensor
5. Incubate at 25°C
6. Read CO₂ ppm at 24hr
Solvita Basal Respiration Test

- Field measure of background CO2 evolution from soil microbial activity
- Soils with a carbon source and adequate microbial activity will respire more than soils without
- Measurement is a proxy for available nitrogen – 10 parts C released = 1 part N
Integrating Tests into Holistic Soil Health Assessments
The Cornell soil health assessment protocol emphasizes the integration of soil biological measurements with soil physical and chemical measurements. These measurements include soil texture and stone content, wet aggregate stability, available water capacity, field penetrometer resistance, potentially mineralizable nitrogen, active carbon, organic matter content, root health assessment, and macro- and micro-nutrient level assessment. These measurements were selected from 39 potential soil health indicators (page 10, Table 1) that were evaluated for their:

- sensitivity to changes in soil management practices
- relevance to soil processes and functions
- consistency and reproducibility
- ease and cost of sampling
- cost of analysis.

The results of these measurements have been synthesized into a grower-friendly soil health report that can initially be used by the grower as a baseline assessment. Subsequent...
ARS Dr. Haney: Testing in Nature’s Image

Traditional Soil Test:
1. pH, CEC
2. Soil N, P, K.
3. Maybe % OM
How can we measure soil health?

- Treat the soil as a living, integrated system
- Use new indicators of soil health and function
- Better information leads to better efficiency
- Measure biological activity
- Measure microbial food
- Not just the house
- Use soil extracts that are naturally occurring
- Integrate the data to form a more complete picture of biology and chemistry
Haney Test: measures the food!

- House: 2% SOM, 12,000 ppm C
- Food: 100-300 ppm C from water extract = microbial food
NRCS\ARS begin 5 yr field trial project

Measure soil health by asking our soil the right questions:

- What is your condition?
- Are you in balance?
- What can we do to help?
Commercial Soil Health Tests for plant available nutrients

Haney Test .......................................................... $49.50
The Haney Test is a dual extraction procedure that allows the producer to assess overall soil health. The test is used to track changes in soil health based on management decisions. This test examines total organic carbon and total organic nitrogen to determine a C:N ratio used to make general cover crop recommendations. This test also includes the Solvita CO₂ Burst Test to look at microbial activity and potentially mineralizable nitrogen. The weak acid (H3A) extraction represents some available plant nutrients.

http://www.wardlab.com
Ward Lab, Kearney, Nebraska*

http://www.blinc.com/soils.htm
Brookside Lab, New Breman, Ohio

http://www.solvita.com
Woods End Lab, Mt Vernon, Maine

*Also provides a biology presence test of microbial functional groups identified by phospholipid fatty acid markers
Jim Harbach, Clinton County Conservation District Director, testified September 18 at a Congressional Agricultural Sub Committee hearing in Washington DC.

Mr. Harbach was one of four panel members invited to speak about the benefits of promoting soil health in agriculture and rural America. NRCS Chief Jason Weller also testified at the hearing.
Where to go for more information?

NRCS's "Unlock the Secrets in Soil Health" communications website


NRCS’s Science & Technology Training Library:

http://www.conservationwebinars.net/webinars

Cornell’s Soil Health Assessment Manual

http://soilhealth.cals.cornell.edu/extension/manual.htm

ARS Grassland Soil and Water Research Lab Dr. Rick Haney

http://research.brc.tamus.edu/snap/