Soil Health and Maize Yield Analysis Detects Long-Term Tillage and Cropping Effect

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On behalf of Dr. Harold van Es Dr. Marcio Nunes Robert Schindelbeck

soilhealth.cals.cornell.edu
Soil Health is...

“the capacity of the soil to function....”

(Doran and Parkin, 1993)

Full NRCS definition used by NRCS national Soil Health Initiative:

“The continued capacity of the soil to function as a vital living ecosystem that sustains plants, animals, and humans.”
Quantification

“You don’t know if you don’t measure....”

“What gets measured, gets done.....”
Management for healthy soils
Cornell Soil Health Assessment Framework

- **Publically available** since 2006
- **Identifies soil constraints**
- **Measures 16 indicators**
  - Representing agronomically important soil processes
  - Consistent and easy to implement
  - Includes standard nutrient test
- **Guide for management decisions**
  - Values interpreted with scoring functions
  - Report includes written interpretations and management suggestions table

**Comprehensive Assessment of Soil Health**

Grower: Bob Schindelbeck
306 Tower Rd.
Ithaca, NY 14853

Agricultural Service Provider:
Mr. Bob Consulting
rs3@cornell.edu

Sample ID: LL4
Field ID: AUR E Zone Till - WITH Cover Crop
Date Sampled: 05/14/2015
Given Soil Type: Lima silt loam
Crops Grown: COG/COG/COG

**Measured Soil Textural Class: loam**

<table>
<thead>
<tr>
<th>Group</th>
<th>Indicator</th>
<th>Value</th>
<th>Rating</th>
<th>Constraints</th>
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<tbody>
<tr>
<td>physical</td>
<td>Available Water Capacity</td>
<td>0.22</td>
<td>82</td>
<td>Rooting, Water Transmission</td>
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<tr>
<td>physical</td>
<td>Surface Hardness</td>
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<tr>
<td>physical</td>
<td>Subsurface Hardness</td>
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<td>Aggregate Stability</td>
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</table>

Overall Quality Score: **65** / Excellent
We know what works......

From: Lehman et al., 2015

Tend to Reduce Soil Health
- Aggressive tillage
- Annual/seasonal fallow
- Mono-cropping
- Annual crops
- Excessive inorganic fertilizer use
- Excessive crop residue removal
- Broad spectrum fumigants/pesticides
- Broad spectrum herbicides

Tend to Promote Soil Health
- No-till or conservation tillage
- Cover crops; Relay crops
- Diverse crop rotations
- Perennial crops
- Organic fertilizer use (manures)
- Crop residue retention
- Integrated pest management
- Weed control by mulching and/or cultural tactics

Develop plans addressing concerns and opportunities
Current Research

Musgrave Research Farm - Aurora, NY

Continuous corn for 22 yrs on 6 replicated plots

No-till (NT) vs. Plow-till (PT)

In 2013, interseeded cover crop (CC) vs. no cover (NC)

Honeoye-Lima silt loam

Nunes et al, 2018. (Geoderma)
Soil Health Indicators and Management

- Soil health increases from reducing tillage over the long term
- Adding cover crops resulted in benefits after only a few seasons
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- Soil health increases from reducing tillage over the long term
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Infiltration and Management

- Infiltration improved from reducing tillage
- Adding cover to reduced tillage improved infiltration
Combining the various management practices that promote soil health can have an additive effect.
Musgrave Soil Health Yields

22 years continuous corn
3 years of cover crop
3 seasons of corn silage yields

Treatments by tillage and time of corn monoculture factors

Reduced tillage management resulting in significantly higher yields

CC shows improvements too

USDA NRCS
Long term research plots
Russell Ranch – UC Davis

Conventional (CMT), Low-input (LMT) and Organic (OMT), Russell Ranch, UC Davis

Scow and Kabir, 2017
Assessment of Soil Health Summary

- Soil health important to resilience and crop productivity
- Measure to know
- Identify constraints, target management
- Major management changes need to be carefully planned and guided through a planning framework
- Reducing tillage and cover cropping appear to relate improvement in key soil health indicators
Integrating soil health and nutrient management through the use of advanced tools:

- **Adapt-N** dynamic N management tool
- **Soil Health Assessment**

Sela and van Es, 2018 (JSWC)
Resources
Information!

http://www.sare.org/Learning-Center/Books