Creating a Soil Health Management Plan

How do I use the information?

• Understand soil processes & management impacts
• Identify constraints through soil health assessment
• Select & implement appropriate management strategies
• Monitor change and adjust management

Bob Schindelbeck, rrs3@cornell.edu
Aaron Ristow, ajr229@cornell.edu
http://soilhealth.cals.cornell.edu
1. Report is a Management Guide, not a prescription
2. Different mgmt approaches can mitigate same problem
3. One management practice can affect multiple indicators
4. Information from varied sources: workshops, field days, local experience
5. Adapt Report Information to a mgmt strategy to fit your field/farm
6. Soil health changes slowly over time

Principles of Soil Health Management

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Overall Quality Score: 64 / Excellent
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<tr>
<th>Constraint</th>
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<th>Long Term Management Suggestions</th>
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| Available Water Capacity Low                    | • Add stable organic materials, mulch  
  • Add compost or biochar  
  • Incorporate high biomass cover crop | • Reduce tillage  
  • Rotate with sod crops  
  • Incorporate high biomass cover crop |
| Surface Hardness High                           | • Perform some mechanical soil loosening (strip till, aerators, broadfork, spader)  
  • Use shallow-rooted cover crops  
  • Use a living mulch or interseed cover crop | • Shallow-rooted cover/rotation crops  
  • Avoid traffic on wet soils, monitor  
  • Avoid excessive traffic/tillage/loads  
  • Use controlled traffic patterns/lanes |
| Subsurface Hardness High                       | • Use targeted deep tillage (subsoiler, yeomans plow, chisel plow, spader.)  
  • Plant deep rooted cover crops/radish | • Avoid plows/disks that create pans  
  • Avoid heavy loads  
  • Reduce traffic when subsoil is wet |
| Aggregate Stability Low                         | • Incorporate fresh organic materials  
  • Use shallow-rooted cover/rotation crops  
  • Add manure, green manure, mulch | • Reduce tillage  
  • Use a surface mulch  
  • Rotate with sod crops and mycorrhizal hosts |
| Organic Matter Low                              | • Add stable organic materials, mulch  
  • Add compost and biochar  
  • Incorporate high biomass cover crop | • Reduce tillage/mechanical cultivation  
  • Rotate with sod crop  
  • Incorporate high biomass cover crop |
| ACE Soil Protein Index Low                      | • Add N-rich organic matter (low C:N source like manure, high N well-finished compost)  
  • Incorporate young, green, cover crop biomass  
  • Plant legumes and grass-legume mixtures  
  • Inoculate legume seed with Rhizobia & check for nodulation | • Reduce tillage  
  • Rotate with forage legume sod crop  
  • Cover crop and add fresh manure  
  • Keep pH at 6.2-6.5 (helps N fixation)  
  • Monitor C:N ratio of inputs |
| Soil Respiration Low                            | • Maintain plant cover throughout season  
  • Add fresh organic materials  
  • Add manure, green manure  
  • Consider reducing biocide usage | • Reduce tillage/mechanical cultivation  
  • Increase rotational diversity  
  • Maintain plant cover throughout season  
  • Cover crop with symbiotic host plants |
| Active Carbon Low                               | • Add fresh organic materials  
  • Use shallow-rooted cover/rotation crops  
  • Add manure, green manure, mulch | • Reduce tillage/mechanical cultivation  
  • Rotate with sod crop  
  • Cover crop whenever possible |

Constrained and Suboptimal indicators are flagged in Report management table
SH Management Planning Process Overview

1. Determine farm background and management history

Compile background info: history by management unit, farm operation type, equipment, access to resources, situational opportunities or limitations.

Grower
strengths

2. Set goals and sample for soil health

Determine number and distribution of soil health samples needed according to operation background and goals.

Grower goals
Soil sampling

3. For each management unit: identify and explain constraints, prioritize

Soil Health Report identifies constraints, guides prioritization. Explain results based on background, and adjust priorities.

Evaluate
results

4. Identify feasible management options

Management suggestions table available as part of Soil Health Report, or online with NRCS practice linkages.

Define
options

5. Create short and long term Soil Health Management Plan

Integrate agronomic science of 2-4 with grower realities of 1 to create a specific short-term schedule of management practices for each management unit and an overall long-term strategy.

Refine
options

6. Implement, monitor, and adapt

Implement and document management practices. Monitor progress, repeat testing, and evaluate outcomes. Adapt plan based on experience and data over time.

Implement Evaluate

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Focus the information

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### Comprehensive Assessment of Soil Health

From the Cornell Soil Health Laboratory, Department of Soil and Crop Sciences, School of Integrative Plant Science, Cornell University, Ithaca, NY 14853. [http://soilhealth.cals.cornell.edu](http://soilhealth.cals.cornell.edu)

**Grower:** Deb Schmidtbeck

**Sample ID:**

- Field ID: pg617
- Date Sampled: 02/13/2017
- Soil Type: Calcareous silt loam

**Soil Textural Class:** silt loam

- Sand: 10%
- Silt: 73%
- Clay: 16%

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**Overall Quality Score:** 52 / Medium
SH Management Planning Process Overview

1. Determine farm background and management history
   Compile background info: history by management unit, farm operation type, equipment, access to resources, situational opportunities or limitations.

2. Set goals and sample for soil health
   Determine number and distribution of soil health samples needed according to operation background and goals.

3. For each management unit: identify and explain constraints, prioritize
   Soil Health Report identifies constraints, guides prioritization. Explain results based on background, and adjust priorities.

4. Identify feasible management options
   Management suggestions table available as part of Soil Health Report, or online with NRCS practice linkages

5. Create short and long term Soil Health Management Plan
   Integrate agronomic science of 2-4 with grower realities of 1 to create a specific short-term schedule of management practices for each management unit and an overall long-term strategy

6. Implement, monitor, and adapt
   Implement and document management practices, monitor progress, repeat testing, and evaluate outcomes. Adapt plan based on experience and data over time.

Phase I
- Grower strengths
- Soil sampling
- Evaluate results

Phase II
- Grower goals
- Define options
- Refine options

Phase III
- Implement
- Evaluate
Soil Health Management Planning Process

1. Determine farm background and management history

Given on your Group Report

2. Set goals and sample for soil health

Grower needed baseline soil health info, wants to increase soil resiliency, likes green manures as feed for his new beef operation, access to equipment

3. For each management unit: identify and explain constraints, prioritize

Continuous corn ground is addicted to tillage. Soil is hard, biologically sluggish, low in organic nitrogen stores. Grower has learned of some new cover crops available and wants to know if he can “grow” needed nitrogen and not have to pay for it. And at the same time produce some needed feed for beef.

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Overall Quality Score: 64 / Excellent
Soil Health Management Planning Process

30 acre field just bought
Lima silt loam
Long term moldboard tillage
Long term corn for grain

Robust conventional grower
Interested in cover cropping
Lots of smaller equipment
Does NOT have a no-till drill
Brother now has beef

30 acre field just bought
Lima silt loam
Long term moldboard tillage
Long term corn for grain

Measured Soil Textural Class: loam
Sand: 38% - Silt: 45% - Clay: 16%

Your goal this hour..
Brainstorm

4. Identify feasible management options
Hard soil could be decompacted with tillage. Crops need to be used that prevent reconsolidation of the surface. Loosen deeper zones and ensure that root penetration will keep subsoil “open”. Legume cover crop could provide for soil N and for forage material. Research cover crop to learn of availability, rates, etc.
Step 4– Feasible Management Options

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

NRCS Planning Process – Analyze Resource Data, Formulate and Evaluate Alternatives
Ripper unit with strip-filling coulters and rolling baskets to fit row

- Opening disk
- Rip shank
- Closing coulters
- Firming basket
- Opening disk
Cover Crop Chart

- **GROWTH CYCLE**
  - A = Annual
  - B = Biennial
  - P = Perennial

- **PLANT ARCHITECTURE**
  - Upright
  - Upright-Spreading
  - Prostrate

- **RELATIVE WATER USE**
  - Low
  - Medium
  - High

- **GRASS**
  - Barley
  - Corn
  - Cereal Rye
  - Clover
  - Turnip
  - Vetch

- **BROADLEAF**
  - Canola
  - Lentil
  - Molasses
  - Mustard
  - Pea
  - Wilson

- **MANJOINT**
  - Buckwheat
  - Field Pea
  - Lentil
  - Mustard
  - Pea
  - Wilson

- **LEGUME**
  - Alfalfa
  - Brome Grass
  - Canary Grass
  - Cheat Grass
  - Japanese
  - Klee Grass

Cover Crops for Vegetable Growers

### Why Cover Crops?
- **Soil Health**
- **Cover Crops Decision Tool**
- Newsletter Articles
  - Early Summer
  - Mid and Late Summer
  - Late Summer Legumes
  - Late Summer Crucifers
  - Early Fall
  - Fall
  - Early Spring

- **Why use cover crops in vegetable rotations**
  - Suppressing weeds
  - Protecting soil from rain or runoff
  - Improving soil aggregate stability
  - Reducing surface crust
  - Adding active organic matter to soil
  - Breaking hardpan
  - Fixing nitrogen
  - Scavenging soil nitrogen
  - Suppressing soil diseases and pests

This website is part of a project that enables growers to use a broader range of cover crops to improve soil health by biological means. It will complement the chemical (fungicidal) and physical (tiltage) methods that are being developed by our colleagues. It will also take advantage of the Cornell Soil Health Team's new diagnostic tool for determining which aspects of soil health need improvement. Our goal is to provide a key component of an integrated management recommendation for growers.
**Comprehensive Assessment of Soil Health**

From the Cornell Soil Health Laboratory, Department of Soil and Crop Sciences, School of Integrative Plant Science, Cornell University, Ithaca, NY 14853. [http://soilhealth.cals.cornell.edu](http://soilhealth.cals.cornell.edu)

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**Measured Soil Textural Class: loam**

- Sand: 38%
- Silt: 45%
- Clay: 16%

**5. Create short and long term Soil Health Management Plan**

**Present these to the group**

**Rent deep ripper in May 2018. Spring drill barley, clover, vetch cocktail. Harvest as forage when barley is in flower. Fall drill wheat with rented no-till drill. June 2019 roll down wheat and plant no-till soybeans for forage or grain.**
Conventional Cash Grain 1

Location/Site History:
Five years ago Bob bought a piece of the Aurora research farm ~32 ac of mostly Lima silt loam. Field has been in continuous corn for 25 years. Tried NT and some interseeded cover cropping now for 5 years. Wet springs mean late planting and low areas had generally poor stands of corn. Soil is crusted but a few earthworms are present. Grower feels that this could be good land but it is “tired”.

Opportunities, Challenges, Grower Info:
There are a number of dairy farms and an equipment dealer in close vicinity. Grower wants to try to incorporate some of the features of the “new” cover crops into the rotation to 1) loosen the profile, 2) add N to the soil, 3) produce forage for his brothers beef operation that has been brought in.
Bob has a moldboard plow, disc set, and an old grain drill. He has a modern Deere corn planter which can handle high residue. Brother brought TWO 65HP Deere tractors, a haybine and round baler with him. The brothers want to split the land and grow grain corn for the animals and graze the stover. The rotated land would be used for pasture and haylage.

Comprehensive Assessment of Soil Health
From the Cornell Soil Health Laboratory, Department of Soil and Crop Sciences, School of Integrative Plant Science, Cornell University, Ithaca, NY 14853. http://soilhealth.cals.cornell.edu

Grower: Sandy Rockland
Vernon Center, NY

Sample ID: RR4424
Field ID: Conventional field
Date Sampled: 08/22/2017
Given Soil Type: Lima
Crops Grown: COG/COG/COG
Tillage: no till

Measured Soil Textural Class: loam
Sand: 38% - Silt: 45% - Clay: 16%

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Overall Quality Score: 64 / Excellent
Conventional Cash Grain 2

Location/Site History:
Productive soil near the Aurora research farm – 50 ac of mostly Lima silt loam. Long history of moldboard plowing at 7-9” depth. Field has been in continuous corn/soybean for well over 20 years, and soil was eroded when taken on by this grower back then. Sidedressing usually done at V6 at 200lb/ac since 200 bu/ac is the usual yield. Extreme rainfall caused late planting and poor stands resulted. Corn was yellow. Much of field was soggy, some ponded areas. Crusts formed in higher areas.

Opportunities, Challenges, Grower Info:
There are a number of dairy farms and an equipment dealer in close vicinity. Farmer is concerned with weather variability, especially with all the talk of climate change. He is fairly social, willing to talk to growers in the area about options, but is also cautious/risk-averse. Participated in a research trial for which he was given this soil health test and was told his soil looks ‘tillage addicted’ – all news to him. He isn’t up for spending a ton of money on equipment. He does have a smartphone, and is somewhat computer-inclined. He’s ideally looking for one tried-and-true, simple solution that can apply to the rest of his farm, since he manages 2000 acres and does not have a lot of extra time for special management of one field.
**Conventional Dairy**

**Location/Site History:**
This 40 ac field is part of a 60 cow dairy near Niagara Falls, NY. This field has been in **corn silage for 5 years**, receiving bedded pack manure frequently since there is not much storage. The dairy buys wood shavings from a local carpenter and wood chips from the city of Niagara Falls. Before this the field was hay field for a long time. Corn grew well early on but then just seemed to shut down in August and the soil surface got VERY dry.

**Opportunities, Challenges, Grower Info:**
Growers are older, but **their nephew is taking an interest in their operation.** They have never used a tillage system other than moldboard plowing and don’t really want to branch out. **They incorporate manure with their Aerway** on occasion. The dairy has received requests to compost food waste from the college cafeteria since the nephew started to windrow some of their bedded pack to sell compost to a local nursery. He is **considering other options for diversification** and value addition now that he’s done with college. He wants to move to more rotational grazing. He has also found some neighbors with a **Unverferth Zone Builder** that he could rent.

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<td><a href="mailto:rrs3@cornell.edu">rrs3@cornell.edu</a></td>
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**Measured Soil Textural Class:** silty clay loam

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<tr>
<td>biological</td>
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<td>ACE Soil Protein Index</td>
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<td>biological</td>
<td>Soil Respiration</td>
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<td>Soil pH</td>
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<tr>
<td>chemical</td>
<td>Extractable Phosphorus</td>
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<td>6</td>
<td>High Phosphorus, Environmental Impact Risk</td>
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<td>Extractable Potassium</td>
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<td>Minor Elements Mg: 164.0 / Fe: 4.3 / Mn: 16.4 / Zn: 1.7</td>
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</tbody>
</table>

**Overall Quality Score:** 70 / Excellent
Organic Vegetables

Location/Site History:
Western PA, within 10 miles of population centers. 50 acres total of very intensive production on this farm. **Good vegetable land** is getting to be hard to come by -- this 5 ac field is partly covered by **two high tunnels** (they happen to be movable, but haven’t been moved). Long history of moldboard tillage and intensive secondary tillage. Regular cultivation using Allis-Chalmers G tractors. Multiple crops grown per year. Recently crops in high tunnel are looking a little odd (curled and brown leaf edges). **White crust was noticed on the surface a few times** -- grower didn’t know what it was. **Growing a lot of greens, tomatoes and brassicas for wholesale.** Sweet corn looked awful after all that rain last year. Some veggies sold at one larger farmer’s market.

Opportunities, Challenges, Grower Info:
Grower uses **seasonal laborers.** Farm has access to an **organic matter source** -- a nursery for wood chips, sawdust. **Daughter just finished college** and wants to **increase vegetable quality.** She is interested in taking over the business. Grower has no experience with cover crops. Varied equipment for veg production is available.
Pasture/ hay field

**Location/Site History:**
250 total acres of diversified organic hay and dairy production *(increasing)* on this farm. This 25 ac field has been in long term hay production with the alfalfa component decreasing. The naturally well-draining field is easily eroded and there is a pond located at the bottom of the 6% slope. There is a CNMP-required buffer strip around the pond but the family can no longer swim due to excessive algae blooms.

**Opportunities, Challenges, Grower Info:**
The farm uses most of the land to grow organic hay for sale off-farm. Limited inputs include wood ash and horse manure. The farm now offers eggs, meat, and **more milk** (sold to a local cheesemaker) all with organic certification. Farm goals are to improve soil health and farm productivity, long-term sustainability and the regained use of the pond for recreational uses. The CNMP showed that net nutrient exports off the farm were causing nutrient deficiencies on some of the fields. Diverse equipment is available to the younger generation of farmers who want to use cover crops to improve pastures and enhance the function of the land resource.
**SH Management Planning Process**

1. **Determine farm background and management history**
   Compile background info: history by management unit, farm operation type, equipment, access to resources, situational opportunities or limitations.

2. **Set goals and sample for soil health**
   Determine number and distribution of soil health samples needed according to operation background and goals.

3. **For each management unit: identify and explain constraints, prioritize**
   Soil Health Report identifies constraints, guides prioritization. Explain results based on background, and adjust priorities.

4. **Identify feasible management options**
   Management suggestions table available as part of Soil Health Report, or online with NRCS practice linkages.

5. **Create short and long term Soil Health Management Plan**
   Integrate agronomic science of 2-4 with grower realities of 1 to create a specific short-term schedule of management practices for each management unit and an overall long-term strategy.

6. **Implement, monitor, and adapt**
   Implement and document management practices. Monitor progress, repeat testing, and evaluate outcomes. Adapt plan based on experience and data over time.
### SH Management Planning Process

1. **Determine farm background and management history**

2. **Set goals and sample for soil health**

3. **For each management unit: identify and explain constraints, prioritize**

4. **Identify feasible management options**

5. **Create short and long term Soil Health Management Plan**

6. **Implement, monitor, and adapt**
<table>
<thead>
<tr>
<th>Physical Concerns</th>
<th>Suggested Management Practices</th>
<th>NH NRCS Practice</th>
<th>code</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low Aggregate stability</strong></td>
<td>• Incorporate fresh organic materials • Use shallow-rooted cover/rotation crops • Add manure, green manure, mulch</td>
<td>• Reduce tillage • Use a surface mulch • Rotate with sod crops</td>
<td>(328) Conservation Crop Rotation; (340) COVER CROP; (329) Residue Mgmt No-Till/Strip-Till; (484) Mulching; (512) Forage &amp; Biomass Planting; (528) Prescribed Grazing</td>
</tr>
<tr>
<td><strong>Low Available Water Capacity</strong></td>
<td>• Add stable organic materials, mulch • Add compost or biochar • Incorporate high biomass cover crop</td>
<td>• Reduce tillage • Rotate with sod crops • Incorporate high biomass cover crop</td>
<td>(328) Conservation Crop Rotation; (329) Residue Mgmt No-Till/Strip-Till; (317) Compost Facility; (340) COVER CROP; (512) Forage &amp; Biomass Planting; (528) Prescribed Grazing</td>
</tr>
<tr>
<td><strong>High Surface Hardness</strong></td>
<td>• Perform some mechanical soil loosening (strip till, aerators, broadfork, spader) • Use shallow-rooted cover crops • Use a living mulch or interseeded cover crop</td>
<td>• Shallow-rooted cover/rotation crops • Avoid traffic on wet soils, monitor • Use controlled traffic patterns/lanes</td>
<td>(328) Conservation Crop Rotation; (345) Residue Mgmt, Mulch Till; (340) COVER CROP; (484) Mulching; (528) Prescribed Grazing</td>
</tr>
<tr>
<td><strong>High Subsurface Hardness</strong></td>
<td>• Use targeted deep tillage (subsoiler, yeomans plow, chisel plow, spader.) • Plant deep rooted cover crops/radish</td>
<td>• Avoid plows/disks that create pans • Avoid heavy loads • Reduce traffic when subsoil is wet</td>
<td>(324) Deep Tillage; (329) Residue Mgmt, No-Till/Strip-Till; (345) Residue Mgmt, Mulch Till; (340) COVER CROP; (606) Subsurface Drain</td>
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<table>
<thead>
<tr>
<th>Biological Concerns</th>
<th>Suggested Management Practices</th>
<th>NH NRCS Practice</th>
<th>code</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low Organic Matter</strong></td>
<td>• Add stable organic materials, mulch • Add compost and biochar • Incorporate high biomass cover crop</td>
<td>• Reduce tillage/mechanical cultivation • Rotate with sod crop • Incorporate high biomass cover crop</td>
<td>(328) Conservation Crop Rotation; (340) COVER CROP; (329) Residue Mgmt No-Till/Strip-Till; (317) Compost Facility; (528) Prescribed Grazing</td>
</tr>
<tr>
<td><strong>Low Active Carbon</strong></td>
<td>• Add fresh organic materials • Use shallow-rooted cover/rotation crops • Add manure, green manure, mulch</td>
<td>• Reduce tillage/mechanical cultivation • Rotate with sod crop • Cover crop whenever possible</td>
<td>(328) Conservation Crop Rotation; (329) Residue Mgmt No-Till/Strip-Till; (345) Residue Mgmt, Mulch Till; (512) Forage &amp; Biomass Planting; (528) Prescribed Grazing</td>
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<tr>
<td><strong>Low Mineralizable Nitrogen</strong></td>
<td>• Add N-rich organic matter (low C:N source like manure or well-finished compost) • Incorporate legume or young, green cover crop (inoculate legume seed) • Adjust pH to 6.2-6.5 (helps molybdenum)</td>
<td>• Reduce tillage • Rotate with forage legume sod crop • Cover crop and add fresh manure • Keep pH at 6.2-6.5 (helps molybdenum) • Monitor C:N ratio of inputs</td>
<td>(328) Conservation Crop Rotation; (329) Residue Mgmt No-Till/Strip-Till; (317) Compost Facility; (340) COVER CROP; (512) Forage &amp; Biomass Planting; (528) Prescribed Grazing; (590) Nutrient Mgmt</td>
</tr>
<tr>
<td><strong>High Root Rot Rating</strong></td>
<td>• Use disease-suppressive cover crops • Biofumigate • Plant on ridges/raised beds • Monitor irrigation</td>
<td>• Use disease-suppressive cover crops • Increase diversity of crop rotation • Sterilize seed and equipment • Improve drainage/monitor irrigation</td>
<td>(328) Conservation Crop Rotation; (346) Residue Mgmt, Ridge Till; (340) COVER CROP; (449) Irrigation Water Mgmt; (595) Integrated Pest Mgmt; (606) Subsurface Drain</td>
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<td>Test Results</td>
<td>Suggested Management Practices</td>
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<tr>
<td><strong>Chemical Concerns</strong></td>
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</table>
| **Low pH** | • Add lime or wood ash per soil test recs  
• Add calcium sulfate (gypsum) in addition to lime if aluminum is high  
• Use less ammonium or urea | (340) COVER CROP; (512) Forage & Biomass Planting; (590) Nutrient Mgmt |
| **High pH** | • Stop adding lime or wood ash  
• Add elemental sulfur per soil test recs | (590) Nutrient Mgmt |
| **Low Phosphorus** | • Add P amendments per soil test recs  
• Use cover crops to recycle fixed P  
• Adjust pH to 6.2-6.5 to free up fixed P | (340) COVER CROP; (590) Nutrient Mgmt |
| **High Phosphorus** | • Stop adding manure and compost  
• Choose low or no-P fertilizer blend  
• Apply only 20 lbs/ac starter P if needed  
• Apply at or below crop removal rates | (340) Cover Crop; (393) Filter Strip; (484) Mulching; (590) Nutrient Mgmt; (633) Waste Recycling |
| **Low Potassium** | • Add wood ash, fertilizer, manure, or compost per soil test recs  
• Use cover crops to recycle K  
• Choose a high K fertilizer blend | (340) COVER CROP; (590) Nutrient Mgmt |
| **High Potassium** | • Stop adding high K fertilizer or manure  
• Grow high K removing crops | (340) COVER CROP; (590) Nutrient Mgmt |
| **Low Micronutrients** | • Add chelated micros per soil test recs  
• Use cover crops to recycle micronutrients  
• Do not exceed pH 6.5 for most crops | (340) COVER CROP; (590) Nutrient Mgmt; (633) Waste Recycling |
| **High Micronutrients** | • Raise pH to 6.2-6.5 (for all high microns except Molybdenum)  
• Do not use fertilizers with micronutrients | (449) Irrigation Water Mgmt; (512) Forage & Biomass Planting; (590) Nutrient Mgmt; (606) Subsurface Drain |
| **High Salinity** | • Leach soils  
• Use fertilizers with a low salt index (avoid chloride and ammonium/urea fertilizers)  
• Do not use Chilean nitrate | (449) Irrigation Water Mgmt; (512) Forage & Biomass Planting; (590) Nutrient Mgmt; (606) Subsurface Drain |
| **Long Term** | • Test soil annually & add “maintenance” lime per soil test recs to keep pH in range  
• Raise organic matter to improve buffering capacity | |