Understanding and Building Your Soil Health

Presented By:

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Responding to the Challenges

4R Nutrient Stewardship
Right source
Right rate
Right time
Right place
4R Management Systems & Education Based on Basic Universal Scientific Principles

1. Supply in plant available forms
2. Suit soil properties
3. Recognize synergisms among elements
4. Blend compatibility

1. Appropriately assess soil nutrient supply
2. Assess all available indigenous nutrient sources
3. Assess plant demand
4. Predict fertilizer use efficiency

1. Assess timing of crop uptake
2. Assess dynamics of soil nutrient supply
3. Recognize timing of weather factors
4. Evaluate logistics of operations

1. Recognize root-soil dynamics
2. Manage spatial variability
3. Fit needs of tillage system
4. Limit potential off-field transport

www.4RTomorrow.org
Don’t Guess – Soil Test
Why Test Your Soil Fertility

• To understand the chemical and physical qualities of the soil.
• To learn the soil's pH.
• Discloses information about the nutrient content of the soil.
• Reveals the Cation Exchange Capacity (CEC).
• Discover the "mineral components" of the soil – Soil Texture
• Can also provide information on the organic content of the soil.
Separate Test for Each Crop

Specific crops*: Optimum levels for Turf - pH should be between 6.6 – 7.5  
- Phosphorus should be between 10ppm – 20ppm  
- Potassium should be between 60ppm – 125ppm

Optimum levels for Most Vegetables - pH should be between 6.2 – 7.2  
- Phosphorus should be between 40 ppm – 70 ppm  
- Potassium should be between 90 ppm – 125 ppm

Optimum levels for Most Flowers - pH should be between 6.2 – 7.5  
- Phosphorous should be between 70 ppm – 90 ppm  
- Potassium should be between 150 ppm – 200 ppm

*Optimum levels determined by Michigan State University Soil Testing Lab.
The Soil's pH.

- Problems with soil pH are addressed by lime recommendations to raise the pH, or sulfur (or other soil acidifiers) recommendations to lower soil pH.
10 - Years of pH Data
Information About the Nutrient Content of the Soil

SOIL TEST REPORT FOR: Hamilton COUNTY SWCD

CONSULTANT: 517-772-7645

DATE: 4/18/2012

ACRES: 1

SOIL NUTRIENT LEVELS:

- Soil pH: 6.6
- Lime Index: 70.0
- Phosphorus (P): 134 ppm
- Potassium (K): 352 ppm
- Magnesium (Mg): 558 ppm

Below Optimum | Optimum | Above Optimum

ADDITIONAL RESULTS:

- Calcium (Ca): 3700 ppm (mg/100g)
- CEC: 17.4
- % of Exchangeable Bases: K = 5.2, Mg = 17.2, Ca = 77.6
- Micronutrients (ppm): B, Cu, Mn, Zn, Fe
- Organic Matter %: 11.7
- Nitrate-N: 11.7 ppm

RECOMMENDATIONS FOR: Garden, Home

Limestone: NONE

NUTRIENT NEEDS:

- Nitrogen (N): 3-4 lb/1000 sq ft
- Phosphorus (P): NONE
- Potassium (K): NONE
- Target pH: 6.5

FERTILIZER OPTIONS:

MESSAGES

Test Methods: 1. 1:1 soilwater pH, 2. Bray P1 Extractant, 3. IN Ammendum Azoate Extractant
Education Opportunity on Application

NOTE: The maximum single nitrogen application for lawn and garden should not exceed 1 lb/1000 sq. ft.
Soil Properties: They Are Not Independent!
Compaction and "Upside Down" Soil Profiles

Trouble on the Horizon

Topsoil Removed

Topsoil Stockpiled
### HCSWCD - 2010 Compost Data

#### Chemicals

<table>
<thead>
<tr>
<th>Location</th>
<th>B Alan</th>
<th>IMAGO</th>
<th>Cororan</th>
<th>Findlay Market</th>
<th>Walnut Center</th>
<th>SWCD</th>
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<td>Calcium ppm</td>
<td>409</td>
<td>825</td>
<td>300</td>
<td>1125</td>
<td>713</td>
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<td>Chloride ppm</td>
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<td>285</td>
<td>41</td>
<td>1400</td>
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<td>Conductivity</td>
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<td>4.48</td>
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<td>Nitrate ppm</td>
<td>54</td>
<td>191</td>
<td>24</td>
<td>5</td>
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<td>171</td>
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<tr>
<td>Ph</td>
<td>7.6</td>
<td>7.1</td>
<td>8.1</td>
<td>7.7</td>
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<tr>
<td>Phosphorus ppm</td>
<td>2.3</td>
<td>11.6</td>
<td>8.7</td>
<td>127.8</td>
<td>131.9</td>
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<td>Potassium ppm</td>
<td>56</td>
<td>614</td>
<td>99</td>
<td>2184</td>
<td>1350</td>
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<tr>
<td>Sodium ppm</td>
<td>108</td>
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<td>441</td>
<td>84</td>
<td>287</td>
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#### Organic Matter

<table>
<thead>
<tr>
<th>Waste, Veggie Scraps</th>
<th>Leaves</th>
<th>Yard Waste</th>
<th>Oak leaves, Veggie Scraps, Wood Ash</th>
<th>Food Scraps</th>
<th>Horse Manure</th>
<th>Worm Castings</th>
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<tbody>
<tr>
<td>Waste, Veggie Scraps</td>
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<tr>
<td>Leaves</td>
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<tr>
<td>Yard Waste</td>
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<td>Oak leaves, Veggie Scraps, Wood Ash</td>
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</table>
Where are Cover Crops used?

- Commodity Farming
- Vegetable Production
- Gardening
- Orchards
- Riparian and Land Use Stabilization
- Pastures/Forage cover
- Brown Infrastructure Rehabilitation-Phytoremediation
Cover Crop Benefits

- Reduce Weed Pressure
- Reduce erosion and nutrient leaching
- Reduce soil compaction
- Add soil organic matter (SOM)
- Increase water infiltration/water holding capacity
- Moderate soil temperature
- Add nitrogen either by fixation or scavenging
- Feed soil organisms (builders of soil structure)
What makes a good Cover Crop?

- Quick to establish, out-compete weeds
- Rapid, significant root development
- Long or rapid vegetative growth (biomass)
- Ability to accumulate or produce nutrients (N)
- Ease of termination (except for permanent covers)
- Low maintenance, tolerant
- Inexpensive and available
General Types of Cover Crops

Grasses/Grains

Legumes

Brassicas

Broadleaf

Used by permission: Ray Archuleta
# Cover Crop Periodic Table

<table>
<thead>
<tr>
<th>Cool Season Plants</th>
<th>Warm Season Plants</th>
<th>Grass</th>
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<tbody>
<tr>
<td><strong>Grass</strong></td>
<td></td>
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</tr>
<tr>
<td>Barley</td>
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<td>Oat (wk)</td>
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<tr>
<td>Ryegrass</td>
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<tr>
<td>Wheat</td>
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<tr>
<td>Cereal rye</td>
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<td>Triticale</td>
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<td>Annual Fescue (wk)</td>
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<td><strong>Broadleaf Plants</strong></td>
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<tr>
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<td>Radish (wk)</td>
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<tr>
<td>Kale</td>
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<td>Canola</td>
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<td><em>Mustard</em></td>
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<tr>
<td>Turnip (wk)</td>
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<td>Rape</td>
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<td>Kale</td>
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<tr>
<td><em>Mustard</em></td>
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<td><strong>Legumes</strong></td>
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<td>Field Pea</td>
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<td>Chickling vetch (wk)</td>
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<td>Sunflower (wk)</td>
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<td>Sudan grass (wk)</td>
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<td>Amaranth (wk)</td>
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<td>Foxtail Millet (wk)</td>
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<td>Buckwheat (wk)</td>
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<td>Safflower (wk)</td>
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<td>Teff (wk)</td>
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<td>Grain Sorghum (wk)</td>
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<td>Soybean (wk)</td>
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<td>Chicory</td>
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<td>Squash (wk)</td>
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<tr>
<td>Corn (wk)</td>
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</tbody>
</table>

(wk) = winter killed

USDA is an equal opportunity provider and employer
Grasses & Grains
Barley, Oats, Ryegrass, Cereal Rye

• Generally Used to:
  – Scavenge nutrients, especially N, from previous crop, long term release for crop
  – Reduce or prevent erosion
  – High residue producers (C:N)
  – Add organic matter to the soil (SOM)
  – Suppress weeds (allelopathy in cereal rye)
Brassicas
Oilseed Radish, Turnips, Ethiopian Cabbage

• Generally Used to:
  – Scavenging nutrients, especially N (140-170lb/acre from deep soil profile), release early with decomp
  – Reduce or prevent erosion
  – Alleviate soil compaction (tap root)
  – Nematode suppression
  – Suppress weeds (allelopathy in dispute)
Legumes
Peas, Vetch, Clovers, Alfalfa, Sunnhemp

• Generally Used to:
  – Fix Atmospheric Nitrogen
  – Reduce or prevent erosion
  – Add active organic matter to the soil (SOM)
  – Suppress weeds
Nitrogen Fixation

Inoculation: Rhizobia soil bacteria form a symbiotic relationship with plant.

The bacteria invade the plant root and form nodules to convert atmospheric nitrogen into plant-accessible forms of nitrogen.

Treated legumes can provide 45-160 lbN/A/yr to subsequent crops.

Each plant requires a specific bacterium
- Peas, vetch, lentils need Rhizobium leguminosarum biovar viceae
- Clovers need Rhizobium leguminosarum biovar trifolii
Broadleaf
Sunflowers, Flax, Phacelia, Buckwheat

- Mixed bag of uses, plant specific:
  - Some scavenge nutrients
  - All reduce or prevent erosion
  - Some high residue producers (C:N)
  - All add organic matter to the soil (SOM)
  - Most suppress weeds
  - Sunflowers have deep tap root for compaction
How to Choose Covers

- Soil condition? soil test?
- Land use?
- What crop is it following?
- What crop will be coming?
- What are you trying to add, correct or do?
- When will you be planting?
- How long does it have to grow?
- How will you terminate?
High Achievers

- Nitrogen Fixation – Vetch
- Nitrogen Scavenging – Cereal Rye, Radish
- Loosen Topsoil – Cereal Rye, Ryegrass
- Subsoilers – Sorghum-sudan, Radish
- Scavenge/Free P & K, Ca – Buckwheat
- Light Heavy Metal Contamination*
  - Mercury: Brassica napus (rapeseed)
  - Lead: Alfalfa, Sunflowers w/ chelation
  - Arsenic, Zinc, Uranium, Copper: Sunflowers

*Always seek professional guidance on testing, remediation
How to Choose
Monoculture vs. Diverse Mix

Either can be used for weed suppression, increased water holding capacity, erosion prevention

Hairy Vetch-legume

AWP/Radish-2 way mix

7-way Mix
How to Choose
Monoculture vs. Diverse Mix

Monocultures are usually used to achieve very specific results, poor comparative soil improvement
- severe compaction - oilseed radish
- add N for upcoming corn crop - peas, vetch

Complex Mixes provide diversity, resilience, and superior soil health improvement
Fall Cover Crop Planting
(Community Garden – Cincinnati, Ohio)

Hamilton Co. SWCD donated 93 lbs of Winter Cover Crop Seed to Community Gardens in 2013. They are tracking impacts on soil fertility for the next three years.
Use of Clover in a Raised Bed

And Field
Spring Management

Cover & Color Mix

Fall Growth  Early Spring  Spring Growth

Fall Cover Mix  Spring Mulch
Know Your Plants

Whether monoculture or mix, choose plants with the attributes you desire.

Research to know how each plant behaves in your region.
Remember, these are still plants and need quality soil in which to grow and perform. They are meant to improve and stabilize, not create.

Works best in long-term approach.

From “Managing Cover Crops Profitably” 3rd Edition, Published by SARE, 2007
Midwest Cover Crop Council
Cover Crop Crop Selector

http://www.mccc.msu.edu/selectorINTRO.html
Programs and Support

- SWCD Cover Crop Seed Program – 11 Offices in Ohio Participating
- Research/Testing/Experience
- Presentations/Education

To contact Ann Brandt: 330-475-6352 or ann.brandt@walnutcreekseed.com
or Holly Utrata-Halcomb: 513-772-7645 or holly.utrata-halcomb@hamilton-co.org