

Soil Health Toolkit for County Agents



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Curriculum Sections:

I. Soil Health Foundations

- a. Understanding Soil Health and Soil Properties
- b. Soil Health Testing & Assessment

II. Building and Managing Healthy Soils

- a. Organic Inputs & Compost Use
- b. Cover Crops & Crop Rotation
 - i. Planning and Selecting Cover Crops
 - ii. Managing and Terminating Cover Crops
 - iii. Crop Rotation Strategies for Soil Health

III. Whole-Farm Soil Management Strategies

- a. Soil Management & Conservation Practices
- b. Irrigation, Drainage, and Water Efficiency

IV. Soil Health and Ecosystem Services

a. Pollinators & Soil Biology

I. Soil Health Foundations

a. Understanding Soil Health Properties

- i. Key Concepts:
 - Definition: Soil health is the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans (Source)
 - Soil must have biological, chemical, and physical integrity to function
 - Soil health is influenced by tillage and disturbance, vegetation cover and living roots, organic inputs and nutrient management, soil biodiversity and structure
 - Improved soil health can lead to better crop productivity, water retention, nutrient cycling, and resistance to pests or disease

ii. Core Principles of Soil Health:

- Minimize Soil Disturbance
- Maximize Soil Cover
- Maximize Living Roots

- Maximize Plant Diversity
- (Optional) Integrate Livestock

iii. Consequences of Soil Degradation:

- Erosion, compaction, salinity (in high tunnels), and loss of organic matter
- Reduces productivity and increases management costs
- Soil with poor structure struggles to absorb water, retain nutrients, and support plant health

iv. Field Demonstrations:

Impacts of Tillage Using a Rainfall Simulator (Example Video)
a. Rain Simulator Link

v. Resources:

- Publications:
 - a. FSA2202 Understanding Soil Health (UADA)
 - b. Building Better Soils (Southern SARE)
 - c. <u>Managing Soil Health: Concepts and Practices</u> (Penn State Extension)
 - d. <u>Soil Salinity in High Tunnel Production</u> (University of Kentucky CES)

b. Soil Health Testing & Assessment

i. Key Concepts:

- Field Indicators
- Sampling Basics
- Types of Tests
- How to Select a Lab
- Interpreting Soil Health Reports
- vi. Field Demonstrations:
 - How to Collect a Soil Sample (Example Video)

vii. Resources:

- Publications:
 - a. <u>Which Laboratory Method Do I Use for Horticulture</u> <u>Substrate Samples?</u> (UADA)
 - b. <u>Soil Testing Labs That Offer the Soil Health Nutrient Tool</u> (Haney Test) (UADA)
 - c. Example of a Soil Health Report and How to Interpret Results (UADA)

II. Building and Managing Healthy Soils

a. Organic Inputs, Compost and Soil Fertility

- i. Key Concepts:
 - Compost Basics: common ratios and types
 - Benefits: improves structure, feeds microbes, retains nutrients
 - Application Strategies: surface vs incorporation
 - Compost Quality
 - Fertilizer Considerations: types, common materials

ii. Human Influences:

- Tillage: needs, systems, and it's importance
- Cover crop considerations
- Cover crops in high tunnels
- Crop rotations

iii. Field Demonstrations:

- Compost Source Comparison (Example Video)
- <u>Compost Source Comparison Results</u>

iv. Resources:

- Publications:
 - a. FSA2087R: Composting (UADA)
 - b. 10 Ways Cover Crops Enhance Soil Health (SARE)
 - c. <u>Soil Management Using Cover Crops in Organically</u> <u>Managed High Tunnels (SARE)</u>
- Videos
 - a. What is composting? (UADA)
 - b. <u>Compost 101 Webinar</u> (UADA)
 - c. <u>A Closer Look at Compost</u> (UADA)

b. Cover Crops & Crop Rotation

i. Planning and Selecting Cover Crops

• Key Concepts:

- a. Cover Crop Goals: nitrogen fixation, erosion control, weed suppression, etc.
- b. Species and Mixtures: legumes, grasses, brassicas, etc.
- c. Seasonal Timing: spring, summer, fall/winter planting windows
- d. Site considerations: high tunnels, field drainage, equipment, etc.
- e. Planning constraints: labor, cost, seeding method, irrigation
- f. Planting methods: broadcast, drill

• Cover Crop Species & Benefits:

- a. Legumes (e.g., clover, cowpea): fix nitrogen, improve soil fertility, support microbes
- b. Grasses (e.g., rye, oats): suppress weeds, prevent erosion, build organic matter, improve soil structure
- c. Brassicas (e.g., radish, turnip, mustard): break compaction, biofumigant, scavenge nutrients
- d. Broadleaf Non-Legumes (e.g., buckwheat, sunflower): attract pollinators, suppress weeds, improve tilth
- Multi-Species Mixes (e.g., rye + crimson clover, oats + Austrian winter pea): combine multiple benefits, support biodiversity, improve C:N balance

• Field Demonstrations:

- a. Seeding Considerations (Example Video)
- b. Seeding Methods (Example Video)
 - i. Broadcast application vs drill seeding
 - ii. Half rate vs full rate comparisons
- c. Cover Crop Mixes (Example Video)

| Cover Crop Species | Seeding Rate (lbs./acre) | Cover Crop Species | Seeding Rate (lbs./ acre) |
|----------------------------------|-----------------------------|--|------------------------------|
| Single Species | | Mixed Species | |
| Vetch | 15 | Cereal Rye (CR) + Austrian Pea (AP) | CR = 25 AP = 30 |
| Cereal Rye | 60 | Cereal Rye (CR) + Crimson Clover (CC) | CR = 25 CC = 10 |
| Black Oats | 60 | Black Oats (BO) + Crimson Clover (CC) | BO = 25 CC = 10 |
| Winter Wheat | 60 | Black Oats (BO) + Austrian Pea (AP) | BO = 25 AP = 11 |
| Crimson Clover | 12 | Cowpea (CP) + Pearl Millet (PM) | CP = 100 PM = 10 |
| Aust. Pea | 13 | Cowpea (CP) + Sorghum Sudan (SS) | CP = 100 SS = 5 |
| Radish | 3 | | |
| Mustard | 10 | | |
| Turnip | 6 | | |
| Cowpea | 120 | | |
| Sorghum 'range grazer hybrid' | 25 | | |
| Pearl Millet | 30 | | |
| Buckwheat | 50 | | |

• Resources:

- a. Presentations:
 - i. Why Plant Cover Crops
 - ii. Cover Crop Selection
- b. Publications:
 - i. FS2156 Understanding Cover Crops (UADA)
 - ii. Cover Crop Decision Aid (USDA ARS)

- iii. <u>10 Ways Cover Crops Enhance Soil Health</u> (SARE)
- iv. <u>Cover Cropping for Pollinators and Beneficial</u> <u>Insects</u> (SARE)
- c. Videos:
 - i. The Why of Cover Crops (UADA)
 - ii. Cover Crop Mixes (UADA)
 - iii. <u>Summer Cover Crops</u> (UADA)
 - iv. <u>Winter Cover Crops</u> (UADA)
- ii. Managing and Terminating Cover Crops
 - Key Concepts:
 - a. Termination methods: mowing, tilling, herbicides, rollercrimping, combinations
 - b. High tunnel termination challenges
 - c. Managing residue and replant timing
 - d. Integration with rotations or cash crops
 - Field Demonstrations:
 - a. Termination (Example videos)
 - i. Four treatments
 - 1. Roller Crimping
 - 2. Roller Crimping + Herbicide Application
 - 3. Mowing
 - 4. Mowing + Till

• Resources:

- a. Presentations:
 - i. Establishment & Termination
- b. Videos
 - i. Cover Crop Seeding & Establishment (UADA)
 - ii. <u>Cover Crop Termination</u> (UADA)

iii. Cover Crops in Crop Rotation Plan

- Key Concepts:
 - a. Timing and Planting Window
 - b. Termination Method & Timing
 - c. Equipment Compatibility
 - d. Rotation Goals
 - e. Pest & Disease Pressure: different plant families, green bridge

• Field Demonstrations:

- a. Differences in planting date
 - i. On-Time vs Late Planting Dates

b. Insect Scouting in Cover Crops (<u>Example video</u>)

Resources:

- a. Presentations:
 - i. Estimating Nitrogen Credits
 - ii. Cover Crops for Pest Management
 - iii. Cover Crops in Vegetable Systems Part I
 - iv. Cover Crops in Vegetable Systems Part II
- b. Publications:
 - i. <u>Cover Crop Economics</u> (SARE)
 - ii. <u>Managing Cover Crops Profitably</u> (SARE)
- c. Videos:
 - i. <u>The How of Cover Crops</u> (UADA)
 - ii. Cover Crops in Vegetable Systems (UADA)

III. Whole-Farm Soil Management Strategies

- a. Integrated Soil Management & Conservation Practices
 - i. Key Concepts:
 - Common degradation issues: erosion, compaction, salinity
 - Prevention tools: mulching, cover crops, rotation, reduced tillage
 - Conservation practices: terraces, buffer strips, high tunnel design
 - Funding & technical assistance (NRCS programs: EQIP, High Tunnel Initiative)

ii. Weed Management Strategies:

- Crop rotation and diversified planting disrupt weed cycles
- Cover crops smother weeds and outcompete them for resources
- Mulches suppress weed germination and conserve moisture
 - a. Synthetic: plastic, landscape fabric
 - b. Biodegradable: paper-based, compostable materials
 - c. Organic: straw, hay, wood chips, leaves
- Soil solarization for non-chemical weed suppression
- Herbicides: when and how to use them responsibly
- Livestock grazing as a weed management tool in rotations
- Tillage: pros and cons, and reduced/no-till alternatives
- Preventative strategies: timing, crop density, sanitation

iii. Field Demonstrations:

- Mulch comparison (Example video <u>1 & 2</u>)
 - a. Demo Details:
 - i. 4 rows, 50 feet each

- ii. Treatments:
 - 1. Row 1: Organix AG Biodegradable Mulch
 - 2. Row 2: Bio 360 Biodegradable Mulch
 - 3. Row 3: a third of the row with straw, a third with compost, and a third bare ground
 - 4. Row 4: standard plastic mulch
- iii. Demo Crop: Sweet Corn
- iv. <u>Demo Results Blog Post</u>
- Weed suppression comparison between cover crop species & mixes

iv. NRCS Resources:

- <u>Conservation Stewardship Program</u>
- Organic Initiative
- <u>Regional Conservation Partnership Program</u>
- Environmental Quality Incentives
- <u>Agricultural Management Assistance</u>
- <u>Assistance with Water Management</u>
- <u>High Tunnel Initiative</u>
- Water Quality Initiative

b. Water Management, Drainage & Irrigation

i. Key Concepts:

- Irrigation types: drip, furrow, sprinkler, micro-irrigation
- Soil moisture sensors and interpreting data
- Soil amendments to improve infiltration and retention
- Crusting and drought resistance through soil biology

ii. Field Demonstrations:

- How to build soil moisture sensors (Example video)
- How to install soil moisture sensors (Example video <u>1 & 2</u>)
- How to read soil moisture sensors Example video <u>1 & 2</u>)

iii. Resources:

- FSA6160 Basics of Drip Irrigation and Fertigation for Specialty Crops (UADA)
- FSA58 How to Use Watermark Soil Moisture Sensors for Irrigation (UADA)
- FSA2198 Understanding the Number in Your Irrigation Water Report (UADA)
- How to Install Watermark Sensors for Plasticulture Beds (UADA)
- Irrigation Management Basics (Oregon State University)

- Water Quality and Water Quantity Best Management Practices for <u>Specialty Crops</u> & <u>Vegetable and Agronomic Crops</u> (Florida Department of Agriculture and Consumer Services)
- Irrigation Scheduling Tools (University of Idaho)

IV. Soil Health and Ecosystem Services

a. Pollinators, Beneficial Insects & Soil Microbiology

- i. Key Concepts:
 - Beneficial insect cycles and habitat needs
 - Soil microbes: importance of organic matter, living roots, and low disturbance
 - Practices that serve dual roles: cover crops, mulches, reduced tillage, compost
 - Compost as habitat and food resource for soil microbes; supports nutrient cycling and soil structure
- ii. Field Demonstrations:
 - Pollinator habitat species comparison (Example video)
- iii. Resources:
 - Cover Cropping for Pollinators and Beneficial Insects (SARE)
 - <u>Compost & Fertilizer Analyses from Various Local & Online</u> <u>Sources</u> (UADA)
 - FSA2087R: Composting (UADA)
 - FSA2206 Soil Biology Affects Soil Health (UADA)