Discover the Cover!

Soil Health
Planning Principles & Cover Crop Management Strategies for the Virgin Islands

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With material provided by: David Lamm
National Soil Health & Sustainability Team, Leader
Soil Health What is It?

- The continued capacity of the **soil** to **function** as a vital living ecosystem that sustains plants, animals, and humans
  - Nutrient cycling
  - Water (infiltration & availability)
  - Filtering and Buffering
  - Physical Stability and Support
  - Habitat for Biodiversity
Soil Health Planning Principles

- Manage more by Disturbing Soil Less
- Use Diversity of Plants to add diversity to Soil Micro-organisms
- Grow Living Roots Throughout the year
- Keep the Soil Covered as Much as Possible

Goal: To create the most favorable habitat possible for the soil food web
Soil Health Principle 1
Manage More by Disturbing Soil Less

• Agricultural Disturbance Destroys Dynamic Soil Properties
• Destroys “Habitat” for Soil Organisms
• Creates a “Hostile” Environment
• Three Types of Disturbance
  – Physical (tillage)
  – Chemical (Synthetic Fertilizer and Pesticides)
  – Biological (overgrazing)
What Happens to the Soil:

<table>
<thead>
<tr>
<th>Tillage Impacts</th>
<th>No Tillage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Destroys aggregates</td>
<td>Soil pores remain continuous</td>
</tr>
<tr>
<td>Exposes organic matter to decomposition</td>
<td>Soil aggregates form and are not destroyed</td>
</tr>
<tr>
<td>Compacts the soil</td>
<td>Soil Food Web increases and diversifies</td>
</tr>
<tr>
<td>Damages soil fungi</td>
<td>Weed seeds are not planted</td>
</tr>
<tr>
<td>Reduces habitat for the Soil Food Web</td>
<td>Water is captured and stored</td>
</tr>
<tr>
<td>Disrupts soil pore continuity</td>
<td>Bulk density decreases</td>
</tr>
<tr>
<td>Increases salinity at the soil surface</td>
<td>Soil fungi and earthworms increase</td>
</tr>
<tr>
<td>Plants weed seeds</td>
<td>Microarthropods increase (&gt;20% of nutrient cycle)</td>
</tr>
</tbody>
</table>
Soil Disturbance Impacts in Tropical Regions

• Farm management may need to be different in rainy and dry seasons.
  – Hot Humid Conditions with High Evapotranspiration
  – High ambient air temperatures and solar radiation
  – Increased microbial activity
  – Rapid Decomposition rates
  – Increased microbial activity
  – High soil temperatures
  – High nutrient volatization of nutrients

Results in Rapid SOM loss and difficulty to increase SOM
Tropical Cropping System (High Intensity)

- 3 crop rotation cycles per year (Includes Cover Crop Rotation)
- Amount of soil disturbance
  - 5 to 6 tillage passes to incorporate cover crop
  - 3 to 4 tillage passes to incorporate vegetable crop residue
  - 12 tillage passes per year with a tractor and implement
  - Degrades soils
  - Loss of soil organic matter

- What impact on soil organic matter can cover crops have?
Grass Cover Crops - Monocultures

Sorghum-sudan var. Mega Green

Pearl millet var. Mega Mill
Legume Cover Crop and Grass/Legume Mixtures

Sunn hemp

Sunn hemp and Pearl Millet
## Conventional Full Tillage Crop Rotations

<table>
<thead>
<tr>
<th>Complexity</th>
<th>Cover Crop 1</th>
<th>Cash Crop 2</th>
<th>Cash Crop 3</th>
<th>Cash Crop 4</th>
<th>Cash Crop 5</th>
<th>Cash Crop 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2006</td>
<td>Tatsoi</td>
<td>Corn</td>
<td>Fallow</td>
<td>Tomato</td>
<td>Cucumber</td>
<td></td>
</tr>
<tr>
<td>Spring 2007</td>
<td>Tomato</td>
<td>Cucumber</td>
<td>Fallow</td>
<td>Tatsoi</td>
<td>Corn</td>
<td></td>
</tr>
<tr>
<td>MedG</td>
<td>SS</td>
<td>Tatsoi</td>
<td>Corn</td>
<td>PM</td>
<td>Tomato</td>
<td>Cucumber</td>
</tr>
<tr>
<td>MedG</td>
<td>PM</td>
<td>Tomato</td>
<td>Cucumber</td>
<td>SS</td>
<td>Tatsoi</td>
<td>Corn</td>
</tr>
<tr>
<td>MedG</td>
<td>PM</td>
<td>Tatsoi</td>
<td>Corn</td>
<td>SS</td>
<td>Tomato</td>
<td>Cucumber</td>
</tr>
<tr>
<td>MedL</td>
<td>VB</td>
<td>Tatsoi</td>
<td>Corn</td>
<td>SH</td>
<td>Tomato</td>
<td>Cucumber</td>
</tr>
<tr>
<td>MedL</td>
<td>SH</td>
<td>Tomato</td>
<td>Cucumber</td>
<td>VB</td>
<td>Tatsoi</td>
<td>Corn</td>
</tr>
<tr>
<td>MedL</td>
<td>VB</td>
<td>Tomato</td>
<td>Cucumber</td>
<td>SH</td>
<td>Tatsoi</td>
<td>Corn</td>
</tr>
<tr>
<td>MedL</td>
<td>SH</td>
<td>Tatsoi</td>
<td>Corn</td>
<td>VB</td>
<td>Tomato</td>
<td>Cucumber</td>
</tr>
<tr>
<td>High</td>
<td>SS + VB</td>
<td>Tatsoi + Bean</td>
<td>Corn + Pea</td>
<td>SH + PM</td>
<td>Tomato + Bean</td>
<td>Cuc + Pea</td>
</tr>
<tr>
<td>High</td>
<td>SH + PM</td>
<td>Tomato + Bean</td>
<td>Cuc + Pea</td>
<td>SS + VB</td>
<td>Tatsoi + Bean</td>
<td>Corn + Pea</td>
</tr>
<tr>
<td>High</td>
<td>SS + VB</td>
<td>Tomato + Bean</td>
<td>Cuc + Pea</td>
<td>SH + PM</td>
<td>Tatsoi + Bean</td>
<td>Corn + Pea</td>
</tr>
<tr>
<td>High</td>
<td>SH + PM</td>
<td>Tatsoi + Bean</td>
<td>Corn + Pea</td>
<td>SS + VB</td>
<td>Tomato + Bean</td>
<td>Cuc + Pea</td>
</tr>
</tbody>
</table>

Sorghum Sudan – SS    Pearl Millet – PM    Velvet Bean – VB    Sunn Hemp - SH
Soil organic matter percent in the top 20 cm of soil following cover crop termination but prior to incorporation

<table>
<thead>
<tr>
<th>Organic matter (%) by cover crop rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>CC</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>WF</td>
</tr>
<tr>
<td>SS</td>
</tr>
<tr>
<td>PM</td>
</tr>
<tr>
<td>VB</td>
</tr>
<tr>
<td>SH</td>
</tr>
<tr>
<td>SSVB</td>
</tr>
<tr>
<td>SHPM</td>
</tr>
</tbody>
</table>
Soil nitrate concentration in the top 20 cm of soil at crop termination but prior to residue incorporation

<table>
<thead>
<tr>
<th>CC</th>
<th>Year 1</th>
<th>Year 2</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cycle 1</td>
<td>Cycle 2</td>
<td>Cycle 3</td>
<td>Cycle 4</td>
<td>Cycle 5</td>
<td>Cycle 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WF</td>
<td>71</td>
<td>58</td>
<td>29</td>
<td>30</td>
<td>36</td>
<td>25\textsuperscript{b}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS</td>
<td>90</td>
<td>63</td>
<td>38</td>
<td>30</td>
<td>44</td>
<td>28\textsuperscript{ab}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PM</td>
<td>91</td>
<td>57</td>
<td>38</td>
<td>27</td>
<td>44</td>
<td>27\textsuperscript{ab}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VB</td>
<td>86</td>
<td>56</td>
<td>42</td>
<td>34</td>
<td>31</td>
<td>32\textsuperscript{a}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SH</td>
<td>88</td>
<td>54</td>
<td>46</td>
<td>31</td>
<td>24</td>
<td>28\textsuperscript{ab}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSVB</td>
<td>92</td>
<td>69</td>
<td>35</td>
<td>40</td>
<td>38</td>
<td>27\textsuperscript{ab}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHPM</td>
<td>84</td>
<td>64</td>
<td>34</td>
<td>29</td>
<td>33</td>
<td>28\textsuperscript{ab}</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Implications

• In hot humid tropical environments cover crops may have little to no effect to improve or maintain soil fertility in intensive organic vegetable crop systems utilizing conventional tillage in low-external-input farming systems.

• Cover crops contribute many sustainable ecosystem benefits and thus need to be incorporated into a holistic management plan.
  – Pest Management
  – Weed Control
  – Increase Water Efficiencies
Soil Health Principle 2

Use Diversity of Plants to add diversity to Soil Organisms

• Plants interact with particular microbes
  – Trade sugar from roots for nutrients
• Microbes convert plant material to OM
• Requires a diversity of plant carbohydrates to support the variety of microbes
• Lack of plant diversity will drive system to favor some microbes more than others
Impact of Biodiversity

- Low biodiversity limits any cropping system
- A diverse and fully functioning system provides nutrients, energy, and water
- Diversity above ground equals diversity below ground
How to Increase Diversity in a Crop Rotation

• Lengthen the rotation by adding more crops
  – Increases soil organic matter
  – Breaks pest cycles
  – Improves nutrient utilization and availability
  – Utilize available water deeper in the soil profile
  – Provide windows for management
    • spread manure
    • Plant & harvest crops

• Add more plants in the current crop rotation
  – Utilize cover crops during rainy season when water is abundant and pest pressure is HIGH!
Cover Crop Role in Diversity

1. Allows you to look at cropping periods rather than years
2. Can be used to accelerate rejuvenating soil health
3. Getting 6 to 8 weeks of Cover Crop growth is adequate to get “rotation” effect benefits!
4. Will increase soil biological diversity “Diversity above = diversity below”
Simplified Crop Classification

- Plant morphology
  - Broad leaf
    - Legumes
  - Grasses

- Plant growth habits
  - Rainy season
  - Dry Season
  - Photo Sensitivity
Consideration for Adding Diversity in Tropical Regions

• Consider the pathogen and insect spectrum important for income-producing crop

• Select cover crop species from different plant families as the income crop to interrupt pest life cycles and reduce pest populations

• Many of the cover crops currently in use in commercial production systems are not named varieties

• Photo period sensitivity – impacts growth, plants will go into reproductive stage too early

• Method of termination affects benefits
Soil Health Principle 3
Grow Living Roots Throughout the Year

Benefits:

• Increases microbial activity that influences N mineralization and immobilization
• Increases plant nutrient/nutrient uptake/ and mychorrhizal and bacteria associations
• Increases biodiversity and biomass of soil organisms
• Improves physical, chemical and biological properties of soils
• Sequesters and redeposit nutrients
• Increases OM
Diversity of Plants

Provides Diversity in Roots
How to Keep a Living Root All Year Long

• Lengthen Multi-Crop Rotation
• Select Shorter Season Varieties
  – Choose 80 to 100 day varieties
  – Only need 6 - 8 weeks to provide benefit
• Inter plant into Growing Crops
  – Planting cover crop before final harvesting of cash crop
  – Planting cash crop at termination of cover crop
Soil Health Principle 4

Keep it Covered as Much as Possible

Benefits:
- Control Erosion
- Protect Soil Aggregates
- Suppresses Weeds
- Conserves Moisture
- Cools the Soil
- Provides Habitat for Soil Organisms
Soil Temperatures

- Conserve moisture and reduce temperature.
- Crop yields are limited more often by hot and dry, not cool and wet.
When soil temperature reaches

140°F  Soil bacteria die
130°F  100% moisture is lost through evaporation and transpiration
113°F  Some bacteria species start dying
100°F  15% moisture is used for growth
95°F   85% moisture lost through evaporation and transpiration
70°F   100% moisture is used for growth

J.J. McEntire, WUC, USDA SCS, Kernville TX, 3-58 4-R-12198. 1956
## Soil Organic Matter & Available Water Capacity

<table>
<thead>
<tr>
<th>Percent SOM</th>
<th>Sand</th>
<th>Silt Loam</th>
<th>Silty Clay Loam</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.0</td>
<td>1.9</td>
<td>1.4</td>
</tr>
<tr>
<td>2</td>
<td>1.4</td>
<td>2.4</td>
<td>1.8</td>
</tr>
<tr>
<td>3</td>
<td>1.7</td>
<td>2.9</td>
<td>2.2</td>
</tr>
<tr>
<td>4</td>
<td>2.1</td>
<td>3.5</td>
<td>2.6</td>
</tr>
<tr>
<td>5</td>
<td>2.5</td>
<td>4.0</td>
<td>3.0</td>
</tr>
</tbody>
</table>

**Inches of Water/One Foot of Soil**

1 acre inch = 27,150 gallons of water
Soil Organic Matter Facts

- Soil organic matter (SOM) is <6% of soil by weight but controls >90% of the function.
- Density of SOM: 0.6 g/cm³  Density of Soil: 1.45 g/cm³
- SOM has less density than soil so it has more space for air and water storage.
- SOM is negatively charged, but binds both cations and anions.
- Every Pound SOM holds 18-20 lbs of Water!
- As soil organic matter increases from 1% to 3%, the available water holding capacity of the soil doubles (Hudson, 1994).
- Soils stockpile 1,500 gigatons of carbon in SOM, more than Earth's atmosphere and all the plants combined (Dance, 2008).
- The majority of the SOM is present in the top 10 cm of soil.
Soil Health Planning Principles

- Manage more by Disturbing Soil Less
- Use Diversity of Plants to add diversity to Soil Micro-organisms
- Grow Living Roots Throughout the year
- Keep the Soil Covered as Much as Possible

Goal: To create the most favorable habitat possible for the soil food web
Managing Cover Crop Residue in Tropical Regions
Cover Crop Performance and Nitrogen Contribution from Vegetative Biomass at Termination

No difference was observed in CC plant tissue phosphorus or potassium levels.
Cover Crop Performance. Weed Development, and Nitrogen Contribution Termination

Cover crop (CC), broad leaf (BL) weed, and poacea (GW) weed biomass (kg/ha\(^{-1}\)) within treatments assessed at cover crop termination (112 DAP)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Plant</th>
<th>Biomass at CC Termination kg/ha(^{-1})</th>
<th>Total kg/ha(^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Control</td>
<td>BL</td>
<td>862 ± 293(^a)</td>
<td>2,291 ± 336(^d)</td>
</tr>
<tr>
<td>Control</td>
<td>GW</td>
<td>1,429 ± 293(^ac)</td>
<td></td>
</tr>
<tr>
<td>Pigeon Pea</td>
<td>PP</td>
<td>4,747 ± 293(^b)</td>
<td>4,747 ± 336(^b)</td>
</tr>
<tr>
<td>Pigeon Pea</td>
<td>BL</td>
<td>273 ± 293(^ad)</td>
<td>667 ± 336(^c)</td>
</tr>
<tr>
<td>Pigeon Pea</td>
<td>GW</td>
<td>393 ± 293(^ad)</td>
<td></td>
</tr>
<tr>
<td>Sun Flower</td>
<td>SF</td>
<td>2,027 ± 293(^ac)</td>
<td>2,027 ± 336(^d)</td>
</tr>
<tr>
<td>Sun Flower</td>
<td>BL</td>
<td>180 ± 293(^d)</td>
<td>180 ± 336(^c)</td>
</tr>
<tr>
<td>Sun Flower</td>
<td>GW</td>
<td>&lt;1 ± 293(^d)</td>
<td></td>
</tr>
<tr>
<td>Sunn Hemp</td>
<td>SH</td>
<td>6,418 ± 293(^e)</td>
<td>6,418 ± 336(^d)</td>
</tr>
<tr>
<td>Sunn Hemp</td>
<td>BL</td>
<td>&lt;1 ± 293(^d)</td>
<td></td>
</tr>
<tr>
<td>Sunn Hemp</td>
<td>GW</td>
<td>&lt;1 ± 293(^d)</td>
<td></td>
</tr>
</tbody>
</table>

Values within the same column group followed by different letters differ (p<0.05) according to a least significant range separation.

Estimated Nitrogen Contribution from Cover Crop Biomass at Termination (112 DAP)

Different letters indicate a significant difference (p<0.05)

---

No difference was observed in CC plant tissue phosphorus or potassium levels
Cover Crop Residue Surface Sheet Mulch

- Increases soil conservation through reduced tillage
- Decomposition of CC sheet residue allows for the slow release of nutrients and conversion of organic matter to plant available nutrients
- Sheet residue more efficiently converts carbon into soil organic matter
- Sheet residue acts as a barrier against weeds


- Surface plant residues benefit the microorganism rhizosphere
- Allows for planting of the vegetable rotation shortly after termination when the crop residue dries
Custom Built Roller-Crimper

• Cover crops were terminated at 112 DAP with a custom built roller-crimper
  – Built from a recycled 24 inch disc plough using the disc and plough hubs, 24 inch steel pipe, steel tubing, and steel flat bar.
Measuring Results After Roll Down Termination

- Cover crop residue height and re-growth was assessed after termination to determine the effectiveness of roller-crimper technology on cover crops in the tropics.

- Weed biomass was measured to determine the impact of the resulting surface sheet mulch to inhibit weed development.
Vegetable Management following Roller-Crimping

- Young transplants may survive dry season and have access to increased soil moisture due to reduced evapotranspiration rates.
- May get up to 8 weeks of weed suppression.
Vegetable Management following Rolling/Crimping

- Select the correct cover crop to vegetable crop pairing.
- Cover crops that produce large amounts of biomass resulting in coarse, thick matted surface mulch can be paired with long rotation vegetables (70 to 120 days to harvest).
- These transplants should be larger and more mature than when transplanted into fully tilled beds.
- Cover crops that result in less biomass, produce surface mulch that has a rapid decomposition rate, or is finer in nature can be paired with short rotation vegetables (30 to 60 days to harvest) and may be transplanted or direct seeded.
Cover Crop Establishment

- Germination 7 DAP and drip tape placement

Sun Flower 47 DAP

Weedy Fallow Control

Sunn Hemp 47 DAP

Pigeon Pea 47 DAP
Cover Crop Termination with Roller-Crimper and Crop Residue Surface Sheet Mulch

- Sunn Hemp
- Sun Flower
- Pigeon Pea
- Control
Jalapeno peppers (Invicto-F1) grown in a greenhouse and transplanted into treatment plots 42 DAP and 7 days after CC termination.
Cover Crop Re-Growth and Weed Development at 3 and 6 weeks after CC Termination

1.) At 3 weeks after CC termination, SH surface residue provided the greatest reduction in weed development.

2.) Sun flower was effectively killed with a roller-crimper showing no regrowth.

3.) At 6 weeks after CC termination, SH continued to reduce weed development with less GW than all other treatments and less BL weeds than PP or SF, but similar to the control.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>CC</th>
<th>BL</th>
<th>GW</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Week Harvest</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>NA</td>
<td>27 ± 80a</td>
<td>47 ± 80a</td>
</tr>
<tr>
<td>Pigeon Pea</td>
<td>307 ± 80b</td>
<td>416 ± 80b</td>
<td>93 ± 80a</td>
</tr>
<tr>
<td>Sun Flower</td>
<td>0 ± 80a</td>
<td>440 ± 80b</td>
<td>451 ± 80b</td>
</tr>
<tr>
<td>Sunn Hemp</td>
<td>144 ± 80b</td>
<td>13 ± 80a</td>
<td>0 ± 80a</td>
</tr>
<tr>
<td>6 Week Harvest</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>NA</td>
<td>378 ± 328a</td>
<td>591 ± 238a</td>
</tr>
<tr>
<td>Pigeon Pea</td>
<td>1,413 ± 328b</td>
<td>1,676 ± 328b</td>
<td>282 ± 238c</td>
</tr>
<tr>
<td>Sun Flower</td>
<td>0 ± 328a</td>
<td>1,691 ± 328b</td>
<td>782 ± 238ab</td>
</tr>
<tr>
<td>Sunn Hemp</td>
<td>2,229 ± 328b</td>
<td>409 ± 328a</td>
<td>20 ± 238c</td>
</tr>
</tbody>
</table>

Values within the same column group followed by different letters differ (p<0.05) according to a least significant range separation.
Jalapeno Pepper Plant Development at 1\(^{st}\) Harvest (62 DAT) in Weeded Sub-Plots
Jalapeno Pepper Harvest

First pepper harvest occurred on April 31, 2013 (70 DAT) and on March 31, 2014 (62 DAT)

Peppers were harvested from data rows, graded (marketable or unmarketable), and weighed.
Jalapeno Pepper Production

- **Low frequency weeding of Sunn Hemp plots resulted in the greatest pepper yield, more fruit per plant, and the heaviest fruit.**

- **Non-weeded plots followed similar trends, but with severely reduced yields, fruit per plant, and individual fruit weight.**

### Mean marketable jalapeno pepper fruit per plant and individual fruit weight (g) from weeded and non-weeded sub-plots by treatment

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Weeded</th>
<th>Non-Weeded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunn Hemp</td>
<td>17 ± 3</td>
<td>6.1 ± 1</td>
</tr>
<tr>
<td>Control</td>
<td>13 ± 3</td>
<td>2.3 ± 1</td>
</tr>
<tr>
<td>Sun Flower</td>
<td>6 ± 3</td>
<td>0.3 ± 1</td>
</tr>
<tr>
<td>Pigeon Pea</td>
<td>5 ± 3</td>
<td>1.1 ± 1</td>
</tr>
</tbody>
</table>

Values within the same column group followed by different letters differ (p<0.05) according to a least significant range separation. Sub-plots weeded at 6, 9, & 12 weeks.

### Mean Marketable Fruit Wt. (g)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Weeded</th>
<th>Non-Weeded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunn Hemp</td>
<td>15.1 ± 1</td>
<td>16 ± 3</td>
</tr>
<tr>
<td>Control</td>
<td>14.5 ± 1</td>
<td>17 ± 3</td>
</tr>
<tr>
<td>Sun Flower</td>
<td>12.7 ± 1</td>
<td>10 ± 3</td>
</tr>
<tr>
<td>Pigeon Pea</td>
<td>12.7 ± 1</td>
<td>18 ± 3</td>
</tr>
</tbody>
</table>

Values within the same column group followed by different letters differ (p<0.05) according to a least significant range separation. Sub-plots weeded at 6, 9, & 12 weeks.
Implications and Summary

Cover crops can be a valuable management tool in the tropics that require few if any external inputs.

Cover crop re-growth may cause weed problems when using a roller-crimper for termination of specific CC species in tropical or extended warm season environments.

For indeterminate cover crops, roller-crimper termination may not be viable without additional management.

Surface sheet mulch resulting from CCs terminated with a roller-crimper can be used for natural weed suppression and to protect soil quality for subsequent crop rotations.
Summary

• We have made a lot of progress on refining these systems, but they are not without risk - be prepared to have a back up plan to manage undesirable cover crop results.

• Design an approach that is fully supported by the equipment on hand.

• Recommended vegetable cultivars, planting practices and fertilization strategies apply for conventional practices and not necessarily high residue cover crop systems.

We still have a lot to learn, but we will get there together...