

# Mitigating Soil Disturbance in Organic Systems

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# Fact or Fiction?

- ❖ Soil Disturbance in a typical Organic system is greater than a typical conventional system.
- ❖ Since Organic systems typically rely on tillage for weed control, soil loss is always higher than a mulch-till or even a conventional system.

# Fact or Fiction?

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# Fact or Fiction?

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- ❖ Since Organic systems typically rely on tillage for weed control, soil loss is always higher than a mulch-till or even a conventional system.

Organic systems rely on many practices and activities for weed control, not just tillage. However, tillage is the primary suppression technique.

# Is Organic No-Till Possible?

Yes!

But, that is another presentation altogether.

<http://www.conservationwebinars.net/webinars/reduced-tillage-in-organic-specialty-crop-systems>  
<http://www.conservationwebinars.net/webinars/organic-no-till-systems>

# Steps to Mitigating Soil Disturbance in Organic Systems

- ❖ Get the field management details
- ❖ Identify when soil loss occurs
- ❖ Identify potential mitigation alternatives
- ❖ Assess the effects of those alternatives
- ❖ Implement the agreed-to alternative(s)

# Getting the field management details

- ❖ It is essential that you know the details of the field operations to accurately determine the soil loss rate and to know what part(s) of the year/rotation soil loss is most prominent.

A not-uncommon description of a clients field operations for a mixed vegetable rotation

Prepare and fertilize seed bed in the spring for sweet **corn** with tandem disk as soon as it is dry and warm enough. Plant in April/May. Hand pick corn in the summer. Prepare and fertilize seed bed in the spring for **tomatoes** with tandem disk as soon as it is dry and warm enough. Lay plastic mulch and plant. Hand pick tomatoes all summer long. Prepare and fertilize seed bed in the spring for **pumpkins** with tandem disk as soon as it is dry and warm enough. Pick Pumpkin early October. Prepare and fertilize seed bed in early May for **peas**. Machine harvest in July.

# Getting the field management details

During the Inventory and Evaluation phase of the Conservation Planning process, the planner must ask about:

- ❖ What the producer does (e.g. plow, disk, plant, weed, harvest etc.)
- ❖ When the producer does it (e.g. Nov 15-plow, April 1-disk, April 15-plant, every 2 weeks after planting until canopy closure in early June-weed, July 15-harvest, etc.)
- ❖ How the producer does it (e.g. 4-bottom moldboard plow to 8" depth at a 45° angle from the western edge of the field, tandem disk at 6" depth at 90° angle from plow direction, tine weeder for first 2 passes then rotary row weeder after, etc.)

# Getting the field management details

Management: CMZ 60\c.Other Local Mgt Records\Corn,sweet,SD,cultivated - Tomatoes,SD,plastic - Squash,SD - Peas,SD,drilled;mod Z60

Graphic    
 Rel. row grade, %

Long-term natural rough, mm    
 Normally used as a rotation?  Yes   
 Duration, yr

Management STIR

Avg. annual STIR

Add to this management to make new one

View/edit rotation builder used to make this management

Irrigation system

Fuel for all operations    
 Base equiv. diesel use, gal/ac    
 Base energy use, BTU/ac    
 Base fuel cost, US\$/ac

How set crop year end/start?

Crop Year STIR Values

Crop year	STIR	Crop	Start date, m/d/y	End date, m/d/y
1	127	Corn, sweet	7/11/0	10/1/1
2	91.9	Tomato, fresh mkt	10/2/1	10/1/2
3	150	Squash	10/2/2	10/1/3
4	78.7	Peas, green, drilled	10/2/3	7/10/4

Operations Info

Management Operations

Date, m/d/y	End/Start crop year?	Operation	Vegetation	Yield (harv. units), #/ac	Type of cover material	Cover mat add/remov e, lb/ac	Cover from addition, %	Standing res. added by op. desc., lb/ac
4/25/1	No	Disk, tandem heavy primary op.						
5/1/1	No	Add mulch			Manure, poultry	2000	13	
5/1/1	No	Disk, tandem secondary op.						
5/5/1	No	Harrow, coiled tine						
5/10/1	No	Fert applic. surface broadcast						
5/10/1	No	Planter, double disk opnr	Corn, sweet	10000				
6/1/1	No	Cultivator, row 3 in ridge						
6/15/1	No	Cultivator, row 3 in ridge						
10/1/1	Yes	Harvest, hand pick vegetables						
11/1/1	No	Winter kill annual crop				2700	64	1800
5/15/2	No	Disk, tandem heavy primary op.						
5/20/2	No	Add mulch			compost	4000	93	
5/20/2	No	Disk, tandem secondary op.						
5/25/2	No	Harrow, coiled tine						
5/25/2	No	Plastic mulch applicator 50 percent cover						
5/25/2	No	Planter, transplanter, vegetable on 8 inch high beds	Tomato, fresh mkt	500				
10/1/2	Yes	Harvest, hand pick vegetables						
10/1/2	No	Plastic mulch, remove						
11/1/2	No	Winter kill annual crop				1900	67	1300
5/15/3	No	Disk, tandem heavy primary op.						
5/20/3	No	Add mulch			compost	4000	93	
5/20/3	No	Disk, tandem secondary op.						
5/25/3	No	Harrow, coiled tine						
5/25/3	No	Planter, transplanter, vegetable, no-till	Squash	10000				
6/8/3	No	Cultivator, row 3 in ridge						
6/22/3	No	Cultivator, row 3 in ridge						
7/1/3	No	Cultivator, row 3 in ridge						
7/8/3	No	Weed control, manual hoe			weeds; 0-3 mo	50	2.6	
7/22/3	No	Weed control, manual hoe			weeds; 0-3 mo	50	2.6	
10/1/3	No	Harvest, hand pick vegetables						
11/1/3	No	Winter kill annual crop				1100	47	720
5/1/4	No	Disk, tandem heavy primary op.						
5/5/4	No	Harrow, coiled tine						
5/5/4	No	Drill or air seeder, hoe/chisel openers 6-12 in spac.	Peas, green, drilled	2000				
7/10/4	No	Harvest, vine crops, mechanical				450	23	0

# Getting the field management details

## Effects of some field operation choices in RUSLE2

Management Operations						
Date, m/d/y	End/Start crop year?	Operation	Vegetation	Yield (harv. units), #/ac	Type of cover material	Cover mat add/remov e, lb/ac
5/15/2	No	Disk, tandem heavy primary op.				
5/20/2	No	Add mulch			compost	4000
5/20/2	No	Disk, tandem secondary op.				
5/25/2	No	Harrow, coiled tine				
5/25/2	No	Planter, transplanter, vegetable on 8 inch high beds	Tomato, fresh mkt	500		
6/8/2	No	Weed control, hoeing in row			weeds; 0-3 mo	50
6/22/2	No	Weed control, hoeing in row			weeds; 0-3 mo	50
7/6/2	No	Weed control, hoeing in row			weeds; 0-3 mo	50
7/20/2	No	Weed control, hoeing in row			weeds; 0-3 mo	50
8/3/2	No	Weed control, hoeing in row			weeds; 0-3 mo	50
8/17/2	No	Weed control, hoeing in row			weeds; 0-3 mo	50
8/31/2	No	Weed control, hoeing in row			weeds; 0-3 mo	50
10/1/2	No	Harvest, hand pick vegetables				
11/1/2	No	Winter kill annual crop				1900

Description	Change in Soil Loss (%)
Tomato - benchmark	-
Tomato - lighter disk	-20
Tomato - heavier disk	16
Tomato - flame weed 1st month	-8
Benchmark w/ plastic mulch (50% cover)	-33
Light disk w/ plastic mulch (50% cover)	-45
Benchmark w/ plastic mulch but forget to remove it	-94

# Getting the field management details



## RUSLE2 Information Gathering

**Management Questions:** Select the RUSLE2 management template that best describes the client's crop or rotation and check each line of the record you selected and answer the following question. Questions are referenced on Figure 2.

1. Are the dates of the selected operations correct? \_\_\_\_\_ If not, make it so. \*\*
2. Are the operations selected in the correct order? \_\_\_\_\_ If not, make it so. \*\*
3. Are the operations selected correct? \_\_\_\_\_ Check information by clicking the yellow folders for details. What you are looking for here is that, for example, if a farmer is using a "tandem disk" ensure that the implement operation depth and residue burial value observed in the field operation is the same as that stated in the "tandem disk" record you choose from the RUSLE2 database. \*\*
4. Is/are the correct vegetation(s) selected? \_\_\_\_\_ (see 6. for more detail) \*\*
5. Is/are the yield(s) reported in the RUSLE2 vegetation record and the field yield consistent? \_\_\_\_\_ \*\*
6. Is the correct vegetation record selected? \_\_\_\_\_ This can be checked by graph %canopy of the vegetation selected and matching it up with the vegetation in the Note: vegetation records have a % canopy value for each day of the record and associated total yield value. Changing the yield value will change canopy value.
7. Is the field irrigated? \_\_\_\_\_ If yes, enter irrigation information in the management record if you are modeling an irrigated crop.
8. If external residues (e.g. manure, mulch, compost, etc.) are being applied, when (i.e. which crop(s))? \_\_\_\_\_ T/Ac.

For use with "NRCS summary tab steps 12192014" user template

NRCS summary tab steps 12192014

Similar information needed for WEPS

The screenshot shows the RUSLE2 software interface with several key components:

- Management STR Table:** A table with columns for Crop year, STR, Crop, Start date, and End date. It lists four crop years with their respective STR values and crop types.
- Operations Table:** A large table with columns for Date, A/I/D, Emerg crop, Operation, Vegetation, Yield (bu/acre), Type of cover, Cover soil address, Cover loss address, Standing residue, and Fuel used. It lists various field operations like 'Plow, pre-emergence', 'Plant, double disk open', 'Spray, post-emergence', etc., with their corresponding dates and parameters.
- Vegetation Table:** A table with columns for Vegetation, Yield (bu/acre), Type of cover, Cover soil address, Cover loss address, and Standing residue. It lists different vegetation types like 'Corn, grain' and 'Soybean, row 15-20 in row'.
- Graphs:** Several graphs are visible, including a 'Soil loss for cons. plan' graph, a 'Canopy cover %' graph, and a 'Residue' graph. Red arrows point to these graphs from the text labels M1 through M8.
- Management STR Table:** A table with columns for Crop year, STR, Crop, Start date, and End date. It lists four crop years with their respective STR values and crop types.

# Identifying when Soil Loss Occurs

RUSLE2 Version 2.5.4.9 (Apr 8 2015)

File Database Edit View Options Tools Window Help

Auto update

Profile: NE demo

Manage Soil Topo

Actual row grade, %

Crit. slope length, ft

T value, t/ac/yr

Soil loss for cons. plan, t/ac/yr

Sediment delivery, t/ac/yr

Net event runoff, in/yr

Avg. ann. forage harvest, lb/ac

SCI value OK?

Soil loss for cons. plan OK?

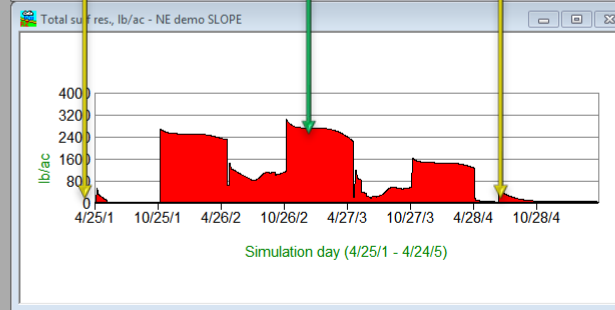
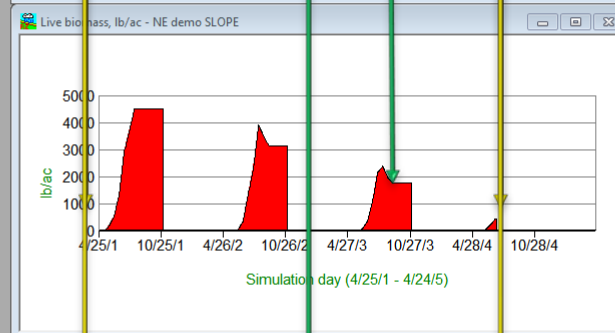
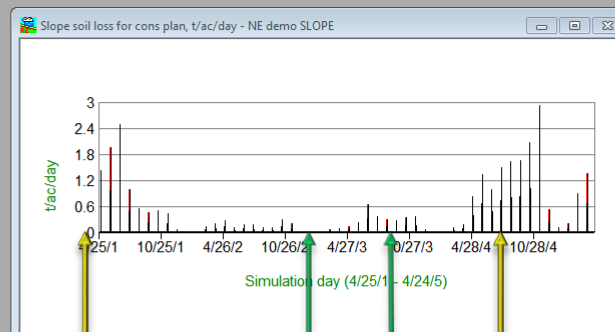
Stripcropping | Track Biomass | Detailed Erosion Results | Misc. Output | Information | Hydrology

Step 1-PRIMARY INPUTS | Step 2-Soil | Step 3-Topography | **Step 4-Management** | Division and Terrace Location

Man. strip builder  | Adjust yields  | Fuel type for entire run: (none)

Rotation builder  | General yield level: Base yield | Adjust ext. res. addition

Segment	Management	Seg length (along slope), ft	Soil loss, t/ac/yr	Sed. delivery, t/ac/yr
1	...cal Mgt Records\Corn,sweet,SD,cultivated - Tomatoes,SD,plastic - Squash,SD - Peas,SD,drilled,mod Z60	200	7.7	7.7



Profile: Soil conditioning index (Soil conditioning index[1]) of NE demo

Wind & irrigation-induced

SCI DM subfactor

SCI FD subfactor

SCI ER subfactor

Avg. annual slope STIR

Soil conditioning index (SCI)

Annual STIR Value by Crop Year			
Start date, m/d/y	End date, m/d/y	Veg.	STIR value
Management 1			

Finished calculating



# What are SCI and STIR?

## Soil Conditioning Index (SCI):

- ❖ A quick way to characterize the organic matter dynamics of a farming system.
  - ❖ OM is the organic material or biomass factor.
  - ❖ FO is the field operations factor.
  - ❖ ER is the erosion factor.

## Soil Tillage Intensity Rating (STIR):

- ❖ Value reflects the kind of soil disturbance as well as the severity of the disturbance caused by tillage operations.
  - ❖ Operational speed of tillage equipment
  - ❖ Tillage type
  - ❖ Depth of tillage operation
  - ❖ Percent of the soil surface area disturbed

# Soil Loss Mitigation Alternatives

Mitigating offsite soil loss impacts (i.e. sediment delivery)

- ❖ Field Border
- ❖ Filter Strip
- ❖ Riparian Forest Buffers
- ❖ Sediment Basin
- ❖ Grassed Waterways



# Soil Loss Mitigation Alternatives

## Other soil loss mitigating techniques

- ❖ Strip crop
- ❖ Diversions and Terraces
- ❖ Mid-slope buffers
- ❖ Contour farming



# Results of Some Mitigation Alternatives

Description	Cons. Plan. Soil Loss, t/ac/yr	Sed. Delivery, t/ac/yr	Soil Conditioning Index (SCI)
Benchmark Condition	7.67	7.67	-0.48
Sediment Basin at the Bottom	7.67	0.562	-0.48
Planting on the Contour	4.07	4.07	-0.19
Planting on the Contour & strip cropping	3.39	3.00	-0.18
Planting on the Contour & midslope diversion	2.4	1.94	-0.11
Planting on the Contour & midslope buffer	2.74	2.39	-0.007
Planting on the Contour & filter strip	3.06	0.471	-0.0035

# Soil Loss Mitigation Alternatives

## Mitigating in-field soil loss

- ❖ Change timing of tillage events
  - ❖ Switching from Fall to Spring tillage
- ❖ Incorporate Cover Crops in the rotation
  - ❖ Look for times when there is little cover or residue in the field
  - ❖ Look for opportunities to grow cover crops simultaneously with cash crops
- ❖ Incorporate more high residue cash crops in the rotation
- ❖ Strip cropping with perennial hay crop in the rotation

# Remember our Benchmark Condition

RUSLE2 Version 2.5.4.9 (Apr 8 2015)

File Database Edit View Options Tools Window Help

Auto update

Profile: NE demo

Manage Soil Topo

Actual row grade, %: 5.0  
 Crit. slope length, ft: 200  
 T value, t/ac/yr: 3.0

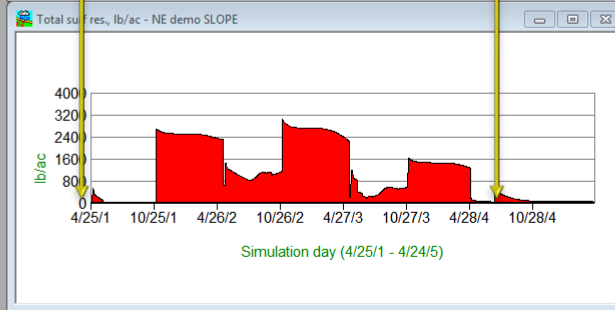
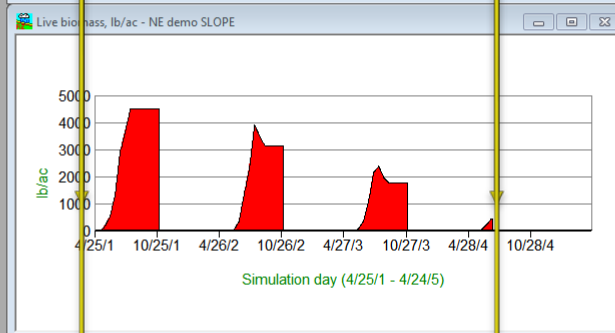
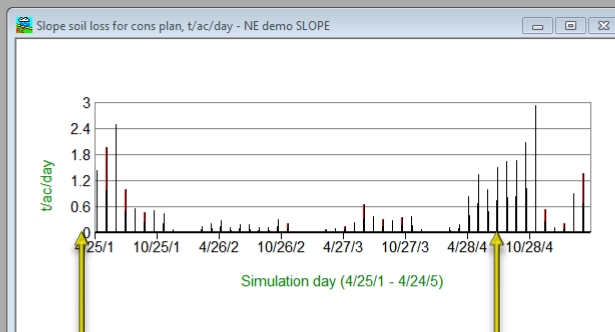
Soil loss for cons. plan, t/ac/yr: 7.68  
 Sediment delivery, t/ac/yr: 7.68  
 Net event runoff, in/yr: 9.0  
 Avg. ann. forage harvest, lb/ac: 0

SCI value OK?:   
 Soil loss for cons. plan OK?:

Stripcropping | Track Biomass | Detailed Erosion Results | Misc. Output | Information | Hydrology  
 Step 1-PRIMARY INPUTS | Step 2-Soil | Step 3-Topography | **Step 4-Management** | Diversion and Terrace Location

Man. strip builder  | Adjust yields  | Fuel type for entire run: (none)  
 Rotation builder  | General yield level: Base yield | Adjust ext. res. addition

Segment	Management	Seg length (along slope), ft	Soil loss, t/ac/yr	Sed. delivery, t/ac/yr
1	...cal Mgt Records\Corn,sweet,SD,cultivated - Tomatoes,SD,plastic - Squash,SD - Peas,SD,drilled,mod Z60	200	7.7	7.7



Profile: Soil conditioning index (Soil conditioning index[1]) of NE demo

Wind & irrigation-induced: 0  
 SCI DM subfactor: -0.070  
 SCI FD subfactor: -0.11  
 SCI ER subfactor: -2.0

Avg. annual slope STIR: 112  
 Soil conditioning index (SCI): -0.48

Annual STIR Value by Crop Year			
Start date, m/d/y	End date, m/d/y	Veg.	STIR value
Management 1 /			

# Results of Some Mitigation Alternatives

## Original Corn-Tomato-Squash-Peas Rotation

Description	Cons. Plan. Soil Loss, t/ac/yr	Sed. Delivery, t/ac/yr	Soil Cond. index (SCI)
Benchmark Condition (Original Corn-Tomato-Squash-Peas Rotation)	7.67	7.67	-0.48
Added cover crops	3.76	3.76	-0.068
Added cover crops & contouring	1.18	1.18	0.13
Added cover crops & contouring & additional 1T compost	0.854	0.854	0.2

# Results of Some Mitigation Alternatives

## Alternative Corn-Tomato-Squash-Cabbage Rotation

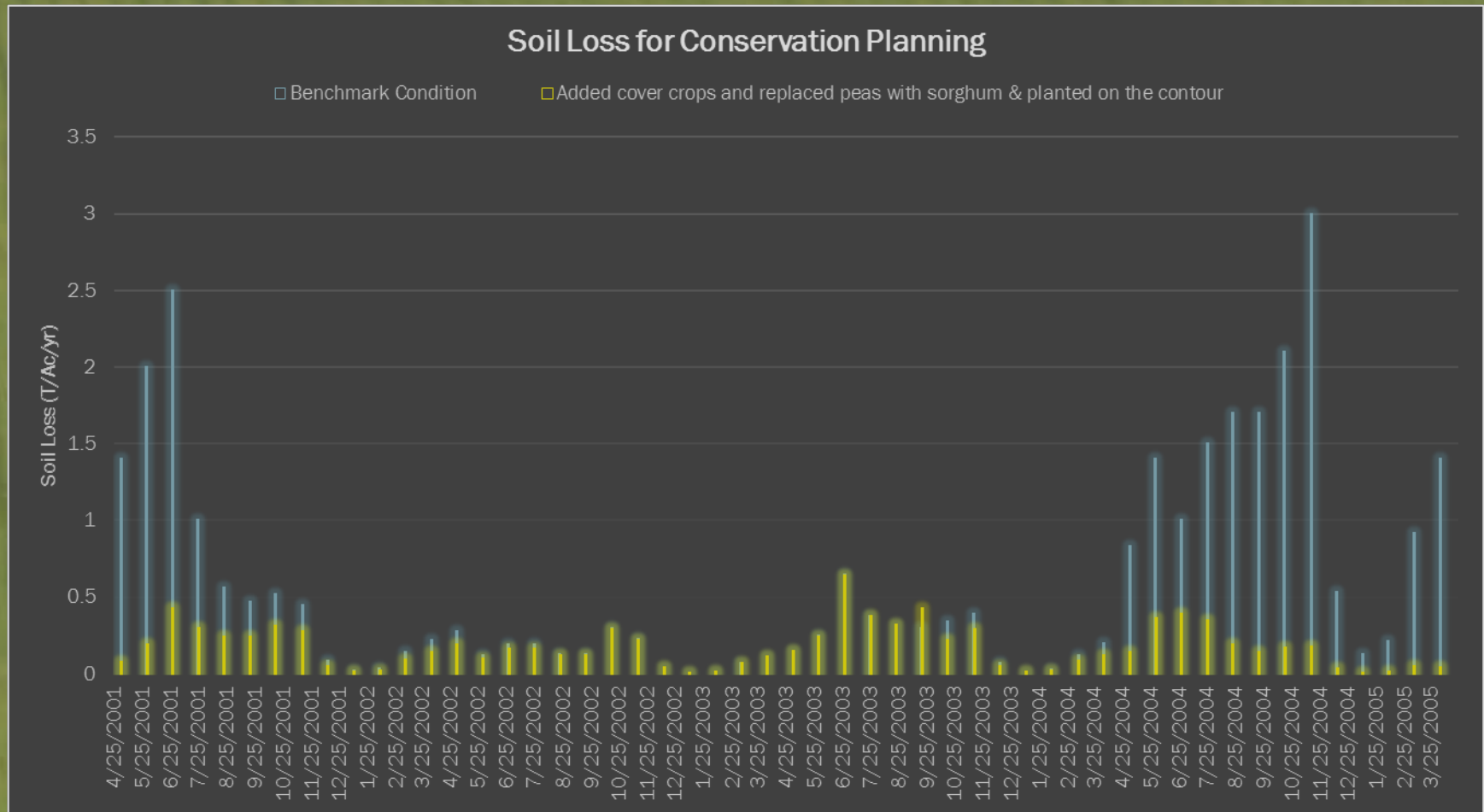
Description	Cons. Plan. Soil Loss, t/ac/yr	Sed. Delivery, t/ac/yr	Soil Cond. index (SCI)
Benchmark Condition (Original Corn-Tomato-Squash-Peas Rotation)	7.67	7.67	-0.48
Added cover crops & replaced peas with cabbage	3.35	3.35	-0.014
Added cover crops & contouring & replaced peas with cabbage	0.935	0.935	0.18
Added cover crops & contouring & replaced peas with cabbage & additional 1T compost	0.8	0.8	0.23

# Results of Some Mitigation Alternatives

## Alternative Corn-Tomato-Squash-Sorghum(hay) Rotation

Description	Cons. Plan. Soil Loss, t/ac/yr	Sed. Delivery, t/ac/yr	Soil Cond. index (SCI)
Benchmark Condition (Original Corn-Tomato-Squash-Peas Rotation)	7.67	7.67	-0.48
Added cover crops & replaced peas with sorghum-hay	2.19	2.19	0.20
Added cover crops & contouring & replaced peas with sorghum-hay	0.427	0.427	0.33
Added cover crops & contouring & replaced peas with sorghum-hay & additional 1T compost	0.424	0.424	0.34

# Results of Some Mitigation Alternatives



# Identifying when Soil Loss Occurs

RUSLE2 Version 2.5.4.11 (Apr 17 2015)

File Database Edit View Options Tools Window Help

Auto update

Profile: NE demo test\*

Manage Soil Topo

Actual row grade, %   
 Crit. slope length, ft   
 T value, t/ac/yr

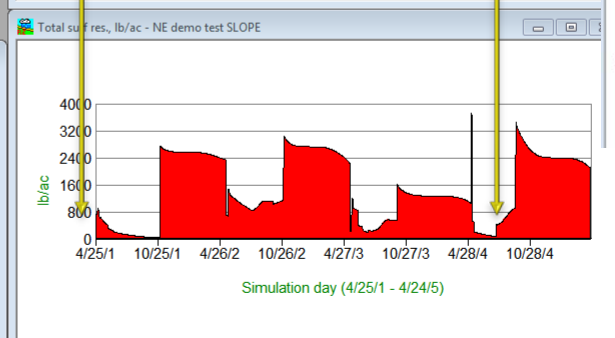
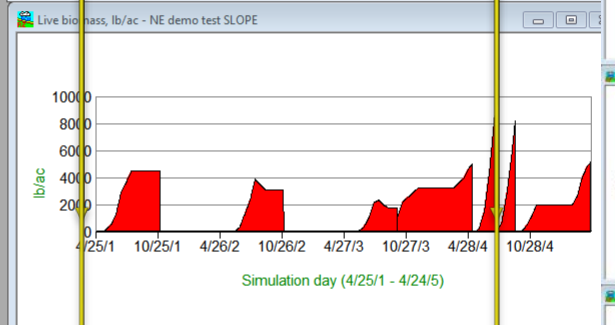
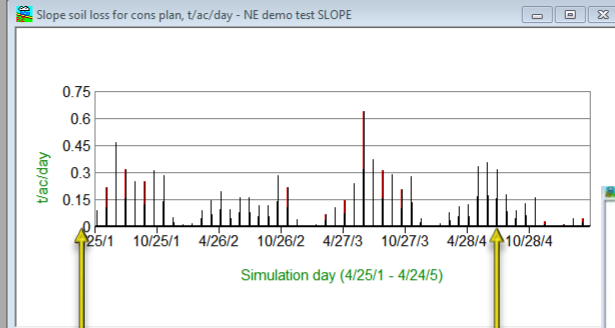
Soil loss for cons. plan, t/ac/yr   
 Sediment delivery, t/ac/yr   
 Net event runoff, in/yr   
 Avg. ann. forage harvest, lb/ac

SCI value OK?   
 Soil loss for cons. plan OK?

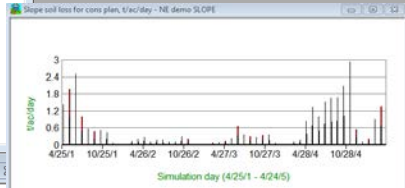
Stripcropping Track Biomass Detailed Erosion Results Misc. Output Information Hydrology  
 Step 1-PRIMARY INPUTS Step 2-Soil Step 3-T-epigraphy Step 4-Management Diversion and Terrace Location

Man. strip builder  Adjust yields  Fuel type for entire run   
 Rotation builder  General yield level  Adjust ext. res. addition

Segment	Management	Seg length (along slope), ft	Soil loss, t/ac/yr	Sed. delivery, t/ac/yr
1	D, cultivated - Tomatoes, SD, plastic - Squash, SD, winter cover - sorghum, SD, drilled, winter cover, mod Z60	200	2.2	2.2



## Benchmark Condition



Profile: Soil conditioning index (Soil conditioning index[1]) of NE demo test

Wind & irrigation induce

SCI OM subfactor   
 SCI FD subfactor   
 SCI ER subfactor

Avg. annual slope STIR   
 Soil conditioning index (SCI)

Annual STIR Value by Crop Year			
Start date, m/d/y	End date, m/d/y	Veg.	STIR value
Management 1			

Finished calculating

R2\_NRCS NRCS summary tab steps 12192014

MOSES NEW FORAGE FY15 (1-29)

# How to See & Graph Important Information to in RUSLE<sub>2</sub>

Profile: NE demo

Add break Erase break

Actual row grade, %

Crit. slope length, ft

T value, t/ac/yr

Soil loss for cons. plan, t/ac/yr

Sediment delivery, t/ac/yr

Net event runoff, in/yr

Avg. ann. forage harvest, lb/ac

SCI value OK?

Soil loss for cons. plan OK?

Step 1-PRIMARY INPUTS | Step 2-Management | **Step 3-Topography** | Step 4-Managements | Diversion and Terrace Location

Stripcropping | Track Biomass | **Detailed Erosion Results** | Misc. Output | Information | Hydrology

Soil loss for cons. plan, t/ac/yr

Soil loss erod. portion, t/ac/yr

Detachment on slope, t/ac/yr

Sediment delivery, t/ac/yr

Soil Loss Results

Simulation day, m/d/y	Detach, t/ac/day	Slope soil loss rate, t/ac/day	Slope soil loss for cons plan, t/ac/day	Slope sed. del. rate, t/ac/day	Slope sed. load, lb/ft/day
4/25/1	0	0	0	0	0
4/26/1	0	0	0	0	0
4/27/1	0	0	0	0	0
4/28/1	0	0	0	0	0
4/29/1	0	0	0	0	0
4/30/1	0	0	0	0	0
5/1/1	0	0	0	0	0
5/2/1	1.4	1.4	1.4	1.4	13
5/3/1	0	0	0	0	0
5/4/1	0	0	0	0	0

Soil loss rate

Simulation day, m/d/y	Soil loss rate, t/ac/day
4/25/1	0
4/26/1	0
4/27/1	0
4/28/1	0
4/29/1	0

Segment 1



# Review the Steps to Mitigate Soil Disturbance in Organic Systems

- ❖ Get the field management details
- ❖ Identify when soil loss occurs
- ❖ Identify potential mitigation alternatives
  - ❖ Changing/substituting tillage implements
  - ❖ Inclusion of cover crops
  - ❖ Adding compost/mulch
  - ❖ Changing crops in the rotation
- ❖ Assess the effects of those alternatives
- ❖ Implement the agreed-to alternative(s)

# Mitigating Soil Disturbance in Organic Systems

## Questions?



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