

TILLAGE DISTURBANCE INDEX FOR SOIL CARBON (T-DISC) USER GUIDE



U.S. DEPARTMENT OF AGRICULTURE

Introduction

The U.S. Department of Agriculture's (USDA) Office of the Chief Economist (OCE) issued a final rule titled, "Technical Guidelines for the Production of Regenerative Agricultural Biofuel Feedstocks." The USDA Feedstock Carbon Intensity Calculator (USDA FD-CIC) is referenced in the final rule and allows users to estimate the carbon intensity (CI) in carbon dioxide equivalent (CO₂e) emissions per bushel of their corn, soybeans, sorghum, and spring canola based on user-supplied nutrient management data and user-supplied selections of specific regenerative agriculture practices including no-till and reduced till.

Tillage is generally categorized as conventional (intensive) till (CT), reduced till (RT), and no-till (NT) depending on the impact on soil disturbance of crop production operations and their associated soil disturbance.

- **Conventional or intensive till** is a full inversion or mixing of the soil, such as from rippers, and leaves low surface residue coverage;
- **Reduced till** means the implementation of a tillage system that limits disturbance to soil from mixing or inversion throughout the crop interval but allows minimal tillage and soil disturbance.
- **No-till** means the implementation of a tillage system that limits the amount of disturbance to soil from mixing or inversion, creating only minor disturbances to the upper layers of soil throughout the crop interval.

The Tillage Disturbance Index for Soil Carbon (T-DISC) tool generates a metric of soil disturbance that allows consistent determination of the intensity of tillage operations as an input for USDA FD-CIC. The tillage intensity metric is calculated based on the methodology outlined in the cropland and grazing land systems chapter of USDA's report "Quantifying Greenhouse Gas Fluxes in Agriculture and Forestry: Methods for Entity-Scale Inventory."¹ This user guide provides guidance on how to use T-DISC to derive a conservation tillage determination for use in USDA FD-CIC. The Appendix provides additional calculation background.

Step-by-Step User Interface Instructions

Getting Started

When opening the tool, users need to ensure that macros are enabled for the Excel file. **To enable macros in Excel, please follow these steps:**

¹ Beginning on page 3-39. [Quantifying Greenhouse Gas Fluxes in Agriculture and Forestry: Methods for Entity-Scale Inventory](#)



1. Confirm that the tool is saved on your device in a desktop or documents folder.
2. Open the Excel workbook from the saved location.
3. If you see a security warning, select "Enable Content" or "Yes" (see example Security Warning dialogue image)
4. Alternatively, go to File > Info > Security Warning > Enable Content > Advanced Options to enable macros for one session.
5. For more permanent changes, go to Excel Options > Trust Center > Macro Settings and activate the "Enable VBA Macros" option
6. Click into the 'User Inputs' tab. In cell C9, change the value to "Field Preparation". If a pop-up window appears, Excel is functioning properly.

For more information, follow the Enable or Disable macros in Microsoft 365 files instructions here: <https://support.microsoft.com/en-us/office/enable-or-disable-macros-in-microsoft-365-files-12b036fd-d140-4e74-b45e-16fed1a7e5c6>

Step 1: Enter Metadata for Records and Documentation

Users begin in the “User Input” tab. Users do not need to use any other tab to run T-DISC. **Users should enable macros prior to using the workbook** (refer to instructions above). First, the user should manually input the date (cell C3) and farm name (cell G3), then select the state (cell C4) and county locations (cell G4) and crop type (cell C5) from the drop-down lists. Users need to choose a state before the state’s counties are available to select. The T-DISC crop options are corn, sorghum, soybean, and canola.

T-DISC can be used to calculate the tillage designation for one or more management units for use in USDA FD-CIC. A **Management unit** in USDA FD-CIC is defined as a field, group of fields, or other land units having the same land use and the same management. If the user will be deriving T-DISC ratings for multiple management units, they can select the number of management units in cell G5, up to a maximum of 10 management units per copy of T-DISC. T-DISC will automatically expand the number of input tables for management units based on the number shown in cell G5.

These metadata input fields are not required for the tool to calculate tillage intensity results but are required documentation for producers who are using the tool to document conservation tillage practice determination for use in USDA FD-CIC.

The following steps are described with reference to cells in the first input table but are relevant to all management units.

Figure 1: Select crop and location.

Tillage Disturbance Index for Soil Carbon (T-DISC)				
Date	6/24/2026	Farm Name	White Sky	
State	IL	County	Champaign	
Crop	Corn	# of Mgmt. Units to Assess ?	1	
Print Results				

Step 2: Enter the Appropriate Management Unit ID Number

The user should enter into cell C7 a management unit ID number that corresponds to the management unit number in USDA FD-CIC for which a tillage designation is being calculated. Tillage designation calculations in T-DISC are required only for those management units in FD-CIC that are claiming a conservation tillage practice in calculating their CI score.

Step 3: Soil Disturbance Equipment Type and Timing Inputs

Next, on the “User Input” tab, the user inputs the details on tillage windows and tillage equipment used for their field passes beginning in row 9, as shown in Figure 2. The order in which operations and field passes are entered is not important as long as all implements and operations are accounted for. Field passes related to fertilization, tillage, residue management and seedbed preparation, planting, and harvest must all be included in the tool calculation; field passes related to other chemical application with no soil disturbance may be excluded.

Figure 2: Tillage operation input table

Tillage Disturbance Index for Soil Carbon				
Date	6/24/2026	Farm Name	White Sky	
State	IL	County	Champaign	
Crop	Corn	# of Mgmt. Units to Assess ?	1	
Mgmt. Unit				
Operation Count	Tillage Window ?	Tillage Implements ?	Go to implement mapping tab	
1-1 Field Preparation	3a	CONDITIONAL FIELD	X	Clear all field operations
1-2 Bedding, planting	3b	BED SHAPE, BEDDER SHAPE	X	

Step 3a: Select Relevant Tillage Windows (Timing)

The T-DISC tool requires users to input all tillage implements and other farm operations conducted during the biofuel feedstock’s crop interval. The feedstock’s crop interval is defined as

1 day after harvest of prior cash crop to harvest of the feedstock crop being assessed for a CI score. In calculating tillage intensity, T-DISC divides the crop interval into 5 tillage windows:

- Field_Preparation (1 day after harvest of prior cash crop to 56 days before planting)
- Before_Planting (55-7 days before planting)
- Planting (6-0 days before planting)
- After_Planting (1 day after planting through 1 day before harvest)
- Harvest (day or days of harvest window)

Selecting a cell in the Tillage Window column will open a drop-down list with the five possible tillage windows. Once the user has selected a tillage window, a pop-up will appear confirming the window of time relative to planting or harvest represented by that tillage window.

Step 3b: Select Tillage Implement Equipment

The **tillage implement column** represents specific field tillage, fertilization, residue management, planting or harvesting operations relevant to soil disturbance. Once users have selected a tillage window, a list of available tillage implements for that tillage window will populate the drop-down list in the tillage implement column. Users must therefore select a tillage window before viewing and selecting the tillage implements.

Some tillage implements are listed twice in the drop-down list with different depths of operation, expressed in inches. In these cases, “LE” refers to “Less than or equal to” and “GT” refers to “Greater than.”

Figure 3: Tillage implements with different depths

	Operation Count	Tillage Window ?	Tillage Implements ?	Go to implement mapping tab
8				
9	1-1	Before_Planting		X
10	1-2		CULTIVATOR, MARKER	X
11	1-3		CULTIVATOR, MIDDLE-BUSTER, GT5IN CULTIVATOR, MIDDLE-BUSTER, LESIN CULTIVATOR, ROLLING	X

Mapping your Farming Activities to Tillage Implements

The drop-down list available for each tillage window includes a limited number of common implements appropriate to that tillage window. If a user does not see the implement or activity they need in that list, a more extensive list of operations is available under the “Implement Mapping” tab, with guidance for how those operations should be translated into the available tillage implements (with equivalent soil disturbance) in the drop down for a disturbance index to be calculated. On the “Implement mapping” tab, users may look for their activity in **column B**

and then identify one or more implements in **columns C-F** that should be used in the Tillage Implement column on the User Input tab to represent that activity.

For easy access to the mapping tab, users can click the “*Go to implement mapping tab*” button (appearing in cell G8) next to the tillage implements input table (shown in Figure 2).

Figure 3: Implement Mapping Tab

	A	B	C	D	E
1	ID	If your operation is this:	Use this TDISC implement	and a second TDISC implement	and a third TDISC implement
2	1	Aerator, field surface, ground driven	AERATOR		
3	2	Aerator, field surface, ground driven 0 degree offset	AERATOR		
4	3	Aerator, field surface, ground driven 10 degree offset	AERATOR		
5	4	Aerator, field surface, ground driven 5 degree offset	AERATOR		
6	5	Aerator, offset	AERATOR, TANDEM DRUM, ANGLE>5		
7	6	Aerator, single drum, lugs, angle 0	AERATOR		
8	7	Aerator, tandem drum, lugs, angle 10	AERATOR, TANDEM DRUM, ANGLE>5		

Cover Crop Field Operations

Users who adopt a cover crop during the biofuel feedstock’s crop interval must account for all cover crop field operations and implements used in their T-DISC rating. If the cover crop is inter- or over-seeded into the prior cash crop, the planting operation should be listed in the “Field Preparation” tillage window, which is the first tillage window in the feedstock’s crop interval.

Step 4: Review Results

After user has input complete tillage window and implement information for the feedstock's crop interval, the crop interval T-DISC rating and tillage intensity designation will populate in cells J7 and J8 in the "User Input" tab, as shown in Figure 4. The background shading of those cells will update corresponding to the crop interval tillage designation as follows: blue for NT, yellow for RT, and orange for CT.

Figure 4: Tillage intensity results table

Tillage Disturbance Index for Soil Carbon (T-DISC)			
Date	6/24/2026	Farm Name	White Sky
State	IL	County	Champaign
Crop	Corn	# of Mgmt. Units to Assess ?	1
Mgmt. Unit			
Operation Count	Tillage Window ?	Tillage Implements ?	Go to implement mapping tab
T-DISC rating		0.1800	
Tillage Intensity		RT	

Users may also review the tillage-window-specific results table below the main T-DISC rating in cells I10–K14 (shown in Figure 5) to see how tillage intensity is calculated for each tillage

window. The T-DISC rating for the feedstock's full crop interval is equivalent to the maximum TW Index across the five tillage windows in the feedstock's crop interval.

Figure 5: Calculated intensity by tillage window

	H	I	J	K
6				
7		T-DISC rating	0.1800	
8		Tillage Intensity	RT	
9				
10		Tillage Window (TW)	TW Index	TW Intensity
11		Field Preparation	0.02	NT
12		Before Planting	0.18	RT
13		Planting	0.01	NT
14		After Planting	0.05	NT
15		Harvest	0	
16		T-DISC rating is equivalent to the		
17		maximum TW Index in the crop interval		
18				

Users can save their results by either generating a PDF copy or by saving a copy of the tool with the completed input tables to their computer. To generate a printable form, click the '*Print Results*' button in the upper right (cell I3) and save or print the generated PDF.

Step 4: Input Conservation Tillage Designation into USDA FD-CIC

Where the production schedule for the feedstock's crop interval is estimated to qualify as either no-till or reduced till (as shown in cell J8 of the T-DISC "User Input" tab) input the relevant conservation tillage intensity designation into row 31 of the "Crop Inputs" tab in USDA FD-CIC for the appropriate management unit (shown in Figure 6.)

Figure 6: Input Tillage Intensity into the “Crop Inputs” Tab of USDA FD-CIC

A	B	C
USDA FD-CIC		
Legend/Key:	Date:	6/18/2026
Cell Color Description	Crop to Model:	Corn
Required User Input Cells	Number of Management Units to Model: Reset Inputs on All MUs	1
Optional User Input Cells		
Print Out Form		MU #1 Reset MU #1 Inputs
Go to Instructions	Management Unit Name (optional):	
Go to Glossary	Location - State	None
	Location - County	None
	Management Unit Size (acres)	0
	Actual average yield per acre (bushels/acre)	0
	Expected yield per acre (bushels/acre)	0
	Total Synthetic N Applied Per Acre (lbs/acre)	0
	(click to navigate to terms Glossary)	
	Management Practices	
	1) Cover Crop	No cover crop
	2) Tillage Practice	Reduced till

Optional: Resetting T-DISC

To start over, use the ‘*Clear all field operations*’ button next to the tillage implements table to reset USDA T-DISC, shown in column G of Figure 2.

Appendix: Background and Calculation Methodology

The T-DISC tool estimates a soil disturbance index to support consistent designation of crop production tillage intensity for use in applications like USDA FD-CIC. The T-DISC index calculates soil disturbance impacts of tillage and other farm operation equipment passes over the soil, organized by distinct tillage windows. The crop interval T-DISC rating is a single number ranging from 0 to 1 and is equivalent to the maximum tillage intensity estimated over the tillage windows within the crop interval. The crop interval tillage designation (NT, RT, or CT) is determined based on the crop interval T-DISC rating; no-till (NT) is returned when the T-DISC rating does not exceed 0.075, reduced till (RT) is returned when the T-DISC rating is between 0.076 and 0.252, and conventional till (CT) is returned when the T-DISC rating exceeds 0.253, shown in Table 1.

Each field operation contributes to varying degrees of soil disturbance. The soil disturbance attributed to an implement depends on the mixing efficiency of the implement (lateral movement and column mixing), as well as the depth at which it operates.

When multiple implements are used within a single tillage window, T-DISC starts with the implement that has the effect to the shallowest depth and then proceeds with the calculation for

each additional implement in order of tillage depth from shallow to deepest implement. If two or more implements have the same tillage depth, the tillage intensity is calculated in order from the least to most intensive implement. The T-DISC rating assumes that each additional tillage implement that mixes the soil does not have a significant impact on the decomposition of SOC in the proportion of the soil in the upper layers that previous implements have already disturbed. The resulting intensity rating is an index that reflects the overall intensity of tillage implements for the system and can be mapped to an overarching tillage designation, as shown in Table 1.

Table 1: T-DISC ranges for conventional till (CT), reduced till (RT) and no-till (NT)²

Tillage Designation	TI Min	TI Max
NT	0.000	0.075
RT	0.076	0.252
CT	0.253	1.000

² Source: Quantifying Greenhouse Gas Fluxes in Agriculture and Forestry: Methods For Entity-Scale Inventory. Table 3-14. USDA. <https://www.usda.gov/sites/default/files/documents/USDA-Methods-Report-2024.pdf>