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

September 4, 2026

U.S. DEPARTMENT OF AGRICULTURE

Contents

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 the T-DISC web tool to derive a conservation tillage determination for use in USDA FD-CIC. The Appendix provides additional calculation background.

Instructions

Getting Started

The tool can be found at usda.gov/t-disc/webtool.

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

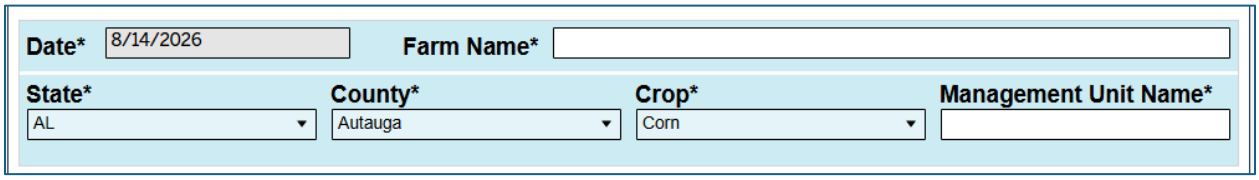
Step 1: Enter Metadata for Records and Documentation

First, the user should manually input the date and farm name, then select the state, county locations, and crop type from the drop-down lists. The T-DISC crop options are corn, sorghum, soybean, and canola.

The T-DISC web tool can be used to calculate the tillage designation for one management unit at a time 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 complete the form and save it as a PDF prior to refreshing the webpage to start a new management unit.

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.

Figure 1: Provide farm name, state, county, crop, and MU name that aligns with FD-CIC.



Step 2: Enter the Appropriate Management Unit Name

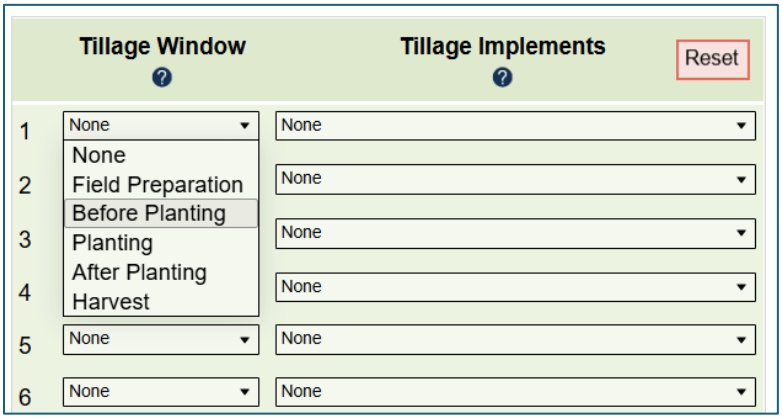
The user should enter a management unit name or ID number that corresponds to the management unit name or number in USDA FD-CIC for which a tillage designation is being calculated. Tillage designation calculations using T-DISC are required only for those management units in USDA FD-CIC that are claiming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

Step 3: Soil Disturbance Equipment Type and Timing Inputs

The user inputs the details on tillage windows and tillage equipment used for their field passes 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

can use the implement entitled "Sprayer/Aerial/Broadcast Application", which calculates to zero disturbance.

Figure 2: Tillage operation input table



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)

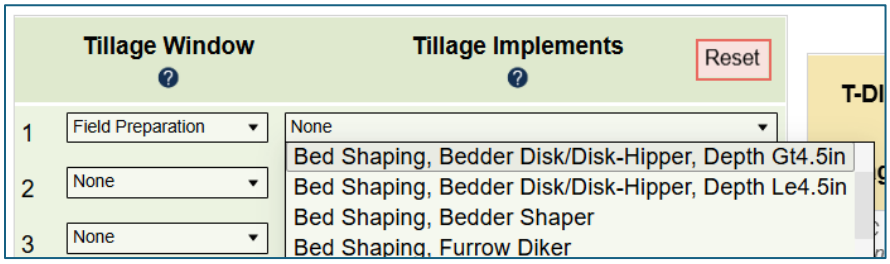
Selecting a cell in the Tillage Window column will open a drop-down list with the five possible tillage windows.

Step 3b: Select Tillage Implement Equipment

The **tillage implement column** represents specific field tillage, fertilization, residue management, planting or harvesting operations relevant to crop production and 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



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 by clicking the "Implement Mapping" button. Guidance for how those operations could be translated into the available tillage implements in the drop down for a disturbance index to be calculated is provided in that table. In the "Implement mapping" table, users may look for their activity in **the first column** and then identify one or more implements in **the second through fifth columns** that should be used in the Tillage Implement column on the User Input tab to represent the full impact of that activity.

Figure 3: Implement Mapping Table

ID	If your operation is this:	Use this TDISC implement	and a second TDISC implement	and a third TDISC implement
1	Aerator, field surface, ground driven	AERATOR		
2	Aerator, field surface, ground driven 0 degree offset	AERATOR		
3	Aerator, field surface, ground driven 10 degree offset	AERATOR		
4	Aerator, field surface, ground driven 5 degree offset	AERATOR		
5	Aerator, offset	AERATOR, TANDEM DRUM, ANGLE>5		
6	Aerator, single drum, lugs, angle 0	AERATOR		
7	Aerator, tandem drum, lugs, angle 10	AERATOR, TANDEM DRUM, ANGLE>5		
8	Aerator, tandem drum, lugs, angle 5	AERATOR, TANDEM DRUM, ANGLE>5		
9	Bed shaper	BED SHAPING, BEDDER SHAPER		
10	Bed shaper high disturbance	BED SHAPING, FURROW DIKER		
11	Bed shaper, 12 inch	BED SHAPING, BEDDER SHAPER		
12	Bed shaper, 12 inch, low flattening	BED SHAPING, BEDDER SHAPER		
13	Bed shaper, low flattening, high disturbance	BED SHAPING, FURROW DIKER		
14	Bedder, disk hiller	BED SHAPING, BEDDER DISK/DISK-HIPPER, DEPTH LE4.5IN		
15	Bedder, hipper, disk hiller	BED SHAPING, BEDDER DISK/DISK-HIPPER, DEPTH LE4.5IN		

Due to the wide range of agricultural implements used, the implement mapping table is also not comprehensive. In general, users should evaluate the various points of soil contact and disturbance arising from their implements and represent them to the best of their ability using the implements available within T-DISC's dropdown menus; the implement mapping table provides guidance on how such mapping might look but can and should be customized according to a user's particular implements and field passes. It is also best practice to document those decisions; in the event the T-DISC user is audited, such documentation will assist in presenting the reasoning behind the decisions during the audit process.

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 completed tillage window and implement information for the feedstock's crop interval, the crop interval T-DISC rating and tillage intensity designation will populate in the Management Unit Result table, as shown in Figure 5.

Figure 5: Tillage intensity results table

Management Unit Result	
T-DISC Rating	**Tillage Intensity**
0.1300	Reduced Till

T-DISC rating is equivalent to the maximum TW Index in the crop interval.

Users may also review the tillage-window-specific results table below the main T-DISC rating in the Tillage Window Results table (shown in Figure 6) 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 6: Calculated intensity by tillage window

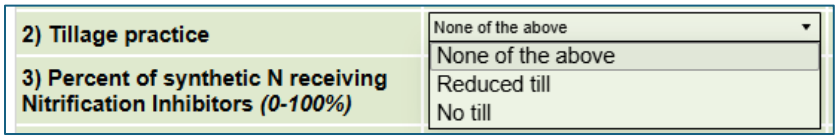
Tillage Window Results		
Tillage Window (TW)	**TW Index**	**TW Intensity**
Field Preparation	0.1300	Reduced Till
Before Planting		
Planting	0.0067	No Till
After Planting	0.0250	No Till
Harvest	0.0000	No Till

Users can save their results by generating a PDF copy. To generate a printable form, click the *'Download PDF'* button in the upper right and save or print the generated PDF.

Step 5: 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 the T-DISC Management Unit Result table) input the relevant conservation tillage intensity designation into the Tillage Practice row of the USDA FD-CIC for the appropriate management unit (shown in Figure 7.)

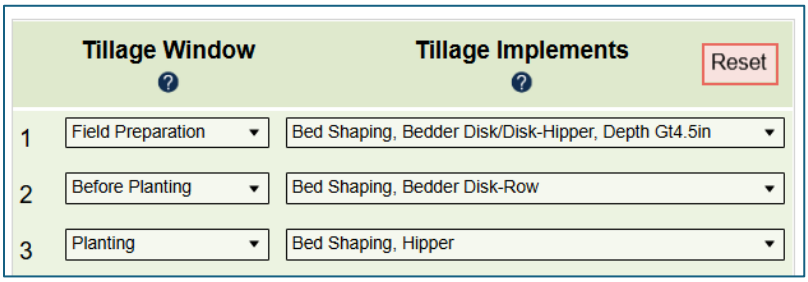
Figure 7: Input Tillage Intensity into the "Crop Inputs" Tab of USDA FD-CIC



Optional: Resetting T-DISC

To start over, use the *'Reset'* button in the top right of tillage implements table to reset USDA T-DISC, shown in Figure 8.

Figure 8: T-DISC Reset Button



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 (no till, reduced till, or conventional till) 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 exceeds .075 but is less than or equal to 0.252, and conventional till (CT) is returned when the T-DISC rating exceeds 0.252, 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 by calculating the disturbance associated with the implement that has the shallowest depth. The calculations associated with additional implements at deeper depths then proceed in order of tillage depth from shallowest to deepest implement, with the impact of each deeper implement adjusted for the impact already calculated for the shallower implements. This methodology is described in Ogle et al. (2024) [2], and the formulas used (shown in Equations box 3-13 of that citation) are:

$$TI = \frac{\sum_{t \to n} T_t}{30}$$

$$T_1 = ME_1 \times D_1$$

$$T_2 = ME_2 \times (D_2 - T_1)$$

$$T_n = ME_n \times (D_n - T_1 - \cdots T_{n-1})$$

Where:

TI	=	*tillage system intensity for all implements used in tillage window to a depth of 30 cm*
T_t	=	*tillage intensity for each implement, 1 to n implements*
ME_n	=	*mixing efficiency of an implement, 1 to n implements*
D_n	=	*depth of the tillage of an implement, 1 to n implements*

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 has a reduced impact on the decomposition of SOC in the

[2] Ogle, S.M., P.R. Adler, G. Bentrup, J. Derner, G. Domke, S. Del Grosso, J.Lehmann, M. Reba, D. Woolf. 2024. Chapter 3: Quantifying greenhouse gas sources and sinks in cropland and grazing land systems. In Hanson, W.L., C. Itle, K. Edquist. (eds.). *Quantifying greenhouse gas fluxes in agriculture and forestry: Methods for entity-scale inventory*. Technical Bulletin Number 1939, 2nd edition. Washington, DC: U.S. Department of Agriculture, Office of the Chief Economist.

soil in the upper layers that are disturbed by shallower implements as well. 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)

Reference Ranges	
TW Tillage Intensity	**TW Index (TW_i) Range**
No Till	$TW_i \leq .075$
Reduced Till	$.075 < TW_i \leq .252$
Conventional Till	$.252 < TW_i \leq 1$