

Residue and Tillage Management, Mulch Till (Acre) (345)

DEFINITION

Managing the amount, orientation, and distribution of crop and other plant residue on the soil surface year-round while limiting the soil-disturbing activities used to grow crops in systems where the entire field surface is tilled prior to planting.

PURPOSES

- Reduce sheet and rill erosion.
- Reduce wind erosion.
- Reduce soil particulate emissions.
- Maintain or improve soil condition.
- Increase plant-available moisture.
- Provide food and escape cover for wildlife.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all cropland and other land where crops are planted.

This practice includes tillage methods commonly referred to as mulch tillage or chiseling and disking. It applies to stubble mulching on summer-fallowed land, to tillage for annually planted crops, and to tillage for planting perennial crops. *For the correct definition and description of various tools used in conservation farming, see Agronomy Tech Note 24 which transmits the American Society of Agricultural Engineers (ASAE) Standard, ASAE S414.1, Terminology and Definitions for Agricultural Tillage Implements, and Agronomy Tech Note 25 which transmits ASAE EP291.2, Terminology and Definitions for Soil Tillage and Soil-Tool Relationships, both found in the Natural Resources Conservation Service (NRCS) Michigan Electronic Field Office Technical Guide (eFOTG), Section I-G, Michigan Technical Notes, Agronomy.*

They also include some planting operations, such as hoe drills, air seeders, and “no-till” drills that disturb a large percentage of the soil surface during the planting operation.

CRITERIA

General Criteria Applicable To All Purposes

All residues shall be uniformly distributed over the entire field.

Residue shall not be burned.

To achieve planned residue levels for a field:

- *Plan equipment type.*
- *Adjust equipment to leave desired residue levels.*
- *Verify with a minimum of 3 or a maximum of 5 random line transect residue measurements.*
- *Repeat for each field.*

See NRCS Michigan Conservation Sheet, Line Transect Residue and Cover Estimates (eFOTG, Section IV-C, Michigan Conservation Sheets, Agronomy).

To plan acceptable residue levels for percent cover after planting, use the residue budget procedure, Agronomy Tech Note 33, Crop Residue Systems for Conservation and Profit (eFOTG, Section I-G, Michigan Technical Notes, Agronomy).

Sow cover crops in the crop rotation to provide additional crop residues to meet NRCS eFOTG quality criteria pertinent to the identified resource concern.

Additional Criteria To Reduce Sheet And Rill Erosion

The amount of randomly distributed surface residue needed and the amount of surface soil disturbance allowed to reduce erosion to the planned soil loss objective for the critical soil type or predominate soil type shall be determined using the Revised Universal Soil Loss Equation 2 (RUSLE2) (eFOTG, Section I-D, Erosion Prediction, Water Erosion) or the current approved water erosion prediction technology. Calculations shall account for the effects of other practices in the management system.

Partial removal of residue by baling or grazing shall be limited to retain the amount needed to meet soil loss Tolerance (T).

Additional Criteria To Reduce Wind Erosion

The amount and orientation of residue needed and the amount of surface soil disturbance allowed to reduce erosion to the planned soil loss objective shall be determined using *the critical soil type or predominant soil type. The Wind Erosion Equation (WEQ) (eFOTG, Section I-D, Erosion Prediction, Wind Erosion) or the current approved wind erosion prediction technology will be used to estimate residue amount and orientation needs to meet soil loss tolerance objectives.* Calculations shall account for the effects of other practices in the conservation management system.

Additional Criteria To Reduce Soil Particulate Emissions

The amount and orientation of residue needed and the amount of surface soil disturbance allowed to reduce wind erosion to the tolerable soil loss value (T) shall be determined using the *WEQ (eFOTG, Section I-D, Erosion Prediction, Wind Erosion) or the current approved wind erosion prediction technology.* Calculations shall account for the effects of other practices in the conservation management system.

Additional Criteria To Maintain Or Improve Soil Condition

An evaluation of the cropping system using the current approved soil conditioning index procedure shall result in a positive trend. *Currently the soil conditioning index can be calculated using the latest version of RUSLE2 (eFOTG, Section I-D, Erosion Prediction, Water Erosion), the water erosion prediction model, along with the appropriate Michigan county Modular Soil Erosion Systems (MOSES) database (eFOTG, Section I-D, Erosion Prediction, Water Erosion).*

Additional Criteria To Increase Plant-Available Moisture

Reducing Evaporation from the Soil Surface. A minimum of 2,000 pounds per acre or 60% surface residue cover shall be maintained throughout the

year. Estimate residue cover and design mulch till systems to meet this residue level using Agronomy Tech Note 33, Crop Residue Systems for Conservation and Profit (eFOTG, Section I-G, Michigan Technical Notes, Agronomy) and the applicable approved erosion prediction technology, currently RUSLE2 (eFOTG, Section I-D, Erosion Prediction, Water Erosion) and WEQ (eFOTG, Section I-D, Erosion Prediction, Wind Erosion).

Trapping Snow. Any fall tillage operation shall leave the crop stubble in an upright position.

Crop stubble height during the time significant snowfall is expected to occur shall be:

- At least 10 inches for crops with a row spacing of less than 15 inches.
- At least 15 inches for crops with a row spacing of 15 inches or greater.

These heights shall be present over at least 50% of the field.

Fall tillage operations shall be done as close to perpendicular as possible to the direction of prevailing winds during the time that significant snowfall is expected to occur.

Additional Criteria To Provide Food And Escape Cover For Wildlife

The time that residue is present, the amount and orientation of residue, and the height of stubble needed to provide adequate food and cover for the target species shall be determined using *Biology Tech Note 12, Wildlife Habitat Evaluation (eFOTG, Section I-G, Michigan Technical Notes, Biology).*

Residue height, amount, and time period shall be determined using *NRCS Michigan Conservation Sheet, Grain Food Plots for Wildlife (eFOTG, Section IV-C, Michigan Conservation Sheets, Biology).*

Harvest or tillage operations that disturb or cover the entire field shall not be performed during the nesting and brood-rearing period of the target species.

CONSIDERATIONS

General - Removal of crop residue, such as by baling or grazing, can have a negative impact on resources. These activities should not be performed without full evaluation of impacts on soil, water, animal, plant, and air resources.

Mulch till may be practiced continuously throughout the crop sequence, or may be managed as part of a residue management system that includes other tillage methods such as no-till. *Selection of acceptable tillage methods for specific site conditions may be aided by RUSLE2 (eFOTG, Section I-D, Erosion Prediction, Water Erosion) or WEQ (eFOTG, Section I-D, Erosion Prediction, Wind Erosion). Also, refer to Agronomy Tech Notes 8 Transitioning to Organic Resources, 9 No-Till Alfalfa MSU Bulletin, 15 The Influence of Organic Matter on Herbicide Reaction, 16 Visual Benchmark References and Estimates: Crop Residue Measuring Techniques, 17 Conservation Tillage, 18 Crop Residue, 22 No-Till on Fine Textured Soils, and 30 Nutrient Stratification in No-Till (eFOTG, Section I-G, Michigan Technical Notes, Agronomy).*

Production of adequate amounts of crop residue necessary for the proper functioning of this practice can be enhanced by selection of high residue producing crops and crop varieties in the rotation, use of cover crops, and adjustment of plant populations and row spacing.

A field border planted to permanent vegetation can:

- Allow unobstructed turning for equipment.
- Eliminate unproductive end rows.
- Provide food and escape cover for wildlife.
- Provide travel lanes for farming operations.

Increasing Soil Organic Matter Level and Reducing CO₂ Loss from the Soil - Where improving soil tilth is a concern, use of undercutting tools will enhance accumulation of organic material in the surface layer.

CO₂ loss is directly related to the volume of soil disturbed, the intensity of the disturbance, and the soil moisture content and soil temperature at the time the disturbance occurs. The following guidelines can make this practice more effective:

- Shallow soil disturbance (1-3 inches) releases less CO₂ than deeper operations.
- When deep soil disturbance is performed, such as by subsoiling or fertilizer injection, make sure the vertical tillage slot created by these implements is closed at the surface.
- Planting with a single-disk opener no-till drill will release less CO₂ than planting with a wide-point hoe/chisel opener air seeder drill.
- Soil disturbance that occurs when soil temperatures are below 50° F will release less CO₂ than operations done when the soil is warmer.

Increasing Plant-Available Moisture - The effectiveness of stubble to trap snow increases with stubble height. Increasing the stubble height beyond the minimum required will increase the amount of snow trapped.

Variable height stubble patterns may be created to further increase snow trapping and storage.

Tillage and planting operations done on the contour will help slow overland flow and increase infiltration, thus increasing the potential for increased water storage in the root zone.

Providing Food and Escape Cover for Wildlife - Avoid disturbing standing stubble or heavy residue during the nesting season for ground-nesting species.

Forgoing fall shredding or tillage operations will maximize the amount of wildlife food and cover during critical winter months.

Leaving rows of unharvested crop standing at intervals across the field or adjacent to permanent cover will enhance the value of residues for wildlife food and cover. Leaving unharvested crop rows for two growing seasons will further enhance the value of these areas for wildlife.

PLANS AND SPECIFICATIONS

Specifications for establishment and operation of this practice shall be prepared for each field or treatment unit according to the Criteria, Considerations, and O&M described in this standard. Specifications shall be recorded using approved specification sheets, job sheets, narrative statements in the conservation plan, or other acceptable documentation. *The minimum documentation required for Residue and Tillage Management, Mulch Till 345 is as follows:*

- *Location map or reference to plan identification.*
- *Purpose.*
- *Estimated kinds and amounts of residue.*
- *Types of operations.*
- *Previous crop residue.*
- *Crops to be planted.*
- *Residue orientation (wind only).*
- *Residue planned percent cover after planting.*
- *Tillage operations needed.*
- *Operation and Maintenance items.*

OPERATION AND MAINTENANCE

No operation and maintenance requirements, national in scope, have been identified for this practice.

REFERENCES

- Bolton, Ryan. 2003. Impact of the surface residue layer on decomposition, soil water properties, and nitrogen dynamics. M.S. thesis. Univ. of Saskatchewan, Saskatoon, Saskatchewan, CA.
- NRCS Michigan Electronic Field Office Technical Guide (eFOTG): <http://www.nrcs.usda.gov/technical/efotg>
 - Section I-G, Michigan Technical Notes, Agronomy and Biology
 - Section IV-C, Michigan Conservation Sheets, Agronomy and Biology
 - Section I-D, Erosion Prediction, Water Erosion and Wind Erosion
 - Section IV-A, Conservation Practices, Nutrient Management 590 and Pest Management 595
- MSU Extension Bulletin E-434, Weed Control Guide, current year.
- Reicosky, D.C., M.J. Lindstrom, T.E. Schumacher, D.E. Lobb, and D.D. Malo. 2005. Tillage-induced CO₂ loss across an eroded landscape. *Soil Tillage Res.* 81:183-194.
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