NATURAL RESOURCES CONSERVATION SERVICE

VIRGINIA CONSERVATION PRACTICE STANDARD

RESIDUE AND TILLAGE MANAGEMENT MULCH TILL

(Ac.)

CODE 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.

PURPOSE

- 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 full-width tillage methods commonly referred to as mulch tillage or chiseling and disking. It applies to tillage for annually planted crops and to tillage for planting perennial crops.

It also includes some planting operations, such as those involving hoe drills, air seeders and "no-till" drills that disturb a large percentage of the soil surface during the planting operation and therefore do not meet criteria for VA Conservation Practice Standard *Residue and Tillage Management No-Till/Strip Till/Direct Seed (Code 329).*

CRITERIA

General Criteria Applicable to All Purposes

All residues shall be uniformly distributed over the entire field prior to planting.

Residue shall not be burned.

At least 30% of the soil surface must be covered by crop and/or organic residues after planting.

Additional Criteria to Reduce Sheet and Rill Erosion

Revised Universal Soil Loss Equation, Version 2 (RUSLE2) shall be used to determine the amount of surface residue that is needed and the amount of soil disturbance that is allowed in order for the overall cropping system to achieve planned soil loss objectives. Calculations shall account for the effects of all management practices (crop rotation, tillage, residue removal, etc.) as well as field-specific factors (climate, soil, topography, etc.) pertinent to the cropping system.

Additional Criteria to Reduce Wind Erosion

The current approved wind erosion prediction technology shall be used to determine the amount and orientation of standing and surface residue that is needed and the amount of soil disturbance that is allowed in order for the overall cropping system to achieve planned soil loss objectives. Calculations shall account for the effects of all management practices as well as field-specific factors pertinent to the cropping system.

Additional Criteria to Maintain or Improve Soil Condition

Surface residues and soil disturbance shall be managed to ensure that the overall cropping system achieves the soil loss and Soil Conditioning Index (SCI) criteria listed below.

A cropping system predicted to *maintain* soil organic matter and soil condition shall satisfy the following criteria:

1. RUSLE2 must predict a soil loss for conservation planning at or below the soil loss tolerance value (T).
2. The Soil Conditioning Index must predict an SCI score of 0.00 or greater.

A cropping system that satisfies the above criteria for maintenance of soil condition shall be referred to as an "Organic Matter Maintenance Cropping System."

A cropping system predicted to *improve* soil organic matter and soil condition shall satisfy the following criteria:

1. RUSLE2 must predict a soil loss for conservation planning at or below the soil loss tolerance value (T)
2. The Soil Conditioning Index must predict an SCI score of +0.25 or greater.

A cropping system that satisfies the above criteria for improvement of soil condition shall be referred to as an "Organic Matter Building Cropping System."

Performance beyond these minimum criteria for soil organic matter improvement can be achieved. See "Considerations" for targets for higher levels of performance.

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 an approved habitat evaluation procedure.

CONSIDERATIONS

General

"Mulch-till" or "MT" refers to any full-width tillage that satisfies the General Criteria under this Standard.

"Continuous mulch-till system" or "continuous MT" refers is a cropping system in which all crops are established using full-width tillage and the General Criteria under this Standard are continuously met.

"Clean-till" or "CT" refers to any full-width tillage that does not satisfy the General Criteria under this Standard.

"Continuous clean-till cropping system" or "continuous CT" refers to a cropping system in which all crops are established using clean-till.

"Rotational tillage system" or "rotational tillage" refers to a cropping system in which different tillage methods are used to establish different crops during the rotation. When describing a rotational tillage system, the different tillage methods used should be indicated. For example, "Rotational tillage system refers to a system in which both no-till (NT) and mulch-till methods are used (see VA Conservation Practice Standard for *Residue & Tillage Management, No-Till/Strip Till/Direct Seed, Code 329*).

Well-managed cropping systems that include full-width tillage have the potential to achieve high levels of conservation performance. This is especially true of rotational tillage systems that include no-till and all tillage systems that include regular rotation to perennials. Calculated soil loss rates, Soil Conditioning Index (SCI) scores, and Soil Tillage Intensity Rating (STIR) values should be used to evaluate these cropping systems and to gauge progress in improving them.

Notwithstanding the previous paragraph, continuous no-till should be promoted as the optimal tillage system for conservation purposes in the vast majority of cases. Properly-managed continuous no-till cropping systems often provide soil conservation and soil quality benefits not fully accounted for by RUSLE2 or the Soil Conditioning Index. Therefore, even in cases where soil loss rates or SCI scores are not predicted to improve significantly, conversion to continuous no-till should be encouraged.

Regardless of the tillage method being used, producers should always strive to minimize soil disturbance as much as possible. STIR values should be used to assess soil disturbance and to gauge progress in reducing it.

Adopting complementary practices can greatly improve the conservation performance of cropping systems involving full-width tillage.

Crop rotation is a key complementary practice (see VA Practice Standard *Conservation Crop Rotation, Code 328*). Recommended strategies include:

- Producing large amounts of crop biomass and residue.
- Including perennial crops in the rotation.
- Maintaining a continuous cycle of living vegetation.
- Maintaining a diverse crop rotation that includes nitrogen-fixing legumes.

Cover cropping may also be used to increase crop residue, continuity, and diversity (see VA Conservation Practice Standard for *Cover Crop, Code 340*).

In cases where soil erosion can not be reduced sufficiently using agronomic practices alone, erosion control support practices should be implemented. Examples include stripcropping and contour farming (see VA Conservation Practice Standards for *Stripcropping, Code 585*, and *Contour Farming, Code 330*).

Soil compaction prevention should be recommended as a way to reduce the need for tillage. Key strategies for compaction prevention include:

- Staying off wet ground.
- Minimizing axle loads (e.g., keep road trucks, grain carts out of the field, etc.) and minimizing tire-to-soil contact pressure (e.g., use flotation tires and keep road tires out of the field).
- Minimizing the percentage of the field tracked over time (e.g., use controlled traffic to keep tires in the same tracks on every pass).

When full-width tillage is used, special emphasis should always be placed on delaying tillage operations until soil is sufficiently dry. Tilling wet soil causes compaction, cloddiness, and significant damage to soil structure.

Significant reductions in tillage and/or increases in residue levels may trigger the need for adjustments to nutrient and pest management practices (see VA Conservation Practice Standards for *Nutrient Management, Code 590* and *Pest Management, Code 595*). Maintaining a diverse crop rotation will often facilitate such adjustments.

Maintaining or Improving Soil Condition

SCI Score

An SCI score of +0.25 is the lowest level of performance acceptable in an Organic Matter Building Cropping System. The following ranges may be used when setting SCI targets for higher levels of performance:

Soil Conditioning Index (SCI) Score	Performance Level – Soil Organic Matter Improvement
+0.25 to +0.49	Minimum
+0.50 to +0.74	Intermediate
+0.75 or greater	Optimum

Soil Disturbance

Minimizing soil disturbance can enhance soil organic matter and soil condition in ways that are not fully accounted for by SCI Score. Therefore, soil disturbance should be minimized as much as possible. The following are performance criteria that should be used to evaluate cropping systems based on degree of soil disturbance.

- A first key measure of performance involves the tillage system being used. Well-managed continuous no-till is the optimal tillage system for the purpose of soil quality improvement.
- A second key measure of performance involves Soil Tillage Intensity Rating

(STIR). In general, cropping systems should be designed so that STIR values are as low as possible. This applies to STIR values for each crop as well as to the average annual STIR value for the overall cropping system.

- Producers should be encouraged to strive for an annual average STIR value of 10 or less for the overall cropping system. This is the optimal STIR value for purposes of soil quality improvement.

- It is possible to meet either of the performance targets described above (continuous NT and STIR of 10 or less) without achieving the other. For example, optimal STIR can be achieved in certain limited cases in cropping systems that include full-width tillage.

PLANS AND SPECIFICATIONS

Specifications for establishment and operation of this practice shall be prepared for each field or Conservation Management Unit (CMU). At a minimum, specifications shall include the following information:

- Tillage method to be used.

- Implementation date.

Additional information shall be included as necessary to ensure that all planned conservation objectives shall be met.

Specifications shall be recorded using approved specification sheets, narrative statements in the Conservation Plan, or other equivalent forms of documentation.

OPERATION AND MAINTENANCE

No operation and maintenance requirements have been identified for this practice.

REFERENCES

Buckingham, F. and Pauli, A.W. 1993. Tillage: A Practical Guide to the Latest Tillage Methods, Conservation Planning, Crop Residue Management, and Solutions to Soil Problems, 3rd Ed. John Deere Fundamentals of Machine Operation Series. Deere & Company Service Publications.

Duiker, S.W. 2004. Avoiding Soil Compaction. Penn State College of Agricultural Sciences.

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