United States Department of Agriculture

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

RESIDUE AND TILLAGE MANAGEMENT, NO TILL

CODE 329

(ac)

DEFINITION

Limiting soil disturbance to manage the amount, orientation, and distribution of crop and plant residue on the soil surface year around.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Reduce sheet, rill and wind erosion and excessive sediment in surface waters
- Reduce tillage-induced particulate emissions
- Maintain or increase soil health and organic matter content
- Reduce energy use
- Increase plant available moisture
- Provide food and escape cover for wildlife
- Conditions Where Practice Applies
- This practice applies to all cropland

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all cropland.

CRITERIA

General Criteria Applicable to All Purposes

Residue shall not be burned.

Distribute all residues uniformly over the entire field. Removing residue from directly within the seeding or transplanting area prior to or as part of the planting operation is acceptable.

This practice only involves an in-row soil disturbance operation during strip tillage, the planting operation, and a seed row/furrow closing device. There is no full-width soil disturbance performed from the time immediately following harvest or termination of one cash crop through harvest or termination of the next cash crop in the rotation regardless of the depth of the tillage

NRCS reviews and periodically updates conservation practice standards. To obtain the current version of this standard, contact your Natural Resources Conservation Service State office or visit the Field Office Technical Guide online by going to the NRCS website at https://www.nrcs.usda.gov/ and type FOTG in the search field.

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operation. The soil tillage intensity rating (STIR) value shall include all field operations that are performed during the crop interval between harvest and termination of the previous cash crop and harvest or termination of the current cash crop (includes fallow periods). The crop interval STIR value shall be no greater than 20.

Additional Criteria to Reduce Sheet/Rill and Wind Erosion, Reduce Excessive Sediment in Surface Water and Reduce Tillage-Induced Particulate Emissions

Soil erosion calculations shall account for the effects of all tillage passes and the effects of other conservation practices in the management system.

Use the current approved water and wind erosion prediction technology to determine:

- Minimum amount of randomly distributed surface residue needed,
- Time of year the residue needs to be present on the field, and
- The amount of surface soil disturbance allowed to reduce erosion to the desired level.

Additional Criteria to Maintain or Increase Soil Health and Organic Matter Content

Ensure the Soil Conditioning Index (SCI) for the cropping system results in a positive rating.

Additional Criteria to Increase Plant Available Water

- Maintain a minimum of 60 percent (2000 pounds) per acre of residue cover on the soil surface throughout the year.
- Maintain crop stubble height of at least 10-inches for row spacing less than 15-inches and at lease 15-inch stubble height for crop row spacing 15-inches or greater.
- To maximize retention of soil moisture, maintain crop residue standing during the winter period to trap snow.

Additional Criteria to Reduce Energy Use

Reduce the total energy consumption associated with field operations by at least 25 percent when compared to the benchmark conditions. Use the current approved NRCS tool for determining energy use to document energy use reductions.

Additional Criteria to Provide Food and Cover for Wildlife

Use an approved habitat evaluation to determine when residue needs to be present, the amount, orientation, and stubble height to provide adequate food and cover for target species.

CONSIDERATIONS

General Considerations

- Soil quality, porosity, and soil health will improve with each subsequent year of no till. Research has shown that maximum gain will be achieved after six consecutive years of no tillage.
- No till can reduce the potential for compaction by improving soil structure, infiltration rates and increasing the soil organic matter levels.
- Removing crop residue by baling or intensive 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.
- Production of adequate crop residues to achieve the purpose of this practice can be enhanced through the use of:
    - High residue producing crops and crop varieties.

    - Cover crops, and double cropping.
    - Increased plant populations through seeding rates and row spacing.
- Use of no till for all crops in the rotation or cropping system can enhance the positive effects of this practice by:
    - Increasing the rate of soil organic matter accumulation.
    - Keeping soil in a consolidated condition, which provides additional resistance to sheet and rill erosion.
    - Sequester more carbon in the soil.
    - Reducing the amount of particulate matter generated by field operations.
    - Reducing energy inputs to establish crops.
    - Increase formation of root channels and other near surface voids that increase infiltration.
- When providing technical assistance to organic producers, ensure residue management, and tillage management activities are consistent with the USDA Agricultural Marketing Service National Organic Program regulations.
- Residue should not be shredded after harvest. Shredding residue makes it more susceptible to movement by wind or water, and areas where residue accumulates may interfere with planting the next crop.

Considerations for Improving Soil Organic Matter Content and Improving Soil Health

Carbon loss is directly related to the volume of soil disturbed, the intensity of the disturbance, the soil moisture content and soil temperature at the time disturbance occurs. The following guidelines can reduce the loss of soil carbon:

- When deep soil disturbance is performed, such as by sub-soiling or fertilizer injection, make sure the vertical slot created by these implements are closed at the surface.
- Minimize soil disturbance at planting by using a single disk opener no-till drill, which will release less CO2 and oxidize less organic matter.
- Limit soil disturbance when soil temperatures are above 50° F. Less oxidization occurs below 50° F.
- Maximize year round coverage of the soil with living vegetation (e.g. cover crops). Crop residue and living cover reduce soil temperature at hot, dry periods thereby slowing organic matter oxidation.
- Use a diverse crop rotation, incorporating multiple crop types (introduced grasses and legumes, warm-season grass and legume/forb) into the crop rotation.
- Plant a cover crop after every annual crop in the rotation to increase the time that roots are actively growing in the soil. Multi-species cover crop mixes provide greater benefits than single-specie cover crops.
- Implement management strategies to increase soil organic matter levels.
- Avoid planting or soil disturbance into wet soils to avoid compaction issues.

Considerations to Increase Plant-Available Moisture

- Leaving stubble taller than the 10-inch minimum required height to increase the relative humidity close to the soil surface and reduces the rate of evaporative loss from the soil.
- Leaving stubble taller than the 10-inch minimum height to trap more snow and provide better protection to plants from freezing or heat desiccation.

- Variable-height stubble patterns may be created to further increase snow storage.
- Performing all field operations on the contour will slow overland flow and allow more opportunity for infiltration.

Considerations for Wildlife Food and Cover

- Leave crop residues undisturbed after harvest (do not shred or bale) to maximize the cover and food source benefits for wildlife.

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

Considerations for Manure Injection

Manure injection will be allowed as long as all associated soil-disturbing activities are documented in the soil loss calculations and the resulting annual STIR value is no greater than 20.

PLANS AND SPECIFICATIONS

Specifications for establishment and operation of this practice shall be prepared for each field or treatment unit. Specifications shall identify and include the following information in the conservation plan or job sheet:

- Resource concern to be treated or the purpose for applying the practice.
- Location Map.
- Planned crop(s).
- Summary of all field operations or activities that affect:
  - Residue cover.
  - Residue orientation.
  - Disturbance of the soil surface.
- The amount of residue (pounds/acre or percent surface cover) required to accomplish the purpose, and the time of year it must be present.
- The planned maximum STIR value allowed to accomplish the purpose, and the time of year that soil disturbance is allowed. Refer to the Soil Tillage Intensity Rating Information Sheet.
- The minimum planned SCI value required to accomplish the purpose. Refer to the Soil Conditioning Index Information Sheet.
- The erosion rate.
- Target species of wildlife if applicable.
- Benchmark and planned fuel consumption if applicable.

OPERATION AND MAINTENANCE

Evaluate/measure the crop residues cover and orientation after each crop to ensure the planned amounts and orientation are being achieved. Adjust management as needed to achieve planned residue amount and orientation, or adjust the planting and/or harvesting equipment.

Limited tillage is allowed to close or level ruts from harvesting equipment. No more than 10

percent of the field may be tilled for this purpose.

If the areas of heavy residue accumulation, as a result of movement by water, harvest equipment or wind in the field, spread the residue prior to planting so it does not interfere with planting operations.

FEDERAL, TRIBAL, STATE AND LOCAL LAWS

Users of this standard shall be aware of potentially applicable federal, tribal, state and local laws, rules, regulations or permit requirements governing residue management. This standard does not contain the text of federal, tribal, state or local laws.

REFERENCES

The following publications are available at the local NRCS field offices or on the Field Office Technical Guide, Section III, Planning Tools.

Soil Conditioning Index

Information Sheet Soil Tillage

Intensity Rating Information Sheet

USDA, Natural Resources Conservation Service, Tillage Equipment Pocket Identification Guide, 2005

USDA, Natural Resources Conservation Service, Wisconsin Agronomy Technical Note WI-4, Estimates of Residue Cover Remaining After Single Operation of Selected Machines

USDA, Natural Resources Conservation Service, Tillage Practice Guide, 2006

ADDITIONAL RESOURCES

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

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

Renard, K.G., G.R. Foster, G.A. Weesies, D.K. McCool, and D.C. Yoder, coordinators. 1997. Predicting soil erosion by water: A guide to conservation planning with the Revised Universal Soil Loss Equation (RUSLE). U.S. Department of Agriculture, Agriculture Handbook No. 703

Shaffer, M.J., and W.E. Larson (ed.). 1987. Tillage and surface-residue sensitive potential evaporation submodel. In NTRM, a soil-crop simulation model for nitrogen, tillage and crop residue management. USDA Conserv. Res. Rep. 34-1. USDA-ARS

Skidmore, E.L. and N.P. Woodruff. 1968. Wind erosion forces in the United States and their use in predicting soil loss. U.S. Department of Agriculture. Agriculture Handbook No. 346

USDA, Natural Resources Conservation Service, National Agronomy Manual, 190-V. 4th Ed.