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
- Increase plant-available moisture.
- Reduce energy use
- Provide food and escape cover for wildlife

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 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

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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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 Waters, and Reduce Tillage-Induced Particulate Emissions

Use the current approved water and wind erosion prediction technology to determine the if field operations planned provide the amount of randomly distributed surface residue needed, time of year residue needs to be present in the field, and amount of surface soil disturbance allowed to reduce erosion to the desired level. Calculations shall account for the effects of other practices in the management system.

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

Ensure the soil condition index (SCI) for the cropping system results in a positive rating.

Additional Criteria to Increase Plant-Available Moisture

Maintain a minimum of 60 percent residue cover on the soil surface throughout the year.

Trapping Snow

Minimum 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.

Additional Criteria to Reduce Energy Use

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

Additional Criteria to Provide Food and Escape Cover for Wildlife.

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

CONSIDERATIONS

General Considerations

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.

Production of adequate crop residues to achieve the purpose(s) of this practice can be enhanced through the use of high residue crops and crop varieties, use of cover crops, double cropping, and adjustment of plant populations through seeding rates and row spacing.

When providing technical assistance to organic producers, ensure residue 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.

Using residue management - 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 and improved aggregate stability.
- Sequestering additional carbon in the soil.
- Further reducing the amount of particulate matter generated by field operations.
- Reduce energy inputs to establish crops.
- Forming root channels and other near-surface voids that increase infiltration.

Considerations to Increase Soil Health and Organic Matter Content

Carbon loss is directly related to the volume of soil disturbed, intensity of the disturbance and soil moisture content and soil temperature at the time the disturbance occurs. To make this practice more effective

- When deep soil disturbance is performed, such as by subsoiling or fertilizer injection, make sure the

  vertical slot created by these implements is closed at the surface.
- Planting with a single disk or slot opener no-till drill will release less CO2 and oxidize less organic matter than planting with a wide-point hoe/chisel opener seeder drill.
- Soil disturbance that occurs when soil temperatures are below 50° F will oxidize less organic matter and release less CO2 than operations done when the soil is warmer.
- Maximizing year-round coverage of the soil with living vegetation (e.g., cover crops) and/or crop residues builds organic matter and reduces soil temperature, thereby slowing organic matter oxidation.
- Use a diverse crop rotation, incorporating multiple crop types (cool-season grass, cool-season legume/forb, warm-season grass, warm-season legume/forb) into the croprotation.
- Plant a cover crop after every cash crop in the rotation. Multispecies cover crop mixes provide greater benefits than single-specie cover crops.

Considerations to Increase Plant-Available Moisture

Leaving stubble taller than the 10-inch minimum will trap more snow.

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

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.

Leave crop residues undisturbed after harvest (e.g., no shredding or baling) to maximize the cover and food source benefits for wildlife.

PLANS AND SPECIFICATIONS

Specifications for establishment and operation of this practice shall be prepared for each field or treatment unit. Record the specifications using the practice implementation requirements

document. The specifications shall identify, as appropriate

- Purpose for applying the practice.
- Planned crop(s).
- Amount of residue produced by each crop.
- All field operations or activities that affect
    - Residue orientation including height (where applicable).
    - Surface disturbance.
    - The amount of residue (pounds/acre or percent surface cover) required to accomplish the purpose, and the time of year it must be present.
- Planned soil tillage intensity rating STIR value, soil condition index value, and 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 either plan a new 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 there are areas of heavy residue accumulation (because of movement by water or wind) in the field, spread the residue prior to planting so it does not interfere with planter operation.

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.

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.

Reicosky, D.C. 2004. Tillage-induced soil properties and chamber mixing effects on gas exchange. Proc. 16th Triennial Conf., Int. Soil Till. Org. (ISTRO).

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. 2011. National Agronomy Manual. 190-V. 4th Ed.

S.J. van Donk, D. L. Martin, S. Irmak, S. R. Melvin, J. L. Petersen, D. R. Davison, 2010. Crop Residue Cover Effects on Evaporation, Soil Water Content, and Yield of Deficit-Irrigated Corn in West-Central Nebraska.
http://watercenter.unl.edu/ResearchDB/publications/Crop_Residue_Cover_Effects.pdf.