United States Department of Agriculture

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

RESIDUE AND TILLAGE MANAGEMENT

NO TILL

(Ac.)

CODE 329

DEFINITION

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

PURPOSE

- Reduce sheet, rill and wind erosion.
  Resource Concern is SOIL EROSION - Sheet, Rill, and Wind erosion.
- Reduce tillage-induced particulate emissions.
  Resource Concern is AIR QUALITY IMPACTS - Emissions of Particulate Matter (PM) and PM Precursors.
- Maintain or increase soil quality and organic matter content.
  Resource Concern is SOIL QUALITY DEGRADATION – Organic matter depletion.
- Reduce energy use.
  Resource Concern is INEFFICIENT ENERGY USE – Farming/ranching practices and field operations.
- Increase plant-available moisture.
  Resource Concern is INSUFFICIENT WATER – Inefficient moisture management.
- Provide food and escape cover for wildlife.
  Resource Concern is INADEQUATE HABITAT FOR FISH AND WILDLIFE – Habitat degradation.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all cropland.

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

This practice includes planting methods commonly referred to as no till, never till, zero till, slot plant, zone till, strip till, or direct seed. Approved implements are: no till and strip till planters, certain drills and air seeders, strip-type fertilizer and manure injectors and applicators, and similar implements that only disturb narrow strips and slots.

CRITERIA

General Criteria Applicable to All Purposes

Residue shall not be burned.

All residues shall be uniformly distributed over the entire field. Removing residue from the row area prior to or as part of the planting operation is acceptable as long as 70% or more of width between rows is still covered by crop residue.

No full-width tillage is performed from the time of harvest or termination of one cash crop to the time of harvest or termination of the next cash crop in the rotation regardless of the depth of the tillage operation. No tillage of any type including vertical tillage is allowed in this practice standard. Planting of cover crops or similar activities will need to be planted with no till drills or broadcast or other options that do NOT include tillage.

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 STIR value shall be no greater than 10 for No Till and no greater than 15 for Strip Till methods.

Additional Criteria to Reduce Sheet, Rill, and Wind Erosion and Tillage Induced Particulate Matter

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

- Amount of randomly distributed surface residue needed.
- Time of year the residue needs to be present in the field.
- The 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 Quality and Organic Matter Content

Ensure that an evaluation of the cropping system using the current approved soil conditioning index (SCI) procedure results in an SCI rating of zero or higher. The SCI results have to be a positive value.

Additional Criteria to Reduce Energy Use

Reduce the total energy consumption associated with field operations by at least 25% compared to the benchmark condition. Use the current approved NRCS tool for determining energy use to document energy use reductions. All field operations from harvest to harvest will be evaluated by the NRCS tool.

Energy Estimator: Tillage http://ecat.sc.egov.usda.gov/Default.aspx

Additional Criteria to Increase Plant Available Moisture

Maintain a minimum of 2000 pounds per acre or 60% residue cover on the soil surface throughout the year.

Crop stubble height during the time of expected evaporation losses 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 stubble heights shall be present on at least 60% of the field.

Trapping Snow. 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.

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.

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. Use the "Bobwhite Quail Habitat Appraisal Guide" or the "Cropland Community Model".

Wildlife habitat guides are located in eFOTG Section IV – Conservation Practices – Upland Wildlife Habitat Management (645) folder. Locate the folder from the below link:

http://efotg.sc.egov.usda.gov/treemenuFS.aspx

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

Avoid disturbing standing stubble or heavy residue during the nesting season for ground nesting species.

CONSIDERATIONS

General Considerations - Removing 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. Effects on soil erosion and soil conditioning index (SCI) will be evaluated with the current approved erosion prediction technology.

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

When providing technical assistance to organic producers, residue management and tillage activities should be consistent with the USDA-Agricultural Marketing Service National Organic Program standard.

Residue should not be shredded after harvest. Shredding residue makes it susceptible to movement by wind or water, and areas where residue accumulates may interfere with planting the next crop.

Using Residue and Tillage 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, which provides additional resistance to the erosive forces of water and wind.
- Sequestering additional carbon in the soil.
- Further reducing the amount of particulate matter generated by field operations.

- Reducing energy inputs to establish crops.
- Forming root channels and other near-surface macropores that increase infiltration.

Considerations for Improving Soil Quality and Organic Matter Content

Carbon 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:

- When deep soil disturbance is performed, such as by subsoiling, manure injection or fertilizer injection, make sure the vertical slot created by these implements is closed at the surface.
- Planting with a single disk opener no till drill will release less carbon dioxide (CO_2) 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 CO_2 than operations done when the soil is warmer
- Maximizing year around coverage of the soil with living vegetation and/or crop residues builds organic matter and reduces soil temperature, thereby slowing organic matter oxidation.

To achieve major improvements in soil health requires more than no till alone. The following activities/practices are needed to make significant changes in soil health:

- Use a diverse crop rotation, incorporating multiple crop types (cool-season grass, cool-season legume/forb, warm-season grass, and warm-season legume/forb) into the crop rotation.
- Plant a cover crop after every cash crop in the rotation. Multi-species cover crop mixes provide greater benefits than single-specie cover crops.

Considerations for Increasing Plant Available Moisture

The type, timing, and depth of soil-disturbing activities all influence moisture loss. Shallow operations (1-2 inches) or operations that do not invert the soil will reduce moisture loss compared to deeper operations.

Soil-disturbing operations performed when the soil surface is moist will result in greater moisture loss than operations done when the top two to three inches of soil have dried.

Cover crop residue will help retain soil moisture and is another effective agronomic management tool.

Leaving stubble taller than the minimum required will increase the relative humidity close to the soil surface, which reduces the rate of evaporative loss from the soil.

Leaving stubble taller than the 10 inch minimum will trap more snow and provide better protection to plants from freezing or 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.

PLANS AND SPECIFICATIONS

Specifications for establishment and operation of this practice shall be prepared for each field or treatment unit. The specifications shall identify, as appropriate:

- The resource concern to be treated or the purpose for applying the practice.
- Planned crop(s).
- The amount of residue produced by each crop.
- All field operations or activities at planting, fertilizing, and harvesting that affect:
  - Residue cover
  - Residue orientation
  - Surface disturbance
- The amount of residue (pounds per acre or percent surface cover) required to accomplish the purpose, and the time of year it must be present.
- The maximum STIR value allowed to accomplish the purpose, and the time of year that soil disturbance is allowed.
- The minimum soil conditioning index (SCI) value required to accomplish the purpose.

Record the specifications using the Missouri Job Sheet 329/345 Practice Implementation Requirements document located in eFOTG Section IV – Conservation Practices – Residue and Tillage Management - No Till (329) folder. Locate the folder from the below link:

http://efotg.sc.egov.usda.gov/treemenuFS.aspx

OPERATION AND MAINTENANCE

Evaluate and 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 25% 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.

U.S.D.A. Natural Resources Conservation Service. 2011. National Agronomy Manual. 190-V. 4th ed