

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD**

**RESIDUE AND TILLAGE MANAGEMENT
NO TILL/STRIP TILL/DIRECT SEED**

(Ac.)

CODE 329

DEFINITION

Managing the amount, orientation and distribution of crop and other plant residue on the soil surface year round while limiting soil-disturbing activities to only those necessary to place nutrients, condition residue and plant crops.

PURPOSE

- Reduce sheet and rill erosion.
- Reduce wind erosion.
- Improve soil organic matter content.
- Reduce CO₂ losses from the soil.
- Reduce soil and diesel particulate emissions.
- 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.

CRITERIA

General Criteria Applicable to All Purposes

This practice includes planting methods commonly referred to as no-till, strip till, direct seed, zero till, slot till or zone till. Approved implements are: no-till and strip-till planters; certain drills and air seeders; strip-type fertilizer and manure injectors and applicators; in-row chisels; and similar implements that only disturb strips and slots. All others are

considered to be full-width or capable of full disturbance and therefore not compatible.

Residue shall not be burned.

All residues shall be uniformly distributed over the entire field. Where combines or similar machines are used for harvesting, they shall be equipped with spreaders to distribute residue over at least 80% of the working width of the header.

No full-width tillage shall be performed regardless of the depth of the tillage operation. Planters or drills shall be equipped to plant directly through untilled residue or in a tilled seedbed prepared in a narrow strip along each row by planter attachments such as rotary tillers, sweeps, multiple coulters or row cleaning devices.

The Soil Tillage Intensity Rating (STIR) value shall include all field operations that are performed during the crop interval between harvest of the previous crop and harvest or termination of the current crop (includes fallow periods). The STIR value shall be no greater than 30.

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 shall be determined using the current approved water erosion prediction technology (currently RUSLE2). Calculations shall account for the effects of other practices in the management system (e.g. grazing and baling).

Additional Criteria to Reduce Wind Erosion

The amount and orientation of standing and surface residue needed and the amount of surface soil disturbance allowed to reduce erosion to the planned soil loss objective shall be determined using the current approved wind erosion prediction technology (currently WEQ). Calculations shall account for the effects of other practices in the management system.

Additional Criteria to Improve Soil Condition

An evaluation of the cropping system using the current approved soil conditioning index procedure shall result in a positive trend.

Additional Criteria to Reduce CO₂ Loss from the Soil

The Soil Tillage Intensity Rating (STIR) value shall include all field operations that are performed during the crop interval between harvest of the previous crop and harvest or termination of the current crop and shall be no more than 15.

An evaluation of the cropping system using the current approved soil conditioning index procedure shall result in a positive trend.

Additional Criteria to Reduce Soil and Diesel 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 current approved wind erosion prediction technology. Calculations shall account for the effects of other practices in the conservation management system.

Soil-disturbing activities in the cropping system shall be limited to low STIR values and the timing of the tillage must be done at sufficient soil moisture conditions to reduce soil particulate emissions.

Combine multiple activities (e.g. tillage, fertilizer placement, herbicide application and seeding) into a single or reduced number of passes to reduce diesel particulate emissions.

Additional Criteria to Increase Plant-available Moisture

Reducing Evaporation from the Soil Surface. The annual Soil Tillage Intensity

Rating (STIR) value for all soil-disturbing activities in the cropping system shall be no more than 20.

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

Fall field operations that disturb residue 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 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 will be provided for the target wildlife species. Crop residues shall remain undisturbed between harvest and planting to maximize food and cover unless it is determined by the Kentucky Habitat Evaluation Procedure that residue removal would not reduce the habitat index to less than a 0.5.

CONSIDERATIONS

General - Removing 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 amounts of crop residues necessary to achieve the purposes 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.

Using no till/strip till/direct seed 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.
- sequestering more carbon in the soil.
- further reducing the amount of particulate matter generated by field operations.
- forming root channels and other near-surface voids that increase infiltration.

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 - 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 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.

Reducing Soil Particulate Emissions -

Slower operating speeds generally produce fewer particulate emissions.

Dry soils will produce more particulates than moist soils.

Reducing the wind erosion rate below the tolerable soil loss will help reduce particulate emissions. This can be done by:

- increasing the level of crop residue cover
- reducing the number of soil-disturbing operations
- installing other practices to reduce wind erosion, such as Herbaceous Wind Barriers (code 603) or Cross Wind Trap Strips (code 589C).

Managing Soil Moisture and Protecting Crops from Freeze Damage - 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 or those that invert and mix the soil.

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.

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.

Performing all field operations on the contour will slow overland flow and allow more opportunity for infiltration.

Trapping Snow. Crop stubble height during the time significant snowfall is expected to occur shall be (these heights shall be present over at least 50% of the field):

- 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.

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.

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.

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

PLANS AND SPECIFICATIONS

Specifications for establishment and operation of this practice shall be prepared for each field or treatment unit according to the Criteria and Considerations described in this standard. Specifications shall be recorded using approved specification sheets, job sheets, narrative statements in the conservation plan, or other acceptable documentation.

OPERATION AND MAINTENANCE

Crops grown in the planned cropping sequence will yield adequate residue cover amounts as stated in the conservation plan for the farming 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. 2002. *National Agronomy Manual.* 190-V. 3rd ed.