

**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 CO<sub>2</sub> losses from the soil
- Reduce soil 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.

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.

**CRITERIA**

**General Criteria Applicable to All Purposes**

Loose residues to be retained on the field, shall be uniformly distributed on the soil surface. Where combines or similar machines are used for harvesting, they shall be equipped with spreaders capable of distributing residue over at least 80 percent of the working width of the header.

Residues shall not be burned, or disturbed by full width tillage operations except as follows: 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.

If row cultivation or spot treatments for weed escapes, leveling ruts, or similar operations become necessary, tillage shall be limited to undercutting operations which minimize burial of surface residue.

Residue shall not be burned.

All residues shall be uniformly distributed over the entire field.

No full-width tillage shall be performed 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 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. Partial removal of residue by means such as baling or grazing, shall be limited to retain the amount needed. Calculations shall account for the effects of other practices in the management system.

### **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. Partial removal of residue by means such as baling or grazing, shall be limited to retain the amount needed. 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 CO<sub>2</sub> 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 20.

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 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.

### **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.

**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.

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 for the target species shall be determined using an approved habitat evaluation procedure.

## **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 CO<sub>2</sub> Loss** - CO<sub>2</sub> 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 CO<sub>2</sub> 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 CO<sub>2</sub> 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 CO<sub>2</sub> 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.

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.

**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 (do not shred or roll) to maximize their cover and food source benefits.

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

### **CULTURAL RESOURCES CONSIDERATIONS**

NRCS policy is to avoid any effect to cultural resources and protect them in their original location. Determine if installation of this practice or associated practices in the plan could have an effect on cultural resources. The National Historic Preservation Act may require consultation with the California State Historic Preservation Officer.

<http://www.nrcs.usda.gov/technical/cultural.htm> is the primary website for cultural resources information. The California Environmental Handbook and the California Environmental Assessment Worksheet also provide guidance on how the NRCS must account for cultural resources. The e-Field Office Technical Guide, Section II contains general information, with Web sites for additional information.

Document any specific considerations for cultural resources in the design docket and the Practice Requirements worksheet.

### **ENDANGERED SPECIES CONSIDERATIONS**

If during the Environmental Assessment NRCS determines that installation of this practice, along with any others proposed, will have an effect on any federal or state listed Rare, Threatened or Endangered species or their habitat, NRCS will advise the client of the requirements of the Endangered Species Act and recommend alternative conservation treatments that avoid the adverse effects. Further assistance will be provided only if the client selects one of the alternative conservation treatments for installation; or with concurrence of the client, NRCS initiates consultations concerning the listed species with the U.S. Fish and Wildlife Service,

National Marine Fisheries Service and/or California Department of Fish and Game.

### **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**

No operation and maintenance requirements, national in scope, have been identified for this practice.

### **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 CO<sub>2</sub> 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. 16<sup>th</sup> 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. 3<sup>rd</sup> ed.