1995

G95-1132 Estimating Percent Residue Cover

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G95-1132-A

Estimating Percent Residue Cover

This NebGuide briefly describes the direct observation, line-transect, photo comparison, and calculation methods that are used to estimate the percentage of the soil surface covered with crop residue.

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Leaving crop residue on the soil surface is the easiest and most cost-effective way to reduce soil erosion caused by water and wind. Residue reduces water erosion by lessening the impact of the raindrops, thus reducing the amount of soil that is detached. It also slows flowing water, reducing the amount of soil that can be transported. Residue helps reduce wind erosion by reducing wind velocity near the soil surface and by trapping soil particles carried by the wind.

Many conservation plans that were developed to meet conservation compliance provisions of the 1985 Food Security Act and the 1990 Food, Agriculture, Conservation, and Trade Act (Farm Bills) specify crop residue management as the primary method for erosion control. Four methods direct observation, line-transect, photo-comparison, and calculation are frequently used to estimate percent residue cover.

Direct Observation Method

Although frequently attempted, percent residue cover cannot be determined merely by looking across a field. Such estimates, often made from the road or edge of the field, grossly overestimate the actual amount of cover. For example, experiences in Nebraska show that, on average, estimates of residue cover made using direct observation are over two times greater than the actual amount of cover present. Accurate estimates of residue cover can only be obtained from measurements taken within the field, while looking straight down at the soil and residue.

Line-Transect Method

The line-transect method is one of the easiest and most accurate methods of estimating percent residue cover. A 100-foot measuring tape is used most often, but other tape lengths, specially made cords with "beads" attached, or knotted ropes are also used.

To use the line-transect method:

1. Select an area that is representative of the whole field. Avoid end rows or small areas of the field where yields or residue cover have been adversely affected.
2. Anchor one end of the measuring device and stretch it diagonally at a 45-degree angle across the crop rows, crossing more than one pass of the implements and/or harvesting equipment used.
3. Count the number of marks on the measuring device that are exactly over a piece of residue. Follow these rules when counting:
    - Do not move the measuring device.
    - Look straight down at the soil surface, measuring device, and marks. Leaning from side to side will result in overestimation because residue may appear to be under the mark when it really is not.
    - Consistently look at the same side of the device.
    - Consistently look at the same point on each mark. This is especially important when using a knotted rope or cord with attached beads. Always focus on a small, single point such as where the bead and cord meet (*Figure 1*).
    - Count only those marks that have residue exactly under them.
    - If a point is questionable, do not count it. A dot 3/32 inch in diameter is the minimum size suggested for residue to be counted (approximately the head of a sewing pin).

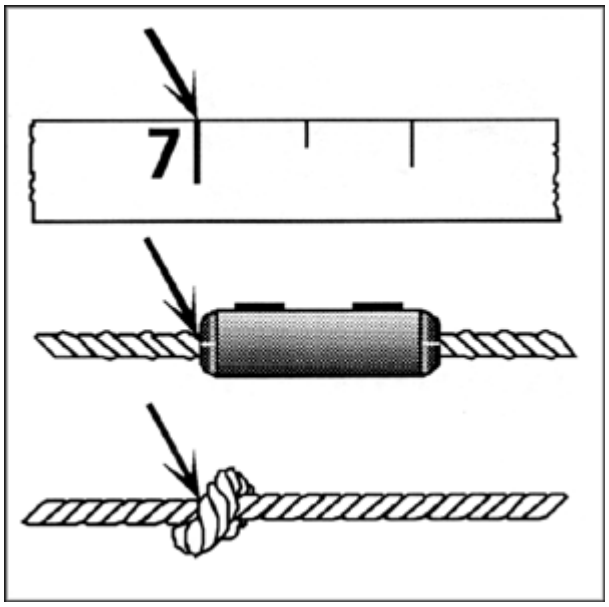

Figure 1. At each mark, consistently focus exactly on a single point on the same side of the measuring device, rather than on the entire mark.

4. When 100 points are observed, the number of marks that are directly over residue will be the percent cover for that area of the field.
5. For increased accuracy, repeat the measuring process in three or more representative areas of the field. Average the individual measurements to obtain an estimate of percent cover for the entire field.

Refer to *Estimating Percent Residue Cover Using the Line-Transect Method*, NebGuide G93-1133 for additional details on using this method.

Photo-Comparison Method

Sometimes, only a quick approximation of percent residue cover is needed. The photo-comparison method may be appropriate in these cases. Percent cover can usually be estimated within 10 to 20 percentage points of the actual cover when using this method.

To use the photo-comparison method:

1. Select an area that is representative of the field.
2. Look straight down at the residue and soil surface.
3. Compare the observed residue cover with photographs of known amounts of cover, such as those shown in *Figure 2*.
4. Estimate percent cover of the area by determining if the observed cover is less, the same, or more than the cover shown in each photograph.
5. Repeat the observations in three or more areas of the field, and average the individual estimates for a better approximation of percent cover.

Grain Sorghum residue, 25% cover

Soybean residue, 50% cover

Corn residue, 75% cover

Wheat residue, 90% cover

Figure 2. Photographs of grain sorghum, soybean, corn, and wheat residue cover percentages.

Refer to *Estimating Percent Residue Cover Using the Photo-Comparison Method*, NebGuide G95-1134, or *Estimating Winter Wheat Residue Cover*, Extension Circular EC 92-128, for additional photographs and details on using this method.

Calculation Method

The calculation method involves first determining the amount of residue cover present after harvest. This value is then multiplied by estimates of the percentage of the cover that will remain after weathering, tillage, and any other residue-disturbing operations.

Because the calculation method is based on average values, the results should be considered as a rough approximation. In many cases though, this is sufficiently accurate for planning purposes.

Residue Cover After Harvest

The amount of residue cover remaining after harvest is best determined using the line-transect or photo-comparison method, but average values can be used.

High-yielding corn (greater than about 120 bushels per acre) usually leaves 90 percent to 95 percent cover after harvest. Lower-yielding corn, grain sorghum, and most small grains generally leave 70 percent to 85 percent cover. Following soybean harvest, 65 percent to 75 percent cover typically remains. After-harvest residue cover for specialty crops such as sugar beets, dry edible beans, and vegetables usually ranges from 15 percent to 30 percent.

Factors Influencing the Amount of Residue Remaining

Fragile or non-fragile residue

Crop residues are classified as fragile or non-fragile based on factors such as plant characteristics, amount of plant material produced, and ease of decomposition or breakdown when the residue is disturbed or exposed to the weather. Residue from corn, grain sorghum, small grains, alfalfa, and hay crops is considered to be non-fragile; while soybean and specialty crop residues are considered fragile.

Livestock grazing

Livestock grazing will reduce the amount of residue cover. The best procedure for grazed residue is to use the line-transect method to measure the amount of cover at the end of the grazing period. This value can be used for the calculations instead of percent cover after harvest. If measurements are not possible, two formulas that can be used to estimate the impacts of grazing on residue cover are presented in *Table I*.

Residue-disturbing operations

Estimates of the percentage of residue cover remaining after various residue-disturbing operations are listed in *Table I*. For a given implement, the actual amount of residue remaining will be influenced by many factors, including implement adjustments, speed, depth of soil disturbance, previous residue disturbance, and soil and residue condition. The ranges of values given for both fragile and non-fragile types of residue account for some of these factors.

Be conservative and use your judgement when selecting values from the table. Do not use all high values; the result is usually overestimation of final cover. This is especially true on land that is designated as highly erodible. For these areas, values near the lower end of the range usually result in better estimates of actual cover.

Timing of operations

Weathering and when the residue-disturbing operations are performed are closely related. If residue is disturbed in the fall by grazing, tillage, stalk chopping, or knifing-in fertilizer, subsequent spring operations reduce cover more than if all operations are conducted in the spring. For fall operations, use values towards the lower end of the ranges in *Table I* or include an additional weathering reduction factor, also listed in *Table I*.

In contrast, when operations are conducted with little elapsed time between them, less reduction of residue occurs. Use values at or near the upper end of the ranges listed in *Table I* when an operation is performed within two or three days of the previous operation. Use values near the middle of the range if a week or more elapses between operations, especially if more than about one-half inch of precipitation or irrigation also occurs. Use values near the lower end of the ranges if operations are conducted over a month apart.

Chopping or shredding of residue

Chopping or shredding residue results in reduced amounts of cover because the chopped residue deteriorates more from the weather and subsequent operations. This additional reduction needs to be included in the calculations.

For small grains, if a rotary combine or a combine with a straw chopper is used, the residue should be considered to be fragile. In these cases, use the values in *Table I* that are for fragile residue.

Using the Calculation Method

An approximation of the percent residue cover after planting can be obtained by multiplying the percent residue cover after harvest by the appropriate values from *Table I* for weathering and for each residue-disturbing operation.

Selecting appropriate values to use in the calculation method is a key to obtaining reasonably accurate results. All operations and other factors that affect residue cover need to be accounted for. Think in terms of a complete sequence of operations. For each operation, evaluate how the residue will be affected by both prior and subsequent operations and by weathering.

Examples

The following examples illustrate how to use information from Table I to estimate residue cover by the calculation method. Assume that a tillage and planting system used in a field of high yielding irrigated corn residue in southeast Nebraska consists of three field operations:

1. knife application of anhydrous ammonia in the fall;
2. tandem disking in the spring; and
3. planting soon after disking using a conventional planter with double-disk openers and no coulters.

95% initial cover	x	0.75 knife applicator	x	0.90 winter weathering	x	0.60 disk	x	0.95 planter	=	37% final residue cover

If the conditions of this example are changed to dryland corn production on highly erodible land in

northeast Nebraska, and rainfall occurred between the disking and planting operations, less than 20 percent cover is likely to remain after planting.

80% initial cover	x	0.75 knife applicator	x	0.99 winter weathering	x	0.35 disk	x	0.85 planter	=	18% final residue cover

The calculation method is only a rough estimate since the variables involved prevent accurate determination of percent residue cover; however, this method can be useful in residue management planning by offering a general idea of how much residue cover will remain after a specific sequence of operations. There are also computer programs available to predict percent residue cover; however, these programs use the calculation method and average values for residue cover reduction, and as such should be used only when a rough estimate is satisfactory.

Refer to *Estimating Percent Residue Cover Using the Calculation Method*, NebGuide G95-1135, for a more extensive list of percent residue remaining and additional details on using the calculation method to estimate percent residue cover.

Summary

Crop residue management, or maintaining residue on the soil surface, is the most cost-effective method of reducing soil erosion available to Nebraska farmers. Crop residue management is a process that must continue year-round and from year-to-year. Estimates of percent residue cover are often needed in this process to determine if enough cover is available to adequately reduce erosion and to comply with conservation plan specifications.

For initial planning, rough approximations of the amount of residue cover are often adequate, and the calculation method can be appropriate. The photo-comparison method can be used when a moderate level of accuracy is desired. The line-transect method is the most accurate method of determining percent residue cover. It is also the most reliable way to determine if your residue management goals are being met.

Related publications:

NebGuide G81-544, Residue Management for Soil Erosion Control

NebGuide G93-1133, Estimating Percent Residue Cover Using the Line-Transect Method

NebGuide G95-1134, Estimating Percent Residue Cover Using the Photo Comparison Method

NebGuide G95-1135, Estimating Percent Residue Cover Using the Calculation Method

Extension Circular, EC 92-128, Estimating Winter Wheat Residue Cover

NRCS Publication NE-MP-10, Crop Residue Estimator

Table I. Estimated percentage of residue remaining after specific implements and field operations.[1] (Change to decimal value before multiplying. Example: 90% is changed to 0.90.)		
Implement	*Non-Fragile Residue*	*Fragile Residue*
	Percentage of Residue Remaining	
Plows		
Moldboard plow	0-10	0-5
Blade plow		
V-blades greater than 30" wide	75-95*	60-80*
with mulch treader attached	60-90*	45-80*
Chisel plows with		
Sweeps	70-85	50-60
Straight spike points	35-75*	30-60*
Twisted points or shovels	25-65*	10-30*
Tandem or offset disks		
Primary tillage	30-60	20-40
Secondary tillage	40-70	25-40
Field cultivators (including leveling attachments)		
Used as primary tillage:		
Sweeps 12" to 20" wide	60-80	55-75
Sweeps or shovels 6" to 12" wide	35-75	50-70
Used as secondary tillage:		
Sweeps 12" to 20" wide	80-90	60-75
Sweeps or shovels 6" to 12" wide	70-80	50-60
RodweedersPlain rotary rod80-9050-60		
Rotary rod with semi-chisels or shovels	70-80	60-70
Rodweeders:		
Plain rotary rod	80-90	50-60
Rotary rod with semi-chisels or shovels	70-80	60-70
Row-crop planters		
Conventional planters with:		
Runner openers	85-95	80-90

Staggered double-disk openers	90-95	85-95
Double-disk openers	85-95	75-85
Planters with:		
Smooth coulters	85-95	75-90
Ripple or bubble coulters	75-90	70-85
Fluted coulters	65-85	55-80
Row cleaning devices	60-80	50-60
Drills		
Hoe opener drills	50-80	40-60
Single disk opener drills	85-95*	75-85
Double disk opener drills	80-95*	60-80
Drills with the following attachments used in residue laying on the soil surface:		
Smooth coulter	65-85	50-70
Ripple or bubble coulters	60-75	45-65
Fluted coulters	50-70*	35-60*
Drills with the following attachments used in standing stubble:		
Smooth coulters	85-95	70-85
Ripple or bubble coulters	80-85	65-85
Fluted coulters	50-80*	40-70*
Other implements		
V ripper/subsoiler	60-80*	40-60*
Knife applicator	75-85	45-70
Subsurface manure applicator	50-80*	40-60
Mulch treader	70-85	60-75
Stalk chopper*	65-95*	60-95*
Climatic effects of overwinter weathering:		
Summer harvested crops	70-90	65-90*
Fall harvested crops	80-100*	75-100*
Fall operations (additional weathering)*	85-95*	80-95*
Weathering losses are highly dependent on preciptation and temperature. In winters with long periods of snow cover and frozen conditions, weathering may reduce residue levels only slightly. In warmer winters without much snow or during wet years, weathing losses may reduce residue levels significantly.		
Grazing impacts: Use the following formulas to estimate residue cover reduction due to grazing and the percentage of residue remaining factor.		
	(0.5) x (number of animals)	

Percent Grazing Reduction=	x (average animal weight in pounds) x (number days grazed) 8 (number of acres grazed) 8 1,000
Percentage of Residue= Remaining Factor	(100 - Percent Grazing Reduction)
[1]Adapted from the pamphlet "Estimates of Residue Cover Remaining After Single Operations of Selected Tillage Machines," published by the Soil Conservation Service and Equipment Manufacturers Institute, February 1992. *Values adjusted based on University of Nebraska research and field observations.	

File G1132 under: FIELD CROPS
H-1, Conservation & Management, 8,000 printed
Issued May 1995

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Elbert C. Dickey, Director of Cooperative Extension, University of Nebraska, Institute of Agriculture and Natural Resources.