



TECHNICAL NOTES

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

MICHIGAN

Agronomy #18
SUBJECT: CROP RESIDUE
DATE: May 1992 (Rev.)

TO: All Offices

FROM: Shirley A. Gammon
Assistant State Conservationist

Purpose: To provide a format for and give guidance in determining the amounts of crop residue left on the soil surface after crop planting.

HOW MUCH CROP RESIDUE

To effectively reduce soil erosion losses, a specific amount of residue is needed. The amount varies depending on the soil texture, slope, tillage, cropping pattern, wind and rainfall. The amount needed should be computed using the USLE or WEQ.

Percent of cover is more important than weight of residue remaining on the soil surface for reducing water or wind erosion.

Standing residue in pounds is more effective in reducing wind erosion than percent of ground cover.

Adequacy of residue on the ground surface can be estimated visually by field measurements or by residue collection and weighing.

On cropland, the residue measurement is made immediately after planting. On pastureland, woodland and land uses with similar vegetative cover, the most accurate ground cover measurements used for estimating erosion are made during the critical erosion period.

1. Visual Estimate.

Experienced personnel can provide estimates of the percent of the surface presently covered by residue or the amount of residue resulting from specific crops and tillage practices. However, even experienced personnel should frequently use measurement to verify accuracy of visual estimates.

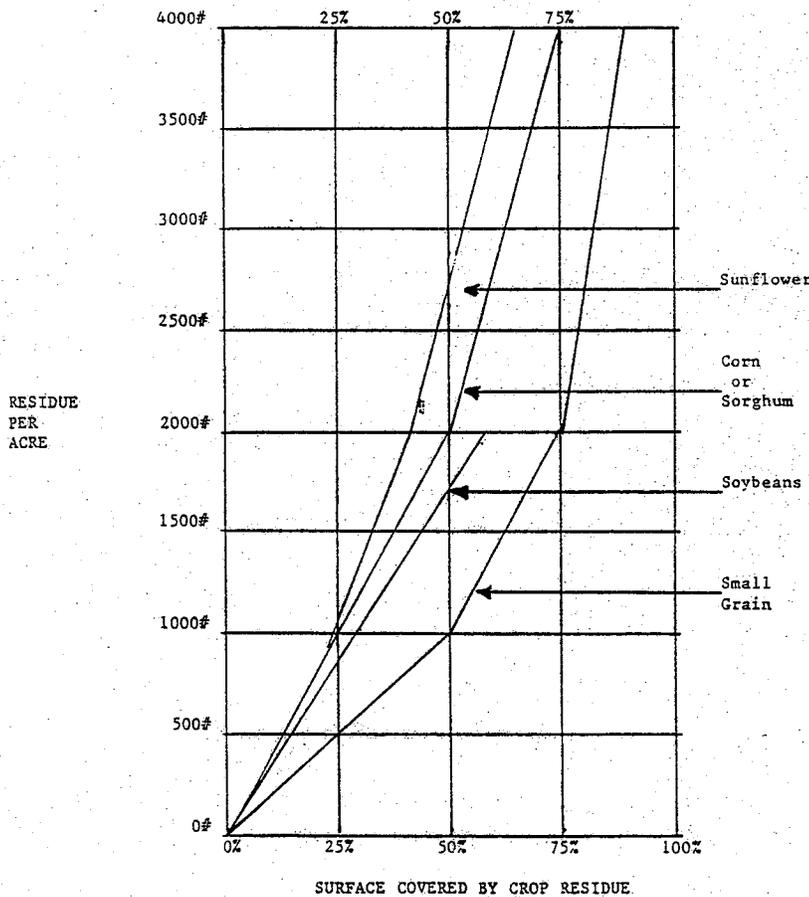
2. Field Measurements.

A. Line point sampling.

This method consists of observing ground cover at 100 equally spaced points along a line or tape. Each point represents one percent of the sample. A minimum of three random transects will be made and the average percent cover of the three or more transects will be used. All transects will be made on a diagonal to the rows on cropland and diagonal to the contour on all other land uses.

A line can be made using a carpenter's chalk-line, a 100-foot tape, or something similar. The line is stretched in a straight line and held securely with pins or stakes at both ends. The observer records either "no cover" or "cover" at each point on the line.

To calculate percent ground cover.*



* Average percent cover based on uniformly distributed residue over research plots. The relationship of weight to percent cover is extremely variable under field conditions.

B. Residue collection and weighing.

To estimate from sample areas, first collect crop residues from three 1-square-yard plots selected at random.

A 1-square-yard frame makes plot marking easier. Collect all residues down to the soil surface. Shake out soil and stones. Air dry and weigh all three samples and record the total weight in ounces. Multiply this weight by 100. This gives pounds of residue per acre.

3. Using Crop Yields. Estimate the residue produced by the crop in pounds per acre by using the crop yield and data given below.

CONVERTING CROP YIELDS TO POUNDS OF RESIDUE

Crop	Residue/Crop Ratio	Bushel Weight		Pounds of Residue/Bushel
		Lbs.	Kg.	
Barley	1.5	48	22	72
Corn	1.0	56	25.4	56
Field beans	0.7	60	27.2	40
Oats	2.0	32	14.4	64
Rye	1.5	56	25.4	84
Sorghum	1.0	56	25.4	56
Soybeans	1.5	60	27.2	90
Spring wheat	1.3	60	27.2	78
Sugarbeets	-	-	-	2500 lbs for beets
Winter wheat	1.7	60	27.2	102

Crop Residue = (straw/grain ratio x bushel weight x crop yield)

ESTIMATES OF RESIDUE COVER REMAINING AFTER SINGLE OPERATION OF SELECTED TILLAGE MACHINES

Each tillage or planting leaves a percent of the residue that was present just prior to that operation. The following tables are classified as being either Non-Fragile or Fragile. See list below. This is a subjective classification based in part on the ease in which crop residues are decomposed by the elements or buried by tillage operations. Plant characteristics such as composition and size of leaves and stems; density of the residue; and relative quantities produced were considered.

Many factors affect the amount of residue left after a pass with a tractor and tillage or planting machine. Residue levels are sensitive to depth and speed of equipment operation and to row spacing. When selecting values from the ranges in Table 2. for a specific machine, consider the following: (1.) At shallower operating depths greater amounts of residue are left on the surface, while at deeper operating depths, more residue is buried. (2.) Slower operating speeds tend to leave more residues on the surface while at faster speeds more residues are buried. Under some conditions field cultivators and other finishing tools with field cultivator gangs and some planters and drills may return as much as 20% of the residue incorporated at shallow depths by recent previous operations. Excess wheel slippage caused by improper ballasting of tractor tires can destroy valuable residues in the wheel tracks.

Use the figures as a guide in selecting the types of equipment and types of blades, points or sweeps to be used in the tillage system. Measure the actual amount of residue being left by the operation and make adjustments accordingly.

RESIDUE TYPES

NON FRAGILE

Alfalfa or legume hay
 Barley*
 Buckwheat
 Corn
 Cotton
 Flaxseed
 Forage Seed
 Forage Silage
 Grass hay
 Millet
 Oats
 Pasture
 Pineapple
 Popcorn
 Rice
 Rye*
 Sorghum
 Speltz*
 Sugarcane
 Tobacco
 Triticale*
 Wheat*

FRAGILE

Canola/Rapeseed
 Dry Beans
 Dry Peas
 Fall seeded cover crops
 Flower seed
 Grapes
 Green peas
 Guar
 Lentils
 Mint
 Mustard
 Peanuts
 Potatoes
 Safflower
 Soybeans
 Sugar Beets
 Sunflowers
 Sweet Potatoes
 Vegetables

* If a combine is used with a straw chopper or otherwise cuts straw into small pieces in harvesting small grain then the residue should be considered as being fragile.

PERCENT RESIDUE REMAINING AFTER EACH TRIP OR PASS OVER THE FIELD

<u>IMPLEMENT</u> ^{1/}	<u>NON FRAGILE</u>	<u>FRAGILE</u>
PLOWS:		
Moldboard plow	0-10	0-5
Disk Plow	10-20	5-15
MACHINES WHICH FRACTURE SOIL:		
Paratill/Paraplow	80-90	75-85
"V" ripper/subsoiler 12-14" deep 20" spacing	70-90	60-80
Combination Tools:		
Subsoil-chisel	50-70	40-50
Disk-subsoiler	30-50	10-20

^{1/} Developed jointly by the SCS, USDA and the Equipment Manufacturers Institute. February, 1992

IMPLEMENT^{1/}

NON FRAGILE

FRAGILE

CHISEL PLOWS With:

Sweeps	70-85	50-60
Straight chisel spike points	60-80	40-60
Twisted points or shovels	50-70	30-40

COMBINATION CHISEL PLOWS:

Coulter Chisel plows with:

Sweeps	60-80	40-50
Straight chisel spike points	50-70	30-40
Twisted points or shovels	40-6-	20-30

Disk Chisel plows with:

Sweeps	60-70	30-50
Straight chisel spike points	50-60	30-40
Twisted points or shovels	30-50	20-30

Disks Harrows:

Offset

Heavy plowing 10" spacing	25-50	10-25
Primary cutting 9" spacing	30-60	20-40
Finishing 7"-9" spacing	40-70	25-40

Tandem

Heavy Plowing 10" Spacing	25-50	10-25
Primary cutting 9" spacing	30-60	20-40
Finishing 7"-9" spacing	40-70	25-40
Light tandem disk after harvest, before other tillage	70-80	40-50

One-way disk with:

12"-16" blades	40-50	20-40
18"-30" blades	20-40	10-30

Single gang disk

	50-70	40-60
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FIELD CULTIVATORS:(Including leveling attachments)

Used as the primary tillage operation:

Sweeps 12-20"	60-80	55-75
Sweeps or shovels 6-12"	35-75	50-70
Duckfoot points	35-60	30-55

Field Cultivators as secondary

Operation following chisel or disk:

Sweeps 12-20"	80-90	60-75
Sweeps or shovels 6-12"	70-80	50-60
Duckfoot points	60-70	35-50

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IMPLEMENT^{1/}

NON FRAGILE

FRAGILE

FINISHING TOOLS:

Combination finishing tools with:

Disks, shanks and leveling
attachments

50-70

30-50

Spring teeth & rolling basket

70-90

50-70

Harrows:

Springtooth (coil tine)

60-80

50-70

Spiketooth

70-90

60-80

Flextooth

75-90

70-85

Roller harrow (cultipacker)

60-80

50-70

Packer roller

90-95

90-95

Rotary Tiller:

Secondary operation 3" deep

40-60

20-40

Primary operation 6" deep

15-35

5-15

STRIP TILLAGE MACHINES:

Rotary Tiller 12" tilled
on 40" rows

60-75

50-60

Row Buster

60-75

50-60

ROW CULTIVATORS: (30" and wider)

Single sweep per row

75-90

55-70

Multiple sweeps per row

75-85

55-65

Finger wheel cultivator

65-75

50-60

Rolling disk cultivator

45-55

40-50

Ridge Till cultivator

20-40

5-25

UNCLASSIFIED MACHINES:

Anhydrous applicator

75-85

45-70

Anhydrous applicator with
closing disks

60-75

30-50

Subsurface manure applicator

60-80

40-60

Rotary Hoe

85-90

80-90

Bedders, listers & hipers

15-30

5-20

Furrow diker

85-95

75-85

Mulch Treader

70-85

60-75

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IMPLEMENT^{1/}

NON FRAGILE

FRAGILE

IMPLEMENT

DRILLS:

Single disk opener drills	85-100	75-85
Double disk opener drills (conventional)	80-100	60-80

No till drills and drills with the following attachments in standing stubble:

Smooth no till coulters	85-95	70-85
Ripple or bubble coulters	80-85	65-85
Fluted coulters	75-80	60-80

Air seeders: (Refer to appropriate field cultivator or chisel plow depending on the type of ground engaging device used.)

Air drills: (Refer to corresponding type of drill opener.)

ROW PLANTERS:

Conventional planters with:

Runner openers	85-95	80-90
Staggered double disk openers	90-95	85-95
Double disk openers	85-95	75-95

No till planters with:

Smooth coulters	85-95	75-95
Ripple Coulters	75-90	70-85
Fluted coulters	65-85	50-80

Strip tillplanters with:

2 or 3 Fluted coulters	60-80	50-75
Row cleaning devices	60-80	50-60
(8-14" wide bare strip using brushes, spikes, furrowing, disks, or sweeps)		

Ridge till planter	40-60	20-40
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CLIMATIC EFFECT:

Over winter weathering.**

Following summer harvest	70-90	65-85
Following fall harvest	80-95	70-80

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EXAMPLES OF CALCULATIONS

ESTIMATING THE AMOUNT OF CROP RESIDUES ON THE SOIL SURFACE AFTER PLANTING.

STEP 1 - Determine the crop rotation, field and soil limitations and proceed to estimate how much residue will be required to provide the needed protection for each specific site. Use the USLE or WEQ to determine what percent cover is needed. You can then proceed to plan a system which will leave a minimum of that amount of residue.

STEP 2 - Determine the amount of residue after harvest. For each pound of shelled corn you harvest, there is approximately one pound of crop residue produced. Therefore, if you harvest 100 bushels of corn per acre, you will have 5,600 pounds of residue. However, the amount of residue will vary with soil type, yield goal, fertility, seed variety and other management decisions.

<u>Approximate Crop Residue</u>		
<u>Bushels of Corn/Ac x Weight/Bu</u>	<u>----</u>	<u>-----equals-----Pounds of Crop Residue at Harvest</u>
75x56 lbs./bu.	=	4,200
100x56 lbs./bu.	=	5,600
125x56 lbs./bu	=	7,000
150x56 lbs./bu	=	8,400

STEP 3 - Tillage with different implements has varying impacts on the amount of crop residue left on the soil surface. Reduce the crop residue left on the soil surface after each tillage operation by multiplying the residue left after harvest by the factors for each tillage operation in actual sequence.

STEP 4 - Determine the tillage implements and sequences being used to estimate the crop residue on the surface. Then determine the tillage implements and sequences needed to leave enough crop residue on the soil surface to be effective in erosion control.

EXAMPLES OF CALCULATIONS

EXAMPLE: Crop Residue Calculation (Yield x Lb. Residue/Bushel)

From: Converting Crops Yields To Pounds of Residue (Table on page 3)

Given: C/SB rotation - what is the spring residue equivalent?

Corn Yield: 100 bushel: 1/ Fall residue equivalent is: $100 \times 56 = 5600$
 2/ Over winter decomposition leaves: $95\% = 5320$
 3/ 5320 equivalent spring residue

Soy Yield: 50 bushel: 1/ Fall residue equivalent is: $50 \times 90 = 4500$
 2/ Over winter decomposition rate: $95\% = 4275$
 3/ 4275 equivalent spring residue

Tillage system calculation estimate of percent cover remaining after planting:

After Yr.	System Planting Crop	Spring (Residue Yield)	Field/Tillage Operations	% Residue Remaining
				(Non-fragile)
1	C	5320	1/ Chisel plow w/sweeps	.85
			2/ Combo tool disks, shanks, leveling bucket	.70
			3/ Coventional planter double disk openers IH 900 cyclo.	.95
				(Fragile)
2	SB	4275	1/ Chisel plow w/sweeps	.55
			2/ Combo tool disks, shanks, leveling bucket	.40
			3/ Coventional planter double disk openers IH 900 cyclo.	.85

Residue Remaining Calculation:

Corn 5320 (.85)(.70)(.95) = 3007 Use 3000 65% cover after planting
 Soys 4275 (.55)(.40)(.85) = 800 lbs 25% cover after planting

**In northern climates with long periods of snow cover and frozen conditions, weathering may reduce residue levels only slightly, while in warmer climates, weathering losses may reduce residue levels significantly.

Formula: Crop Residue Remaining = Pounds of crop residue x tillage factors x decomposition rate.

If the amounts of residue left after adjusting for each tillage operation are more than needed to control wind and water erosion you have an acceptable conservation tillage system.

If the residue left after adjustments have been made is not adequate for erosion control, change the resource management system until you have an acceptable conservation tillage system.

CROP RESIDUE ON THE SOIL SURFACE AFTER PLANTING

1. Cooperator's name _____ Tech. _____ Date _____
2. Farm # _____
3. Tract # _____
4. Field # _____
5. Acres in field _____ Planting Date _____
6. Crop rotation _____
7. Residue estimates of (last or this) year's crop after harvest prior to tillage _____ lbs.
yield bu. X #/bu.
8. Tillage operations planned: Fall _____
Spring _____
9. Estimated Residue Remaining:
 - a. After Fall Tillage _____ lbs.
Harvest lbs. X % Remaining
 - b. After Winter Decay _____ lbs.
Fall Tillage lbs. X % Decay
 - c. After Spring Tillage _____ lbs.
Winter Decay lbs. X % Remaining
 - d. After Spring Planting _____ lbs.
10. Does the system planned leave required amounts of residue? Yes ___ No ___
11. If answer is "no" to question 10, what changes are needed to provide the required residue? _____
12. Additional conservation practices needed to reduce soil losses to permissible limits. _____
13. _____ % of soil surface covered with crop residue at time of field check.
14. Certification: Date _____ By _____
15. Remarks: _____

Prepared by: Jerry Grigar
State Conservation Agronomist