TECHNICAL NOTES

U.S. DEPARTMENT OF AGRICULTURE Portland, Oregon SOIL CONSERVATION SERVICE

AGRONOMY No. 22 October 1988

ESTIMATING SURFACE RESIDUES AFTER TILLAGE

Controlling soil erosion using crop residues requires advance planning to provide sufficient cover during the critical soil erosion period.

Managing residues after harvest is extremely important. When possible grain stubble and other residue should be left standing or untilled through the erosion period. Crop residue management includes careful selection and proper use of equipment to maintain residues on the soil surface.

This technical note is designed to provide information on average residue produced, and average residue retained on the soil surface after various tillage operations.

Table 1. Average pounds of residue for various crops.

Crop	Unit	Lbs Residue Per Unit
Rye	bushel	120.00
Mustard, rape and safflower	bushel	80.00
Corn,	bushel	75.00
Oats	bushel	50.00
Sunflowers	pound	1.50
Dry edible beans	pound	2.20
Potatoes	pound	.15
Sugar beets	ton	325.00
Rape	pound	3.00

Table 2. Approximate Residue Production for Small Grains and Peas (dry weight) 1/

Winter Wheat	
Grain Yield Bu/Acre	Lbs Residue Per Bushel of Grain
20-40	100
40-70	90
70-110	80
110+	75

Spring Wheat	
Grain Yield Bu/Acre	Lbs Residue Per Bushel of Grain
20-40	110
40-70	80
70-110+	65

Winter Barley	
Grain Yield Lbs/Acre	Lbs Residue Per Pound of Grain
500-1000	2.0
1000-1500	1.7
1500-2000	1.5
2000-3000	1.3
3000-5000	1.2
5000-6000+	1.0

Spring Barley	
Grain Yield Lbs/Acre	Lbs Residue Per Pound of Grain
500-1000	2.8
1000-1500	2.0
1500-2000	1.7
2000-3000	1.4
3000-5000	1.0
5000-6000+	0.9

Spring Peas	
Pea Yield Lbs/Acre	Lbs Residue Per Pound of Peas
500-1000	1.2
1000-1500	1.1
1500-2000	1.0
2000-2500	.9
2500+	.85

Lentils	
Lentil Yield Lbs/Acre	Lbs Residue Per Pound of Lentils
500-1000	1.6
1000-1500	1.4
1500-2000	1.2
2000-2500	1.0
2500+	.94

Long-vined or Winter Peas
Approximate residue production per acre is 1.5 to 1.7 lbs. per pound of peas.

Data was taken from field studies made by SCS personnel.

GENERAL CROP RESIDUE RETENTION FACTORS
-- Normal Equipment Speed 4-5 mphr.2/ --

Operation	Surface Residue Retention Factor
MISCELLANEOUS OPERATIONS:	
Corn stubble grazing (variable) 3/	.50
Stubble flailing, chopping, busting	1.00
Stubble grazing (variable) 3/	.65
Stubble baling (variable) 3/	.35
Stubble burning (variable) 3/	.10
Subsoil 24+" spacing	.85
Paraplow	.95
Skew treader	.70
Rotary hoe or cultivator	.75
Small grain overwinter loss and chaff reduction	.70
MINT AND ROW CROPS	
PRIMARY TILLAGE ONLY:	
Moldboard Plow 4-6" deep	.10
Moldboard Plow 6-8" deep	.05
Moldboard Plow 8+" deep	.00
Rotary tiller 4-6" deep	.10
Chisel straight points 12" spacing	.50
Chisel straight points 24" spacing	.75

2/ When speeds in excess of five miles per hour are used, reduce residue values by five percentage points. Implements pulled in tandem (plow-harrow, rod-weeder-harrow, etc.) will be considered as two separate operations. When field conditions are wet at tillage time, reduce residue values by five percentage points.

3/ Figure to the adjusted up or down, based upon technical judgement, resulting from variable number, stock grazing time, stubble height at harvest, etc.

GENERAL CROP RESIDUE RETENTION FACTORS
-- Normal Equipment Speed 4-5 mphr.2/ --

Operation	Surface Residue Retention Factor
FIELDS WITH GRAIN STRAW YIELDS EXCEEDING 6000 LBS PER ACRE	
PRIMARY TILLAGE ONLY:	
Moldboard plow 6-8" deep, straw 14-20" long.....	.30
Moldboard plow 8-10" deep, straw 14-20" long.....	.15
Moldboard plow with trash rack 8-10" deep, straw 14-20" long	.10
Moldboard plow with trash rack 8-10" deep, straw less than 12" long	.05
Moldboard plow, straw chopped, 8-10" deep	.00
Disc tandem , 4-6" deep, straw less than 12" long	.75
Disc,(light) standing stubble, 1/2" deep	.95
Disc,(heavy) standing stubble, 4-6" deep	.75
Disc,(heavy) standing stubble, 6-8" deep	.70
Chisel, straight points (12"spacing)	.85
Chisel, straight points (18"spacing)	.90
Chisel, straight points (24"spacing)	.95
Chisel, twisted points (12"spacing)	.55
Chisel, twisted points (18"spacing)	.65
Chisel, twisted points (24"spacing)	.70
Chisel, twisted points (12"spacing) following chopped stubble	.45
Combination disc-chisel or mulch tiller	.65
OTHER CROPS AND FIELDS WITH GRAIN STRAW YIELDS OF LESS THAN 6000 LBS ACRE	
PRIMARY TILLAGE:	
Moldboard plow 4-5" deep	.30
Moldboard plow 6-8" deep	.15
Moldboard plow 8+" deep	.00
Moldboard plow with trash racks 4-5" deep	.10
Moldboard plow with trash racks 6-8" deep	.05
Moldboard plow-uphill furrow 4-5" deep	.40

GENERAL CROP RESIDUE RETENTION FACTORS
>> Normal Equipment Speed 4>5 mphr.2/ >>

Operation	Surface Residue Retention Factor
Disc,(light) standing stubble, 1/2" deep	.90
Disc,(heavy) standing stubble, 4>6" deep	.60
Disc,(heavy) standing stubble, 6>8" deep	.40
Disc,(heavy) pea, bean, or lentil residue	.15
Disc, (one>way) 3>5" deep	.50
Disc harrow, (light) 2>3" deep > pea, bean, or lentil residue	.30
Chisel, straight points (12"spacing)	.75
Chisel, straight points (18"spacing)	.85
Chisel, straight points (24"spacing)	.90
Chisel, twisted points (12"spacing)	.40
Chisel, twisted points (18"spacing)	.50
Chisel, twisted points (24"spacing)	.55
Chisel, twisted points (12"spacing) following chopped stubble	.35
Combination disc>chisel, or mulch tiller	.65
Rotary tiller, 4>6" deep	.30
Rotary tiller, 3" deep	.50

OTHER CROPS AND FIELDS WITH GRAIN STRAW YIELDS OF LESS THAN 6000 LBS ACRE

SECONDARY TILLAGE ON SMALL GRAINS AFTER INVERSION 4/
(Secondary tillage to same depth as inversion tillage or cross direction of inversion tillage)

Sweep 12" (first pass after inversion)	1.15
Chisel>rodweeder (first pass after inversion)	1.10
Cultivator, field (first pass after inversion)	1.15
Springtooth harrow (first pass after inversion)	1.20
Rod weeder (first pass after any of above)	1.20
Rod weeder (second and deeper than first pass)	1.00

MOSTLY SECONDARY TILLAGE
(Initial residue has been changed by primary tillage)

Cultivator, field	.85

4/ Inversion tillage inverts or mixes 50 percent or more of the residue in one operation.

GENERAL CROP RESIDUE RETENTION FACTORS
-- Normal Equipment Speed 4-5 mphr.2/ --

Operation	Surface Residue Retention Factor
Disc, (light) 3-5" deep	.50
Disc, harrow, (light) 2-3" deep	.75
Disc harrow, (light) 3-5" deep - chopped straw and pea, bean, or lentil residue	.15
Springtooth harrow	.85
Sweep 12" wide 4-6" deep	.70
Sweep 16" wide 4-6" deep	.85
Sweep 24" wide 4-6" deep	.90
Sweep wide blade,(Towner or Noble)	.90
Harrow, spike 10 bar	.80
Harrow, spike 5 bar	.90
Harrow, tine 10 bar	.85
Harrow, tine 5 bar	.90
Rod weeder with sweeps or chisels	.85
Rod weeder	.90
Rod weeder same depth as previous rod weeding	.95
Swedish harrow	.90
Seedbed maker	.85
OTHER	
Fertilizer shank	.90
Fertilizer, drip or dry	1.00
Fumigation, (injection)	.70
Herbicide	1.00
Irrigation	1.00
Other pesticide application	1.00
Roller packer	.95
PLANTING	
Aerial seeding	1.00
Brillion seeder	1.00
Conventional:	
Double disc drill, 7" spacing	.90
Semi-deep furrow drill	.85
Deep furrow or hoe drill	.80
Air Seeder, chisel type, narrow points	.70
Air Seeder, duck foot	.60

GENERAL CROP RESIDUE RETENTION FACTORS
-- Normal Equipment Speed 4-5 mphr.2/ --

Operation	Surface Residue Retention Factor
IRRIGATED PLANTINGS:	
Corn planter	.95
Onion planter	.75
Potato planter	.60
Vegetable seed planter	.90
No-till Drills:	
Light double disc drill	.75
Chisel point or hoe opener drill	.65
Heavy double disc drill	.60
Heavy double disc drill on pea, bean, or lentil residue	.30
Heavy double disc drill on spring grain residue	.45
Heavy double disc drill, with scuffer	.50
Heavy double disc drill, with scuffer on pea, bean, or lentil residue	.30
Heavy double disc drill- corn residue 36"	.75
AFTER PLANTING (IRRIGATED)	
Hill	.80
Furrow marker	.85
Cultivator with shovel 18-36" spacing	.40
Cultivator w/sweep	.85
Dammer diker or similar	.85
HARVESTING (IRRIGATED)	
Potato digger	.20
Sugar beet digger	.10
Vegetable root digger	.30

Example #1

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CONSERVATION TILLAGE WORKSHEET

Farmer Joe Sample Technician J. Cons. Date Sept.88

ASCS Tract 917 Fields # 1, 2, 4, 7 Acres 702

Crop Rotation Winter wheat - Spring barley fallow

Dryland XX Precipitation 17 R Factor = 50

Irrigated Cropland ____

1. Type of Conservation Tillage. (check appropriate)

No-till ____, Strip Till ____, Ridge Till ____ Reduced Till XX

2. Residues required after planting crop (percent residue cover or Lbs./Ac.

Crop	Kind of Erosion	Erosion Period (Dates)	Residues Need lbs.	Total Residue & Green Cover Needs lbs.
Winter wheat	water	Dec to March	500 lbs	500 lbs+ 15-25% Green
Spring barley	"	" to "	1000 lb	1000 lbs

3. List all tillage equipment on farm and apply Residue Retention Factors to determine alternative tillage.

Item	Factor	Item	Factor
Moldboard Plow	.15	Spike harrow	.80
18" chisel twisted pts	.50	Fertilizer shank	.90
Field cultivator	.85	Deep furrow drill	.80
Rod weeder	.90	Double disc drill	.90

List all tillage equipment on the farm for determining alternative tillage.

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* This worksheet will be filled out by the SCS planner and the *
* landuser to help develop an acceptable tillage program. *
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4. Tillage Systems

A) No-till:
Straw spreaders or choppers used on combine Yes __ No __

Type of drill to be used.
light double disc____, chisel or hoe opener____, Heavy double disc____,
Estimated residue after planting _____Lbs/Ac.

B) Strip-till:
Planted into, residue___, or cover crop___ Row spacing_____ inches.
Type of planter _____

C) Ridge-till:
Type of planter_____ Ridge Height ___ inches,
Row spacing___ inches.

D) Reduced-till:
Method Non-inversion tillage - chisel, field cultivate, rod weed

5) Weed Control

A) Type of weed control:
tillage _____, chemical and tillage__XX_____, chemical_____

B) Chemicals used shall be federally, state and locally registered and will be applied in acccordance with the label.

6. Planned tillage program

	Crop	Yield	Initial Residue Lbs/Ac
1.	Winter Wheat	55 bu.	55x90 = 4950
2.	Spring Barley	2700 lbs	2700 x 1.4 = 3780
3.			

Date Performed	Tillage or Other Operation	Residue Retention Factor	Lbs/Ac	% Residue Cover
7/30	Crop residue at harvest = Sp. Barley	-	3780	
	Overwinter loss & chaff reduction	.70	2646	
10/15	Chisel 18" twisted points	.50	1323	
4/15	Field cultivator	.85	1125	
5/15	Herbicide application	1.00	1125	
7/15	Rod weed	.90	1012	
8/1	Fertilizer shank w/spike harrow	(.90)(.80)	728	
8/15	Rod weed	.90	655	
9/15	Drill double disc 7"	.90	590	30%

* See Agronomy Technical Note No. 22 for residue production by crop & residue retention factors for different tillage equipment.