RESIDUE MANAGEMENT TO CONTROL SOIL EROSION BY WATER

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Conservation Tillage

FACTS

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The Erosion Process

Erosion of topsoil begins when water detaches individual soil particles from clods and other soil aggregates. A single raindrop may seem insignificant, yet collectively, raindrops strike the ground with surprising force. During an intense storm, rainfall can loosen and detach up to 100 tons of soil per acre and can be especially erosive when residue, mulch or vegetation are not present to absorb their impact.

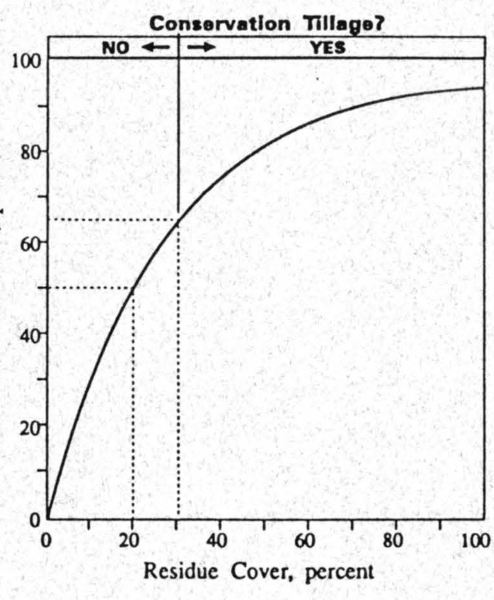
Two problems often occur during rainstorms. The rate of rainfall can exceed the rate at which water can enter the soil and raindrop impact forces can partially seal the soil surface. In the first instance, the excess water either collects on or runs off the soil surface and in the second, less water can infiltrate into the soil, causing more runoff. This runoff will travel downhill, carrying soil particles with it.

Runoff from steeper areas flows at greater velocities and may transport considerable amounts of soil. Further, longer slopes have greater flows because water is concentrated from a larger area. As runoff flows across unprotected soil surfaces, additional soil particles are dislodged, thus creating even more soil erosion.

Residue Reduces Erosion

Crop residue helps protect the soil surface from raindrop impact. It also reduces surface crusting, sealing and rainfall-induced soil compaction, all of which increase water runoff by reducing infiltration. In addition, runoff is reduced because pieces of residue form a complex series of small dams and obstructions that slow the runoff.

Years of research show that no-till planting systems, which leave the greatest amount of residue cover, can reduce soil erosion by 90 to 95 percent of that occurring from cleanly tilled systems. As little as a 30 percent residue cover can reduce erosion by 65 percent as shown in the illustration. Prior land use, crop canopy and surface roughness also influence erosion from different tillage and planting systems, but residue cover is the single most important factor.



At least 30 percent of the soil surface must be covered with residue after tillage and planting is completed in order to be classified as conservation tillage. The examples show that a 20 percent residue cover will reduce erosion by about 50 percent of that occurring from a cleanly tilled field while a 30 percent cover can reduce erosion by as much as 65 percent.

Conservation Tillage

Conservation tillage is defined as any tillage and planting system that leaves at least 30 percent of the soil surface covered by residue after planting. Several tillage systems, including chisel plow,

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disk, rotary-till, ridge-plant and no-till systems, can leave this minimum amount of cover in corn, grain sorghum and small grain residues. However, the number of field operations must be limited. This is more crucial than the type of implement used. When using a chisel or disk system in high yielding corn residue, two tillage operations will generally leave about a 30 percent cover.

No-till is the only system that consistently leaves a 30 percent or greater cover in soybean residue.

Estimates of residue remaining after various tillage operations are shown in the table. The actual percent of residue remaining is a result of several factors, including speed, depth of tillage operation, and the condition of the soil and residue and the type of implement being used. The lower end of the percentage range listed in the table corresponds to fragile residue such as soybeans. The upper end corresponds to high yielding corn, while values between these extremes should be used for low yielding corn.

Corn, grain sorghum and small grains generally leave about 95 percent of the soil surface covered with residue after harvest, assuming it is uniformly spread behind the combine. Following soybean harvest, about 75 percent of the soil is covered with residue.

Tillage and Planting Implements	*Percent of Residue Remaining After Each Operation**
Moldboard Plow	3 to 5
Chisel Plow	
Straight shovel points	50 to 70
Twisted shovel points	30 to 60
Knife Fertilizer Applicator	50 to 80
Disk (Tandem or Offset)	
3″ deep	40 to 70
6″ deep	30 to 60
Field Cultivator	50 to 80
Planters	
No coulter or smooth coulter	90 to 95
Narrow ripple coulter (less than 1.5″ flutes)	85 to 90
Wide fluted coulter (greater than 1.5″ flutes)	80 to 85
Sweeps or double disk furrowers (ridge-plant)	40 to 60
Drills	
Disk openers	85 to 90
Hoe openers	50 to 80
Winter Weathering	70 to 90

*Use higher values for residue from corn yielding about 150 bu/ac; use mid-range values for residue from corn yielding about 100 bu/ac; use lower values for fragile residue such as from soybeans.

The following example illustrates how to use information from the table to estimate residue cover by calculation. Assume that a tillage and planting system used on a field of irrigated corn residue has four operations:

- knife fertilizer application
- chisel plowing with straight points
- disking 6 inches deep
- planting with no coulter

Also assume the initial residue cover for irrigated corn is about 95 percent. Winter weathering, fertilizing, tillage and planting operations would reduce the residue cover to about 27 percent which is slightly below the minimum residue cover needed for conservation tillage.

95% ×	90% ×	80% ×	70% ×	60% ×	95% =	27%
initial	weather	knife	chisel	disk	plant	final

Using the same tillage and planting operations in soybean residue would result in less than a 5 percent residue cover.

This method can be used to obtain a rough estimate of residue cover. The variables involved prevent accurate determination of residue cover by calculation.

Actual residue cover should be determined by in-field measurements such as the line-transect method.

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