Conservation Tillage

Effects on Soil Erosion

Soil erosion has been a major world problem for many centuries. Great empires, like the Greek and Roman, fell because of their unchecked soil erosion. Erosion has left the once fertile lands of North China, Persia, Mesopotamia, and North Africa in desert. Increasing demand for grain in these countries resulted in exploitation of the fragile land, which exceeded its natural ability to recuperate. Will this happen in the United States?

Soil erosion has four effects on cropland: nutrient loss, decreased water storage capacity, crop damage, and decreased farmability.

Loss of topsoil is important because it contains the richest supply of soil nutrients of any soil layer. The topsoil contains about $12.50 worth of nitrogen, phosphorus, and potassium per ton. This translates into $62.50 per acre loss when erosion is limited to 5 tons per acre. The organic matter in the topsoil contains most of the micronutrients that are lost with excessive erosion.

Second, erosion reduces the amount of soil available to store moisture. Also, water that causes erosion is lost and cannot be used by the crop. If this water was allowed to infiltrate under a conservation tillage system, higher crop yields would be expected where rainfall is limited.

Third, rills and gullies destroy young plant seedlings by removing the soil from their roots and displaces them down slope. Sediment deposits at the bottom end of fields bury the young plants and the well-structured soil. Because this sediment has poor soil structure, water and air movement is greatly restricted. Field drainage is slow, often delaying spring tillage and planting in this area.

The fourth and most noticeable effect of erosion is land abandonment by farmers when a field is cut up by gullies. Gully growth can be directly related to the increased peak runoff rates of conventionally tilled fields.

Residue protects soil from the forces of wind and water that cause soil erosion. Wind erosion will not begin if the soil surface is protected from wind. Once soil begins to blow, particles of sand bounce along the soil surface detaching more particles on each impact. While wind erosion is very visible, it accounts for only a small percentage of total erosion in Iowa.

Water erosion causes the majority of production loss and off-site damage in Iowa. When conservation tillage practices are adopted, soil erosion is reduced by protecting the soil surface from rain drop energy that detaches soil particles from the soil surface. Residue left on the surface also creates small dams that store water so it can be absorbed by the soil at a later time. These small dams slow runoff and thus reduce the amount of soil the runoff carries.

The effects of water erosion are reduced yields from the land and pollution of water with sediments. Conservation tillage can reduce the impacts of both by keeping the soil on the land and out of the water.

Residue Management

Conservation tillage is a term that covers a broad range of tillage systems that leave residue cover on the soil surface. To be considered conservation tillage, the minimum amount of surface cover after planting must be 30 percent.

By leaving even this relatively low amount of residue, erosion can be cut in half. Figure 1 shows the effect of crop residue on soil erosion. Conservation tillage systems may include chisel plow, disk, ridge-till, or no-till. Each reduction in tillage reduces the amount of erosion. Tillage in the spring rather than the fall also will leave the soil protected for a longer period of time.

Crops that produce large volumes of residue, such as corn, will allow more tillage and still maintain some residue cover. However, soybean residue generally is less abundant and decomposes quickly, allowing little or no tillage to maintain high residue levels. Table 1 presents typical residue reductions from tillage opera-

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AE-3050 | Revised | March 1991

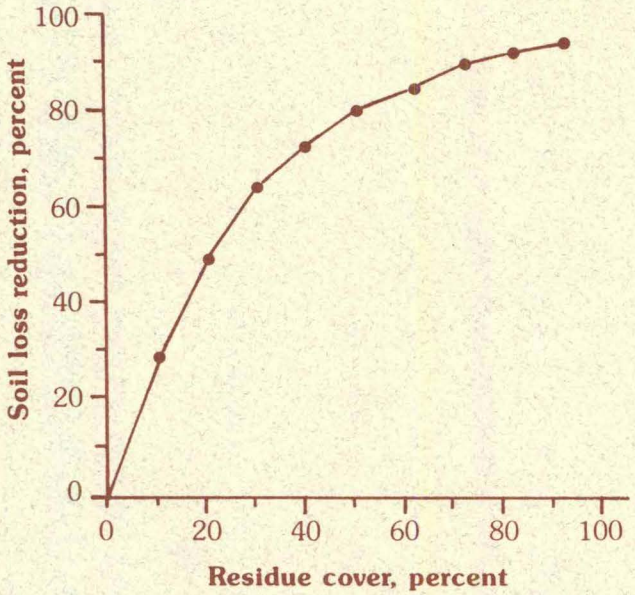

Figure 1. Effect of residue cover on reducing soil erosion.

tions. A good corn crop will leave 90 to 95 percent residue cover after harvest, while a soybean crop may leave less than 80 percent. Because soybean residue decomposes much faster during winter, no-till often is the only way to preserve significant soybean residue through planting.

Table 1. Percentage of cover remaining.

Tillage tool	Remaining cover factor	
	Corn	Soybeans
After harvest	.90-.95	.80-.90
Overwinter decomposition	.80-.90	.70-.80
Plow	.02-.07	.00-.02
Chisel (twisted shank)	.40-.50	.10-.20
Chisel (straight shank)	.50-.60	.30-.40
Paraplow	.65-.75	.35-.45
Disk (offset, deep)	.25-.40	.10-.20
Disk (tandem, shallow)	.65-.75	.25-.35
Anhydrous applicator	.75-.85	.45-.55
Field cultivator	.80-.90	.55-.65
Plant	.80-.90	.80-.90*
Till-plant	.55-.65	.55-.65*

*When these are the only operations where soil is disturbed, multiply by .75.

Example: Soybean residue going into corn, one anhydrous application and then plant. Only 20 percent cover remains in this system.

After Harvest		After Winter		Anhydrous Application		Plant		Remaining Residue
.80	×	.70	×	.45	×	.80	=	**.20**

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Measuring Residue

To ensure that the desired amount of residue is left after planting, it is important to know how the residue will be measured. The standard method of measuring residue is with a 50-foot tape with markings every 6 inches. The tape is stretched diagonally across the rows and the number of points where residue is directly under the leading edge of the 6-inch marks is recorded. This number represents the percentage of residue coverage.

This procedure is done three different places in a field to arrive at an average value. If rain is received after planting and before measuring, two things may happen. First, lightly incorporated residue will be uncovered by the rain, which will increase the residue reading. Second, a heavy rain will wash residue off of side slopes and reduce the residue reading.

For producers who have not measured residue or have not been involved with conservation tillage in the past, start on a few acres before the conservation compliance deadline. If in doubt on how much residue will remain, try measuring the residue on a few acres.

Erosion from cultivated land generally occurs from large rainfall events that occur only two or three times a year. The critical time period is from seedbed preparation until the crop has formed a canopy. This fits with the timing of the SCS personnel who will measure crop residue after planting.

By reducing the amount of tillage on valuable cropland, the land resource can be passed to the next generation.

For more information on conservation tillage systems, see the following publications:

AE-3049 *Conservation Tillage—Planning*
AE-3051 *Conservation Tillage—Effects on Water Quality*
AE-3052 *Conservation Tillage—No-till Systems*
AE-3053 *Conservation Tillage—Ridge-till Systems*
AE-3054 *Conservation Tillage—Fertility Practices and Equipment for No-till and Ridge-till*
AE-3055 *Conservation Tillage—Cultivators for No-till and Ridge-till*
AE-3056 *Conservation Tillage—Planters for No-till*
AE-3057 *Conservation Tillage—Planters for Ridge-till*

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Cooperative Extension Service, Iowa State University of Science and Technology and the United States Department of Agriculture cooperating. Robert M. Anderson, Jr., director, Ames, Iowa. Distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914.