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SOIL EROSION WITH DIFFERENT TILLAGE AND CROPPING SYSTEMS

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Corn and soybeans are produced on approximately three million acres of Kentucky farmland each year. Little soil loss occurs when these crops are grown on nearly level or gently sloping land. However, much of the grain production is on sloping land that is cultivated every year and often excessive soil erosion occurs. If a field is allowed to erode excessively for several years, the soil usually becomes less productive. Soil removed in runoff may pollute lakes and streams or cover highly productive soil with low quality sediments.

It is not possible to determine how much soil is lost during a particular rainfall event or during an entire year by visual observations. Sheet erosion, for example, does not leave behind obvious evidence of its damage, as does gully and rill erosion, and may go virtually unnoticed. Currently, the only method available for predicting soil loss is the universal soil loss equation (USLE). Research is underway at Princeton and Lexington by the University of Kentucky Agronomy Department in cooperation with the Tennessee Valley Authority to measure the effect that different cropping systems and tillage methods have on soil erosion and compare actual soil loss with that predicted by the USLE.

Soybean Cropping Systems and Tillage Methods at Princeton

A site on a Zanesville silt loam soil on a slope of 8% was divided into several small watersheds 12.5 ft wide and 72 ft long. Primary practices being evaluated are full-season soybeans and double-cropped wheat--soybeans, no-tillage and conventional tillage, and a wheat cover crop. Soybean rows and tillage operations were up-and-down hill. Data were collected from May 15 through October 28, 1985. The results are shown in Table 1. Total rainfall for the period was 22.5 inches and was well distributed.

No-tillage of full-season soybeans decreased soil loss from about 4 tons/acre with conventional tillage to about 0.2 ton/acre or lower. A cover crop of wheat with no-tillage decreased the soil erosion slightly further to 0.12 ton/acre. Double-cropping soybeans with wheat also appeared to be an effective means of controlling soil erosion, even with conventional tillage (Table 1). This may be attributed to two factors. One, there were fewer rainfall events and less rainfall during the shorter growing season for the double-cropped soybeans than for the full-season soybeans. Two, the residue from the wheat crop was plowed under in the double-cropped wheat--soybean system. This added organic matter and probably increased infiltration and decreased runoff. The least soil loss occurred with the double-cropped wheat--soybeans with both the wheat and soybeans planted no-tillage, but it was only slightly less than other no-tillage treatments.

Corn Tillage Systems at Lexington

In 1984, a set of erosion plots, 30 ft wide and 72 ft long, was established at Lexington on a Maury silt loam soil with about 9% slope to study the effects of conventional tillage, chisel-plow tillage, and no-tillage on runoff and erosion in corn production. Tillage and planting were on the contour. Results from 1985 are shown in Table 2.

By far the greatest runoff and soil loss occurred with conventional tillage, while there was little difference in soil loss from chisel-plow and no-tillage treatments. The chisel-plow tillage had somewhat lower volume of runoff, probably because of the rough surface left by the chisel plow.

Actual and USLE Predicted Erosion

The universal soil loss equation (USLE) is used to predict soil erosion under various conditions of soil, climate, tillage, and cropping. The USLE greatly overestimated the soil loss for all treatments on the Zanesville soil (Table 1). The range of overestimation was from almost five times for full-season soybeans with conventional tillage to 23 times for the double-cropped wheat--soybeans with conventional tillage. USLE estimates were closer to the actual for the Maury soil at Lexington, except for chisel-plow tillage, which was overestimated by 13 times. The equation overestimated conventional tillage by 1.5 times and no-tillage by 6 times on the Maury soil. It should be pointed out that the actual values are from a single year's measurements and might be somewhat different after several years of measurements.

According to the USLE, each soil has an estimated erosion tolerance, called T value, an amount of erosion which can be permitted without decreasing the potential productivity of that soil. The T value for the Maury silt loam soil is 5 tons/acre/year. Soil loss under conventional tillage exceeded by about 1.6 times the erosion tolerance for the Maury soil. Soil loss was far below the T value with both no-tillage and chisel-plow tillage on the Maury soil. A Zanesville silt loam soil in Kentucky has a T value of 3 tons/acre/year soil loss. No comparisons can be made of actual soil loss and the T value for the Zanesville soil since measurement of actual soil loss was not for the entire year.

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Table 1. Runoff and Erosion from Zanesville silt loam soil at Princeton, KY.

Cropping and tillage system	Runoff loss of water†	Actual soil loss†	USLE predicted soil loss†
	acre-inch	ton/acre	
Full-season soybeans:			
Conventional tillage, without cover crop	7.5	4.04	19.5
No-tillage, without cover crop	2.8	0.19	3.0
No-tillage into wheat cover crop	3.0	0.12	1.3
Double-cropped wheat--soybeans:			
Conventional tillage	5.5	0.51	11.7
No-tillage into wheat residue	4.2	0.08	1.1

† May 15 to October 28, 1985.

Table 2. Runoff and erosion from Maury silt loam soil cropped with continuous corn for grain at Lexington, KY.

Tillage	Runoff loss of water†	Actual soil loss†	USLE predicted soil loss†
	acre-inch	ton/acre	
Conventional tillage	1.16	8.00	12.0
Chisel-plow tillage	0.34	0.18	2.4
No-tillage	0.48	0.16	1.0

† January 1 to December 31, 1985.