Effect of Tillage on Soil Loss and Corn Grain Yields on Sloping Land

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Many areas of sloping land in the United States are experiencing serious erosion problems. Much of this erosion is due to excessive tillage. The eastern half of Kentucky and adjoining areas of Ohio, West Virginia, and Tennessee are gently rolling with 50 percent or more of the tillable soils located on 6 to 20 percent slopes. The corn acreage in these areas has been expanding rapidly, thus more corn is being grown on potentially erodable land. Some type of conservation tillage is required on this land to prevent severe soil erosion and maintain the potential productivity of these soils.

The objective of this study was to determine the effect of four tillage methods on soil loss and corn grain yields on sloping land.

This research was conducted on a farm in eastern Kentucky on a Lowell silt loam soil. The soil is deep, well-drained, with medium textured surface layers, underlaid by a slowly permeable, clayey subsoil. Four naturally separated watersheds adjacent to each other in the same field were chosen. Each watershed contains approximately 0.6 acre with a slope ranging from 8 to 15 percent from top to bottom. These areas had been in no-tillage corn for the two years prior to this study.

Each watershed was prepared for corn each year by one of the following four tillage treatments: (1) no-tillage into established rye, (2) chisel-plowed and disked, (3) disked only, and (4) moldboard plowed and disked (conventional). Corn stalks were chopped each fall following corn harvest and left on the soil surface to provide additional winter cover except for the no-tillage treatment. Rye was established in the fall by broadcasting and disking on the no-tillage plot. Corn was planted each year near May 10 at a seeding rate of 24,500 in 36 inch rows. All other cultural practices were the same on all plots. For collection of water runoff and soil loss an H-type flume with a Coshocton wheel was installed on each watershed. To prevent water from moving into or out of the watersheds a soil berm was constructed around the boundary of each watershed.

RESULTS

The results of the soil losses are presented in Table 1. The no-tillage and disk-only treatments resulted in significantly lower soil losses than the other two tillage methods. The low soil losses in 1983 and 1984 were due to the very dry summers with light showers accounting for most of the rainfall. In 1982, a couple of very intense rainfalls in late July

accounted for the heavier soil losses from the chisel-disk and the conventional tillage areas. Overall, no-tillage reduced soil losses by 97 percent and disk only by 95 percent as compared to conventional tillage. Soil loss data from this study shared that the chisel-disk was not effective in reducing soil erosion losses on steeper slopes.

Table 1. Soil loss for four tillage systems.

	Tons per Acre			
Tillage	1982*	1983	1984	Ave.
No-Tillage	0.14	0.08	0.06	0.09 b
Disk-Only	0.20	0.15	0.11	0.15 b
Chisel-Disk	5.18	2.64	0.97	2.93 a
Conventional	6.10	2.63	1.25	3.33 a

*Includes losses from June through December. Construction of water and sampling equipment was not completed until late May.

The corn grain yields are presented in Table 2. The yields are closely correlated to rainfall and mulch cover. Rainfall was critical during the months of July, August, and September each year. Total rainfall during those periods was 11.35 inches in 1982, 2.4 inches in 1983 and 6.0 inches in 1984. The extra mulch from the rye cover conserved more moisture in both 1982 and 1984 to allow the corn grown under no-tillage to fill longer with no stress as compared to the other tillage methods. In 1984, a very dry June put considerable stress on all treatments early except the no-tillage treatment. In 1983, the rye was removed above the ground by cattle just prior to planting. With the extremely dry weather in 1983, none of the tillage treatments allowed high corn yields.

Table 2. Corn grain yields for four tillage systems.

	Bushels per Acre			
Tillage	1982	1983	1984	Ave.
No-Tillage	200 a	59 a	165 a	142 a
Chisel-Disk	164 b	69 a	105 c	113 b
Disk-Only	169 b	71 a	141 b	127 ab
Conventional	158 b	67 a	102 c	115 b

CONCLUSIONS

The no-tillage and disk-only treatments resulted in significantly lower soil losses than the chisel-disk and conventional tillage treatments. The lower corn yields from disk-only as compared to no-tillage was due in part to the extra moisture conservation provided by the rye mulch. There was no difference between chisel-disk and conventional as far as amount of soil loss or grain yields.