EROSION EVALUATION OF CONSERVATION TILLAGE

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Conservation tillage systems have been evaluated for effectiveness of erosion control on the North Mississippi Branch Experiment Station at Holly Springs, MS since 1956. The first erosion plots were used to evaluate "good" and "poor" management for pastures and corn. Since 1970, we have evaluated no-till and reduced-till for corn, soybeans, and soybean-wheat double-crop. Presently, we are evaluating conservation tillage for cotton on the erosion plots. This paper will discuss the results of these tests and will also mention other research on soil conservation that we have done on the station. A list of publications that fully explain our completed research is attached at the end of this paper.

Most of the research reviewed here was done on erosion plots 13.3 feet wide by 72.6 feet long located on 5% sloping land. The soils on the plots are predominately Providence (Typic Fragiudalfs).

In the no-till system, corn or soybeans were planted in a slot made by a small chisel following a fluted coulter which cut through surface residues. Fertilizer, placed in the bottom of the slot, was covered and separated from the seeds by a 2- to 3-inch layer of soil. A press wheel closed the slot opening. Broadcast pre-emerge and spot treatment post-emerge applications of herbicides controlled weeds during the growing season.

In the reduced-till system, corn or soybeans were planted no-till, but cultivated twice during the growing season. No-till wheat was broadcast in standing soybeans when soybean leaves started to drop. Conservation tillage was evaluated for both corn for grain and corn for silage. Recommended crop varieties, plant populations, planting dates, and fertilization rates were used for all treatments. Rows were spaced 40 inches apart, up and down the slope.

Runoff and soil loss estimates from 1970 to 1981 for soybeans, corn and wheat are given in Table 1. Values in the table are measured soil losses, adjusted to a common base of slope, soil and rainfall; Providence soil has a tolerable soil loss of 3 t/a·y. The conventional till treatment was used as a check, to compare with the conservation tillage treatments. Residue management on the conventional treatments was good. All the crop residue was shredded and spread after harvest; weeds were allowed to grow except during the crop growing season. Crop yields for the conservation tillage systems were about the same or higher than those on the conventional till plots.

No-till and reduced-till greatly reduced soil loss. Disturbance of cover by the corn cultivation in the reduced-till system only slightly increased soil loss. However, the cultivation in soybeans increased annual soil loss to 3.5 t/a, compared to 0.8 t/a for no-till which did not have the cultivation during the growing season. The same increased soil loss with greater tillage is seen for all crops.

The destruction of cover is a major factor contributing to increased soil loss following tillage. The reduced-till system has cultivation only during the corn and soybean growing season. However, the disturbance of surface cover by that tillage affects erosion during cultivation, and also during the remainder of the year. This effect is particularly evident for soybeans, where the reduced-till treatment soil loss of 3.5 t/a exceeded the tolerable amount for Providence soil.

Cover is also gained by weed management. The soil loss values given in Table 1 indicate a significant reduction of soil loss due to weed cover. This type cover is particularly important in the Southeast, where rainfall erosion occurs the year around and soil erosivity is highest during the cool, wet season of the year.

As expected, weeds are more evident in the treatments without tillage. The double crop treatments had few weeds due to year-around cover and chemical weed control. Weeds play an important part in soil conservation with corn grown for silage, since the crop provides good canopy cover only from June to August. Without weed cover, erosion from no-till corn silage is excessive; if the weeds that flourish from harvest until being chemically killed before planting are left undisturbed, soil loss from silage corn is relatively insignificant.

In general, conservation tillage conserves water by reducing runoff. This is particularily important with high summer temperatures of the Southeast and thin soils that have a shallow root zone and low water holding capacity.

Other erosion experiments have been completed in the last 10 years: Erosion from 7-inch rows for soybeans was about two-thirds that from 40-inch rows, but soybean yields were about the same for both spacings. The greater soil loss for the wide rows was attributed to cultivation for weed control and slower canopy cover development that left the soil more susceptible to erosion. Soybeans with 7-inch rows received no cultivation. Also, a system of alternating 16 and 24 inch rows for soybeans was evaluated. Erosion control effectiveness was good and crop yields were comparable to those from conventional tillage soybeans in 40-inch rows.

Several projects are underway on the erosion plots at the station. Preliminary results indicate reduced soil loss from cotton by the use of no till and reduced tillage. However, neither conservation system reduced soil loss below tolerable amounts. Therefore, we are adding a vetch cover crop to all treatments. One conclusion is that land used for cotton production is much more erodible than when used for corn or soybeans.

A project initiated in 1983 seeks to compare nutrient loss from fertilizer applied on the surface with that from fertilizer banded along corn rows. Erosion plots have been established to determine the long term effect of erosion on soil productivity. This project may take 10 to 12 years to complete.

In conclusion, we have learned that tillage must be reduced for erosion control. A large part of the tillage effect is because of disturbance or destruction of cover by the tillage. Keeping crop residue on the soil surface and removing weed cover only when essential for crop production are important requirements for an effective soil conservation system.

Table 1. Expected soil loss from corn, soybeans, and wheat using no-till, reduced-till and conventional tillage. Values computed for a 72.6-ft slope length, 5% slope, Providence soil, and rainfall R = 360.

	With Weeds		Without Weeds
Crop and Tillage System	Soil Loss+	Runoff	Soil Loss*
	tonsfacre	% of rainfall	tonsfacre
Corn grain, conventional till	7.2	31	8.1
Corn grain, no-till	0.4	28	0.8
Corn grain, reduced-till	0.6	18	1.2
Corn silage, conventional till	11.2	33	15.1
Corn silage, no-till	0.2	17	4.2
Soybeans, conventional till	8.3	42	9.3
Soybeans, no-till	0.6	30	0.8
Soybeans, reduced till	3.5	26	3.5
Soybeans-wheat, double crop:			
Soybeans-wheat, no-till	0.2	23	--
Soybeans-wheat, reduced till	1.0	30	1.0

+ Soil loss was computed from measured C factors.

* Soil loss was adjusted by analytically removing the effect of weeds.

List of Publications

1. McGregor, K. C., J. D. Greer, and G. E. Gurley. Erosion control with no-till cropping practices. Trans. ASAE, 18:918-920. 1975.

2. McGregor, K. C. C factors for no-till and conventional-till soybeans from plot data. Trans. ASAE, 21:1119-1122. 1978.

3. McGregor, K. C., J. D. Greer. Erosion control with no-till and reduced till corn for silage and grain. Trans. ASAE, 25:154-159. 1982.

4. McGregor, K. C. and C. K. Mutchler. C factors for no-till and reduced-till corn. Trans ASAE 26:785-788, 794. 1983.

5. Mutchler, C. K. and J. D. Greer. Reduced tillage for soybeans. ASAE Paper 83-2537, (Trans ASAE, In Press), 1983.