Erosion from Reduced-Till Cotton

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Erosion plots at the North Mississippi Branch Experiment Station have been used to evaluate the erosion control effectiveness of conservation tillage systems since 1956. Results from no-till and reduced-till for corn, soybeans, and soybeans-wheat double-crop were described in the 1984 Proceedings of the No-Tillage Conference (Mutchler and Johnson, 1984). In this paper, we will discuss the results of our evaluations using no-till, reduced-till, and conventional-till (control treatment) for cotton. A more complete discussion is given in Mutchler et al. (1985).

Procedures

The research reviewed here was done on erosion plots 13.3 by 72.6 feet located on 5-percent sloping land. The soils on the plots are predominantly Providence silt loams (Typic Fragiudalfs).

Conventional tillage was disk, chisel about 20 cm deep, disk and bed about 3 weeks before planting. The final tillage before planting was disk and spike-tooth harrow leaving the beds about 10 cm high. Weeds were controlled with preemerge herbicides and 3 cultivations. Fertilizer and liming rates were kept to levels recommended by soil testing.

No-till cotton was planted in a slot opened by a small chisel following a fluted coulter which cut through surface residues. Fertilizer was placed in the bottom of the slot and covered by soil under the cotton seed. The remainder of the slot was closed by a press wheel. Fertilizer and lime applications were the same as for the conventional till treatments. In addition to preemerge herbicides used for conventional till, a burn down herbicide was used for control of existing vegetation. Post-directed herbicides were used to control weeds during the crop growing season.

Reduced-till cotton was planted the same as no-till. The cotton was cultivated three times. Preemerge herbicides, fertilizer application, and liming rates were about the same as used for no-till. For all treatments, cotton stalks were shredded after harvest.

Results and Discussion

Data were collected from cotton tillage treatments studied during different periods of years since 1979 because the previous soybean tillage evaluation was not completed on all the erosion plots at the same time.

Rainfall during the experiment was 64, 55, 42, 62, and 58 inches for 1979 to 1983, respectively. Average annual rainfall for all treatments was higher than the long-term average of 52 inches.

The greatest amount of runoff was the conventional-till cotton after 11 years of conventional-till corn or soybeans. This treatment can be compared directly to the conventional-till cotton after 11 years of no-till corn or soybeans. The no-till history reduced runoff 13% from the continuous conventional-till cotton treatment which lost an average 26 in/yr rainfall as runoff. This large amount of runoff undoubtedly contributed to the greater soil loss from the continuous conventional-till treatment.

Annual soil losses adjusted to a common rainfall erosivity are given in Table 1. It is apparent that cotton production on our soils and slopes created a very erodible field condition. Soil loss from continuous cotton, conventionally-tilled, averaged over 30 t/ac*yr. In contrast, losses from conventional-till soybeans tested earlier were about 8 t/ac*yr and losses from corn were about 7 t/ac*yr, all under similar conditions (Mutchler and Greer, 1984; McGregor and Mutchler, 1983).

Table 1. Annual soil loss from treatments adjusted to normal rainfall year and measured cotton yield.

	Seed Cotton lb/acre	Soil Loss t/ac
No-till cotton		
After plot leveling (3-yr average)	1710	8.2
After no-till soybean-wheat (1-yr data)	1550	0.5
Reduced-till cotton		
After no-till fallow (3-yr average)	1910	4.7
After no-till soybean-wheat (2-yr average)	1910	4.8
Conventional-till cotton (3-yr average)		
After 11-yr no-till corn or soybeans	2040	17.5
After 11-yr conventional-till corn or soybeans	1690	32.9

The large effect of prior cropping history is seen in the results from the two no-till treatments. Soil loss from the 3-yr no-till should be lower than the data indicate because the surfaces of the plots were broken to level the plots before starting the cotton treatments. Losses from no-till cotton after soybean-wheat double-crop is lower than expected because of the extensive cover prior to initiating the cotton treatment.

Soil losses from the two reduced-till systems were about the same. In this case, residue cover from the preceding no-till fallow and no-till soybeans-wheat double-crop were not greatly different. Also, tillage during

the growing season in the reduced-till system served to equalize the effect of preceding residue cover.

The two conventional-till treatments give the most interesting comparison. The effect of the 11 years' previous no-till management reduced soil loss by about 47%. The record is probably too short to determine how long the no-till history effect will last.

Major significance of the information about cover is the destructive effect of tillage on cover. The no-till treatment had residue cover as low as 15% only during the period when canopy was highest, and cover was generally greater than 50% for the part of the year when canopy was not present. Cultivation in the reduced-till treatments resulted in much the same annual pattern of cover percentage, but reduced cover from that found for no-till. Conventional-till totally destroyed cover by primary tillage and left the surface with no residue protection during the tillage and early growth cropstages.

Crop yields from the two conventional-till treatments strongly suggest an effect of previous erosion on soil productivity. Crop yields from the conventional-till after no-till were about 20% higher than from the plots with a continuous conventional-till history. It is difficult with the short 3-year record to determine if this loss of productivity from excessive erosion is permanent or whether the higher yield from previous no-till management will disappear with time.

Conclusions

Soil loss from only the no-till cotton after no-till soybeans-wheat double-crop was below tolerable soil loss limits established by the Soil Conservation Service. Residue cover from cotton is less than from soybeans and corn, and the peculiar tap root system of the cotton plant contributes little to holding soil in place.

The beneficial effect of conservation tillage is seen in the comparison of plots conventionally tilled but with either an 11-year no-till or a conventional-till history. The no-till history affected erosion because soil loss from conventional-till cotton was reduced by 47%, runoff reduced to 35% of the rainfall compared with 48% from long term conventional tillage, and seed cotton yield increased about 20%.

References

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