# SOIL AND WATER CONSERVATION THROUGH DOUBLE CROPPING

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## INTRODUCTION

Excessive soil loss from row-cropped land due to water erosion continues to be a prominent problem in West Tennessee. Proven erosion control practices are often rejected by farmers on the basis of implementation and maintenance costs and incompatibility with machinery operation and existing field arrangement. The wind-deposited soils typifying the area are highly susceptible to erosion when vegetative cover is not present. Farmers have historically favored clean cultivation to insure establishment of adequate plant stands and assure effective weed control. Demand for soybeans has resulted in increased use of marginal land having steep slopes for row crop production using conventional tillage practices. As a result, soil loss frequently exceeds tolerable limits; and water quality in receiving streams is impaired by sediment and accompanying pollutants.

One of the most effective methods of controlling water erosion is to maintain either growing vegetation or plant residue on the soil surface. Vegetation tends to absorb the energy of falling raindrops, reduce the velocity of surface runoff, and increase infiltration capacity through improved soil structure. No-tillage cultural practices provide a scheme for engaging in row crop production while simultaneously maintaining a protective cover of vegetative material on the soil surface. Improvements in planting equipment and advances in herbicide and applicator technology are expected to allow more producers to realize the documented advantages of no-tillage cropping without excessive risk of poor stands and inadequate weed control. Currently about 100,000 acres of soybeans are no-till seeded annually in Tennessee; most of these plantings are in wheat stubble as part of a double crop program.

## SOIL AND WATER CONSERVATION STUDIES

Research involving double cropping of soybeans and wheat was initiated at the Milan Experiment Station in West Tennessee in 1963. Several area farmers were already employing the practice on a regular basis. To evaluate the conservation implications of several cropping and management practices, two watersheds were instrumented to monitor rainfall and runoff. Field 8 contained 9.3 acres with an average slope of two percent. Predominant soils were Calloway and Henry silt loams. Field 9 initially consisted of 36 acres with about two percent average slope. In September 1975, the field was graded to an average slope of about 1.2 percent and diversions were installed, reducing the watershed area to 28 acres. Collins and Loring silt loams were the predominant soil types.

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Seasonal distribution of rainfall and runoff rates and volumes on Field 8 is shown in Figure 1. For the 12-year period of record, the maximum rainfall intensity and peak rate of runoff occurred during the period containing the months of April through June. These events thus occurred when soil under conventional cultivation was most vulnerable to soil loss as particles loosened during seedbed preparation were readily available for transport in runoff water. The volume of runoff, in percentage of annual average, was also greatest during this three-month period. While about half of the annual rainfall occurred during the first six months of the year, 61.4 percent of the total runoff occurred in these months. Average annual surface runoff from the watershed over the period of record was 32 percent of the rainfall volume.

Table 1 shows rainfall, runoff, and sediment yield from Fields 8 and 9 €or selected storms. Crops were soybeans, either produced with conventional cultivation or no-till planted in wheat stubble in a double crop program. The selected storms occurred at times when greatest soil loss differences between the two systems would be expected. Sediment yield, as used here, refers to suspended sediment measured at the outlets of grassed waterways which carried surface runoff from the two fields. Some of the soil eroded by raindrops and surface runoff would have been redeposited at points lower in the fields and would not have reached the monitoring station during a given storm. Consequently, actual soil erosion on the field would have been greater than that indicated by sediment yield.

Field 8 was conventionally tilled in 1974 and double cropped in 1975, To illustrate the advantage of vegetative cover, compare the storms occurring June 10, 1974 and April 30, 1975. Note that, for similar antecedent conditions, highest sediment yields usually correspond to highest rates and volumes of rainfall and runoff. The rainfall intensity of the 1975 storm was almost three times that of the 1974 event, and total rainfall volume was over five times as great. Yet the 1974 storm, occurring when the field was cleanly cultivated, produced three times as much sediment as the 1975 storm. Total rainfall between the storm of April 30, 1975 and that of December 15, 1975 was 30.1 inches. However, there was only 1.0 inch of runoff and sediment yields were quite low. This was attributed primarily to the presence of vegetation and stubble residue associated with the double cropping system.

Field 8 was disked on May 5, 1976 to prepare a conventional seedbed. The first storm thereafter occurred on May 13. The 2.82-inch storm (1.20 inches per hour maximum intensity) resulted in a sediment yield averaging 181 pounds per acre. A 2.53-inch rain fell on the cleanly cultivated field on June 2, 1976; and resulting runoff was 1.58 inches. Not only was sediment yield high at 141 pounds per acre, but infiltration was less than *38* percent.

The advantage of no-till practices for erosion control is vividly illustrated by the three storm events shown for Field 9 for 1976. Total rainfall and runoff during the March 5 storm were not very great (1.25 and 0.32 inches, respectively). However, the high rainfall intensity (4.68 inches per hour), coupled with the sparse vegetative cover provided by the wheat at that time, resulthd in a sediment yield of 137 pounds per acre. On April 24, when the rainfall rate and quantity were less and the wheat growth was considerably greater, the sediment yield was only 7 pounds per acre. When the storm of

July 14 occurred, the wheat had been harvested and soybeans had been planted in the stubble. Due to the excellent ground cover on undisturbed soil, the runoff of 0.02 inches was only one percent of the rainfall and sediment yield was only 3 pounds per acre.

Field 9 contained a mixture of conventionally tilled and no-till soybeans in 1977 and 1978. Table 1 shows that more soil was lost in 1978 when a higher percentage of the area was conventionally tilled. Observation of runoff water entering the grassed waterway during the spring and summer months indicated that virtually all of the soil erosion which occurred was on the conventionally tilled areas.

## PERFORMANCE OF DOUBLE CROP SOYBEANS

A total of 310 acres of double crop soybeans were grown in production fields at Milan between 1971 and 1979 as indicated in Table 2. Production practices changed from year to year as improved varieties, herbicides, and field machines were developed and became available. The most promising practices indicated by replicated experiments conducted simultaneously were applied in the production fields. Mean per-acre yield was 32 bushels over the nine-year period. Yields of single crop soybeans in similar production fields averaged 36 bushels per acre. Thus, yields of no-till double crop soybeans averaged 11 percent below yields of single crop beans grown with conventional tillage.

Several researchers have noted that row spacing in stubble planted soybeans was more important than in conventional plantings. Thus, five soybean varieties were evaluated from 1974 through 1976 in rows spaced 40 and 20 inches apart planted no-till in wheat stubble. Table 3 shows that a positive yield response to the closer row spacing was obtained each year. The average response of the five varieties to the closer row spacing was about 5 bushels per acre yield increase. There was no significant variety/row spacing interaction in any year.

. Performance of four soybean varieties was evaluated from 1977 through 1979 in rows spaced 10 and 20 inches apart. Plantings were no-tillage immediately following wheat harvest. Soybeans in the 10-inch rows yielded an average of three bushels per acre more than plantings in 20-inch rows as shown in Table 4. However, the yield response was significant in only one year, 1977. The overall low yields observed in 1977 were attributed to severe drought conditions. The higher production field yields in 1977, shown in Table 2, resulted from plantings made after the severe drought conditions had ended. As in the previous row spacing study, there was no variety/row spacing interaction in any of the three years.

Plantings in narrow rows may help reduce soil erosion as well as increase yield. The plant canopy will tend to absorb most of the raindrop impact energy, and the additional plant material will physically restrain the soil

Date of planting studies have indicated that planting after June 1 results in reduced soybean yields. As indicated in Table 1, production fields planted in stubble were never seeded before mid-June. Consideration is being given to seeding soybeans in green wheat to overcome the penalty of late seeding inherent with stubble planting systems. Performance of soybeans grown in five cropping systems, including seeding in green wheat, was compared at Milan from 1977 to 1979. The cultural practices are described and average annual yields are given in Table 5. Recall that drought conditions existed at the time of planting in 1977 and continued for several days. Seeding in green wheat did not result in increased yields over stubble planting. Soil moisture content at planting was observed to be critical for beans seeded aerially if adequate stands were to be established. Only fields relatively free of weeds lend themselves to seeding in the growing wheat.

## SUMMARY

No-till planting in stubble is an effective practice for reducing soil loss by water erosion. For a 12-year period of record, maximum rainfall intensity apd peak rate of runoff occurred during the months of April through June. These months include the period of concentrated seedbed preparation and planting under a conventional tillage system; and losses of unprotected, freshly tilled soil may be large.

Yields of double crop soybeans stubble planted in wheat averaged 11 percent below those of single crop soybeans in conventional seedbeds. Average yields of double crop beans were increased by five bushels per acre when row spacing was reduced from 40 to 20 inches. Seeding in green wheat did not produce a yield advantage over planting in stubble following wheat harvest.

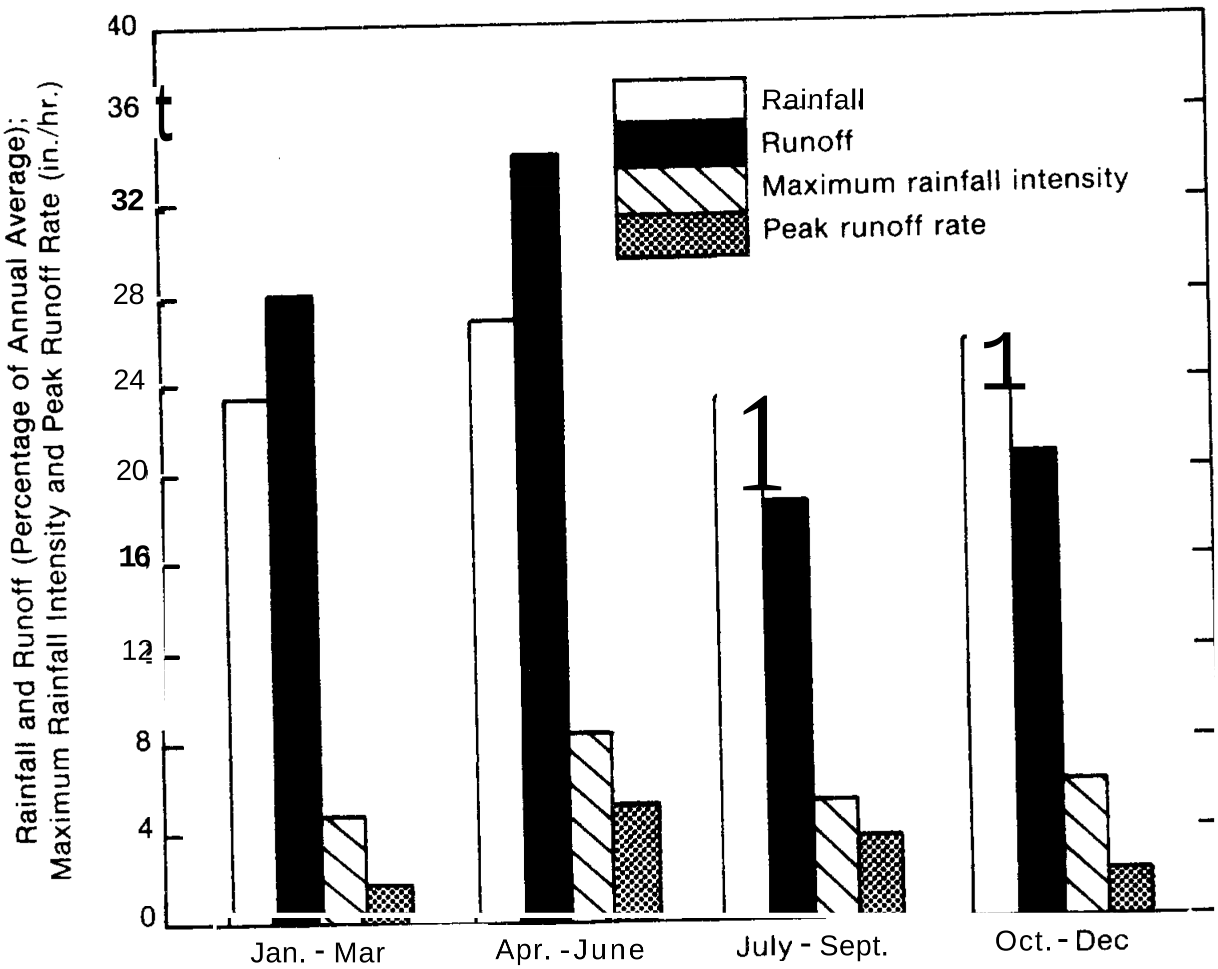


Figure 1. Seasonal distribution of rainfall and runoff on Field 8 at Milan, Tennessee, 1966-1977.

Table 1. Rainfall, runoff, and sediment yield during selected events and associated with conventional tillage (CT) and no-till (NT) soybean production on two fields at Milan Experiment Station

| Field | Date | Tillage | Crop | Rainfall Max. Rate (in./hr) | Rainfall Total (in.) | Runoff Peak Rate (in./hr) | Runoff Total (in.) | Sediment Yield (lb/ac) |
|---|---|---|---|---|---|---|---|---|
| | 5/15/74 | | Soybeans, | 1.44 | 0.60 | 0.29 | 0.31 | 6 |
| 8 | 6/10/74 | CT | No Winter | 0.72 | 0.27 | 0.12 | 0.23 | 10 |
| | 7/4/74 | | Cover | 3.57 | 0.97 | 0.25 | 0.31 | 33 |
| | 3/22/75 | | Double | 2.64 | 0.83 | 0.45 | 0.67 | 10 |
| 8 | 4/30/75 | NT | Crop, Soy- | 2.00 | 1.43 | 0.34 | 0.69 | 3 |
| | 12/15/75 | | beans and | 0.80 | 1.48 | 0.05 | 0.07 | 0.4 |
| | | | Wheat | | | | | |
| | 3/5/76 | | Double | 4.68 | 1.25 | 0.32 | 0.32 | 137 |
| 9 | 4/24/76 | NT | Crop, Soy- | 2.40 | 0.90 | 0.12 | 0.11 | 7 |
| | 7/14/76 | | beans and | 1.60 | 1.60 | 0.02 | 0.02 | 3 |
| | | | Wheat | | | | | |
| | 7/11/77 | 90% NT | Soybeans | 4.27 | 0.70 | 0.12 | 0.13 | 2 |
| 9 | 8/14/77 | | and Wheat | 0.90 | 0.80 | 0.02 | 0.07 | 2 |
| | 9/24/77 | 10% CT | Soybeans | 2.07 | 1.73 | 0.06 | 0.27 | 10 |
| | 1/9/78 | 90% CT | Soybeans | 2.28 | 4.14 | 0.47 | 1.74 | 71 |
| 9 | 5/8/78 | | | 2.28 | 1.15 | 0.29 | 0.50 | 86 |
| | 6/21/78 | 10% NT | Soybeans and wheat | 4.30 | 0.80 | 0.41 | 0.30 | 101 |

Table 2. Performance of soybeans planted no-till in wheat stubble at Milan Experiment Station from 1971 to 1979

| Year | Planting Date | No. of Acres | Mean Yield, Bu/A |
|---|---|---|---|
| 1971 | 6/15-18 | 11 | 36 |
| 1972 | 6/14-17 | 28 | 24 |
| 1973 | 6/19 | 5 | 41 |
| 1974 | 6/20 | 28 | 28 |
| 1975 | 6/18-23 | 47 | 30 |
| 1976 | 6/14-22 | 82 | 27 |
| 1977 | 7/5 | 32 | 24 |
| 1978 | 6/26 | 18 | 34 |
| 1979 | 6/14-16 | 59 | 42 |

Table 3. Mean yields of five soybean varieties planted no-till with row spacings of 20 and 40 inches in wheat stubble at Milan Experiment Station

| Row Spacing, inches | Mean Yield, Bushels per Acre | | | |
|---|---|---|---|---|
| | 1974 | 1975 | 1976 | Avg. |
| 40 | 35 | 18 | 17 | 23 |
| 20 | 38 | 26 | 21 | 28 |

Table 4. Mean yields of four soybean varieties planted no-till with row spacings of 10 and 20 inches in wheat stubble at Milan Experiment Station

| Row Spacing, inches | Mean Yield, Bushels per Acre | | | |
|---|---|---|---|---|
| | 1977 | 1978 | 1979 | |
| 20 | 8 | 29 | 31 | 23 |
| 10 | 14 | 30 | 34 | 26 |

Table 5. Performance of soybeans grown in five cropping systems at Milan Experiment Station from 1977 to 1979

| Cultural Practice | Mean Yield (Bu/A) | | | |
|---|---|---|---|---|
| | 1977 | 1978 | 1979 | Avg. |
| 1. Single crop, conventional seedbed | 56 | 39 | 44 | 46 |
| 2. No-till in wheat stubble | 7 | 34 | 44 | 28 |
| 3. Conventional seedbed after wheat harvest | 4 | 37 | 41 | 27 |
| 4. Drilled in green wheat before heading | 6 | 28 | 46 | 26 |
| 5. Simulated aerial seeding in green wheat | 0 | 14 | 36 | 17 |