Soil Erosion from Tillage Systems Used in Soybean and Corn Residues

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ABSTRACT

RAINFALL simulation techniques were used to compare soil losses from various tillage systems used on plots where corn and soybeans had been grown the previous season. The two year study was conducted on a silty clay loam soil with a 5% slope and on a silt loam soil with a 10% slope. Five tillage treatments, ranging from a moldboard plow system to no-till, were evaluated for each residue at each site. Tillage and planting operations were conducted up-and-down hill on replicated plots. Total soil loss following 63.5 mm of rainfall applied during a 60 min period averaged more than 40% greater from the soybean residue plots than from the corn residue plots for equivalent tillage treatments on the 5% slope. For the 10% slope, the soil loss ranged from 50% to about 12 times greater for the soybean residue. Equivalent tillage treatments in soybean residue had about 40% less surface cover relative to corn residue, which contributed to the difference in soil erosion. Relationships between residue cover and soil loss showed that a 20% cover of either soybean or corn residue generally reduced soil loss by at least 50% of that which occurred from cleanly-tilled soils. Several tillage systems left more than a 20% cover in corn residue. Only no-till consistently left more than a 20% residue cover following soybeans.

INTRODUCTION

Soil erosion and subsequent sedimentation have been identified as major water quality problems in Nebraska (NNRC, 1979). Annual Nebraska erosion losses caused by water runoff from agricultural land are estimated at more than 127 million metric tons. About 75% of these losses from row crop production areas.

Much of the cropland in the midwestern United States is farmed continuously with corn or corn-soybean rotations. In Nebraska, soybean production has grown to a record of nearly one million hectares in 1982 (NCLRS, 1983), nearly double the area in 1975, and has contributed to the erosion problem. Additionally, nearly 60% of the soybeans grown in 1982 were produced on soils having average annual erosion losses exceeding 20 t/ha. Several studies (Laflen and Colvin, 1982; Laflen and Moldenhauer, 1979; Siemens and Oschwald, 1978) have shown that soil erosion following soybeans can be more than double that following corn.

Tillage and planting systems which leave a protective cover of crop residue on the soil surface have been shown to reduce soil losses, and are among the least costly erosion control practices (Nicol et al., 1974; Seay, 1970). Leaving as little as 20% of the soil surface covered with corn residue reduced erosion by 50% of that which occurred from a cleanly-tilled, residue-free surface (Dickey et al., 1984). Similarly, a no-till system which left a 95% cover of wheat residue, reduced erosion by 99.8% of that which occurred from a moldboard plow system (Dickey et al., 1983).

Following harvest of either corn or soybeans, the soil cover often exceeds 90%. However, soybean residue tends to be fragile and easily destroyed by tillage operations (Erbach, 1982; Colvin et al., 1980). The fragile residue combined with the loose, mellow soil that generally occurs following soybeans contributes to differences between erosion from soybean and corn production areas.

The primary objective of this research was to evaluate soil erosion and runoff during the period between spring planting and crop canopy establishment for selected tillage systems used in soybean and corn residues.

METHODOLOGY

Research was conducted at two locations in order to obtain soil erosion information from different soil series and slopes. One location was at the University of Nebraska Rogers Memorial Farm in Lancaster County, 18 km east of Lincoln, Nebraska. The silty clay loam soil evaluated was within the Wymore Series (Aquic Argiudoll, fine, montmorillonitic, mesic) on a 5% slope (SCS, 1980). The other site was at the University of Nebraska Northeast Station in Dixon County near Concord, Nebraska. The silt loam soil at this site was in the Nora Series (Udic Haplustoll, fine-silty, mixed, mesic) on a 10% slope (SCS, 1978). The Soil Conservation Service describes the soils at both locations as friable with soil erosion from water being the main hazard.

The experimental design at both locations was a randomized complete block within residue type with three replications for each tillage treatment. Individual tillage plots were 9.1 m wide and 22.9 m long. Plots were planted up-and-down hill and positioned to obtain nearly equivalent slopes.

Tillage treatments on the continuous corn plots were initiated in the spring of 1980 at the Rogers Farm and in the fall of 1980 at the Northeast Station. Soybeans were grown in a corn-soybean rotation. Prior to planting soybeans, all plot areas at the Rogers Farm were disked

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twice, while those at the Northeast Station were rotary tilled. Tillage plots in the soybean residue were established following soybean harvest in the fall of 1981 at the Rogers Farm and in the fall of 1982 at the Northeast Station.

Tillage methods evaluated in both soybean and corn residues at both locations were the moldboard plow, chisel plow, disk and no-till systems. At the Northeast Station, the disk treatment used in both residues had two disking operations while a single disking was used at the Rogers Farm. Additionally, strip rotary-till and till-plant systems were used in both residues at the Northeast Station. Specific field operations, in order, within each tillage system were:

Moldboard Plow - moldboard plow, disk, disk, plant.

Chisel Plow - chisel plow, disk, plant.

Disk - disk, disk, plant (Northeast Station) disk, plant (Rogers Farm).

No-Till - slot-plant into old row.

Strip Rotary - Till - rotary-till, plant (Northeast Station only).

Till-Plant - till-plant into old row (not used on soybean residue at Rogers Farm).

To obtain more observations in soybean residue, three additional tillage treatments were used at the Rogers Farm. These treatments were: (a) field cultivate, plant; (b) blade plow, plant; and (c) disk, disk, plant. Similarly a single disk treatment was used in soybean residue at the Northeast Station. All field operations were performed in the spring, except for moldboard and chisel plowing of corn residue at the Rogers Farm.

Standard production implements were used for all field operations. Residues had been distributed behind the combine with a straw spreader attachment. Tillage depths were 20 cm for the moldboard plow, 25 cm for the chisel plow and 15 cm for the initial disking. Disking depth was 10 cm for final seedbed preparation. The rotary tiller was operated 13 cm deep and adjusted to till a strip 25 cm wide, centered on the row. The field cultivator (18 cm sweeps) and balde plow (1.5 m sweeps) were operated 10 cm deep. Continuous corn plots at both sites were fertilized prior to spring tillage with a knife-type anhydrous ammonia applicator operated 17 cm deep. The corn residue was shredded on all plots at the Northeast Station.

A model 800 International Harvester* planter with rippled coulters was used on all plots at the Rogers Farm. At the Northeast Station, a 6-row Buffalo All-Flex Till-Planter (25 cm sweep) model 4500 was used for the till-plant plots. All other plots were planted with a 4-row John Deere model 7100 with rippled coulters. Planting depth was 5 cm and row spacing was 76 cm in all plots. Planting into the corn and soybean residue plots occurred on the same date within location.

Soil erosion was measured, after planting and prior to the establishment of appreciable canopy cover, from subplots, 3.0, m wide and 10.7 m long, located within each of the larger tillage plots. A rotating boom rainfall simulator (Swanson, 1965) was used to apply water at a rate of 63.5 mm/h until runoff had been at equilibrium for approximately 15 min. Equilibrium conditions were usually reached 30 to 45 min after rainfall initiation. The rainfall simulator, applying 63.5 mm of rainfall in an hour, has a rainfall erosion index (EI) similar to a single storm event expected to occur once every two years in eastern Nebraska (Wischmeier and Smith, 1978). Every three minutes, the runoff rate was determined from gravimetric measurements and a 0.5 L runoff sample was collected to determine sediment concentration. Rainfall simulations took place May 18 through 20, 1982 at the Rogers Farm and May 24 through 31, 1983 at the Northeast Station.

The percentage of soil surface covered with residue was measured at the time of rainfall simulation using the photographic grid method described by Laflen et al. (1978). Residue was collected from a one square meter area within each tillage plot at the Rogers Farm and oven dried to determine mass.

*Mention of brand names is for descriptive purposes only, endorsement is not implied.

TABLE 1. SOIL SURFACE RESIDUE COVER FOR VARIOUS TILLAGE SYSTEMS USED IN SOYBEAN AND CORN RESIDUES.

Tillage system	Soil surface cover,† %			
	5% slope silty clay loam		10% slope silt loam	
	Soybean residue	Corn residue	Soybean residue	Corn residue
Plow, disk, disk, plant	1.6a‡ *	3.8a	2.0a	3.7a
Chisel, disk, plant	7.2ab *	12.6ab	10.6ab *	21.9bc
Disk, disk, plant	5.4ab	—	10.6ab *	26.8c
Disk, plant	8.5b	14.8ab	14.8ab	—
No-till plant	27.1d	39.1c	48.4c	56.0e
Till-plant	—	21.4b	23.9b *	45.9d
Strip rotary-till, plant	—	—	11.6ab	18.1b
Field cultivate, plant	18.0c	—	—	—
Blade plow, plant	24.5d	—	—	—

*Percent residue cover within slope and soil type was significantly different (Duncan's Multiple Range Test, 10% level) between corn and soybean residues for these systems only.

†Cover measurements taken after tillage and planting but prior to rainfall simulation.

‡Values within each column having the same superscript were not significantly different (Duncan's Multiple Range Test, 10% level).

RESULTS AND DISCUSSION

Soil Surface Cover

The percentage of soil surface covered with soybean residue ranged from 1.6 to 48.4%, whereas the range for corn residue was 3.7 to 56.0% (Table 1). Residue cover for both soybeans and corn tended to be greater at the Northeast Station. This difference was attributed to crop yield differences between locations. The corn grain yield in the year prior to rainfall simulation was 4,190 kg/ha at the Rogers Farm and 6,830 kg/ha at the Northeast Station. Similarly, the soybean grain yield was 1,820 and 2,390 kg/ha at the Rogers Farm and Northeast Station, respectively.

Without exception, the moldboard plow treatments had the least residue cover and the no-till treatments had the most. The chisel and disk treatments had similar soil surface covers within residue types, averaging 7.9 and 13.7 percent for soybeans and corn, respectively, at the Rogers Farm. Soybean residue covers averaged 10.6% for the chisel and disk treatments, whereas the corn residue cover averaged 24.4% at the Northeast Station. Tillage treatments following soybeans at the Rogers Farm and Northeast Station averaged 43.5 and 42.6% less residue cover, respectively, than identical tillage treatments used following corn.

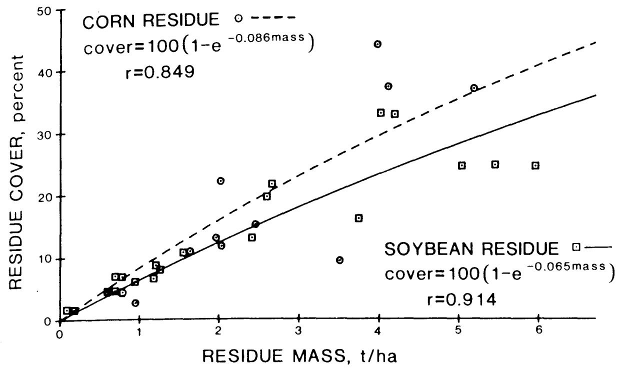

Fig. 1—Relationships between percent residue cover and residue mass for soybean and corn residues.

Fig. 1 illustrates relationships between surface cover and residue mass at the time of rainfall simulation (after tillage and planting) at the Rogers Farm. The residue mass was almost exclusively weathered stem material. The form of the relationships for soybean and corn residues are similar to those derived by Gregory (1982). Percent surface cover rather than residue mass per unit area was used to develop erosion-residue relationships because distribution of residue on the soil surface is the more fundamental factor influencing soil erosion.

Soil Erosion

Cumulative soil losses from the tillage treatments used in soybean and corn residues at the Rogers Farm are shown in Fig. 2. Each curve represents the average of three replications. Without exception, the no-till treatment at both locations had the least amount of soil loss for each residue. With soybean residue, no statistical difference between the double disk and moldboard plow treatment was measured at the 10% significance level in the cumulative soil loss following 50 mm of simulated rainfall at either location (Table 2).

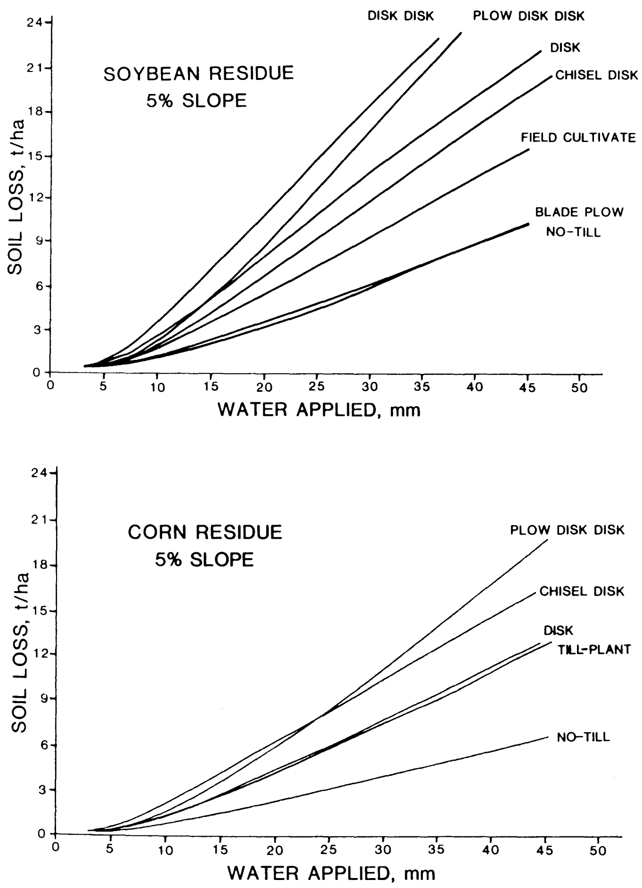

Fig. 2—Cumulative soil loss vs. water application for tillage treatments used in soybean and corn residues on a silty clay loam soil.

TABLE 2. SOIL LOSS AND EROSION RATE FOR VARIOUS TILLAGE SYSTEMS USED IN SOYBEAN AND CORN RESIDUES.

Tillage systems	Soil loss,† t/ha		Erosion rate,‡ t/(ha·h)	
	Soybean residue	Corn residue	Soybean residue	Corn residue
5% slope silty clay loam				
Plow, disk, disk, plant	32.0a§	22.6a	48.0a	* 35.6a
Chisel, disk, plant	21.6bc	18.7ab	27.8cd	24.1b
Disk, disk, plant	32.1a	—	40.9b	—
Disk, plant	23.8b	* 14.8b	31.1c	* 23.0b
No-till plant	11.3d	7.2c	16.9e	12.2c
Till-plant	—	14.5b	—	22.7b
Field cultivate, plant	17.1cd	—	23.2de	—
Blade plow, plant	11.5d	—	18.1e	—
10% slope silt loam				
Plow, disk, disk, plant	13.0ab	6.8a	36.2ab	25.8a
Chisel, disk, plant	6.0c	1.5c	18.1bc	7.8d
Disk, disk, plant	10.1abc	* 2.3c	30.9abc	* 10.2c
Disk, plant	6.7bc	—	19.4bc	—
No-till plant	5.1c	* 0.4c	14.4c	* 1.1e
Till-plant	14.2a	3.2bc	42.1a	9.6c
Strip rotary-till, plant	7.8abc	5.2ab	24.3abc	14.1b

*Soil loss and/or erosion rate within slope and soil type was significantly different (Duncan's Multiple Range Test, 10% level) between corn and soybean residues for these systems only.
†Cumulative soil loss after 50 mm water applied.
‡Erosion rate after reaching equilibrium runoff conditions.
§ Values within each column having the same superscrips were not significantly different (Duncan's Multiple Range Test, 10% level) within slope and soil type.

The cumulative soil loss within equivalent tillage treatments was always greater following soybeans than following corn. Averaged across tillage treatments, the erosion from soybean residue plots was 44% greater than from corn residue plots on the silty clay loam soil with a 5% slope (Table 2). This result closely parallels a 50% difference in erosion reported by Laflen and Colvin (1982). Soil loss difference between soybean and corn residues were more striking on the silt loam soil with a 10% slope. Averaged across tillage treatments, the erosion following soybeans was more than 3.5 times greater than following corn. Similarly, Siemens and Oschwald (1978) reported soil losses about three times greater following soybeans than following corn.

Within residue type, the no-till treatment was very effective in reducing erosion. At the Rogers Farm, no-till reduced soil loss by 64% in soybean residue and 68% in corn residue as compared to the losses from the moldboard plow system. Similarly, at the Northeast Station, no-till reduced erosion by 61 and 94% following soybeans and corn, respectively.

For a more complete evaluation of soil losses from the various tillage systems and residue types, erosion rates were determined for the period after equilibrium runoff conditions were established (Table 2). Similar to the cumulative soil loss data, the erosion rates following soybeans were considerably greater than the rates following corn for identical tillage systems. The no-till treatment had the lowest erosion rate and the moldboard plow treatment tended to have the highest rate. Within residue type, the chisel and disk treatments tended to have similar erosion rates which were about 35 and 50% lower than that of the moldboard plow treatment at the Rogers Farm and Northeast Station, respectively.

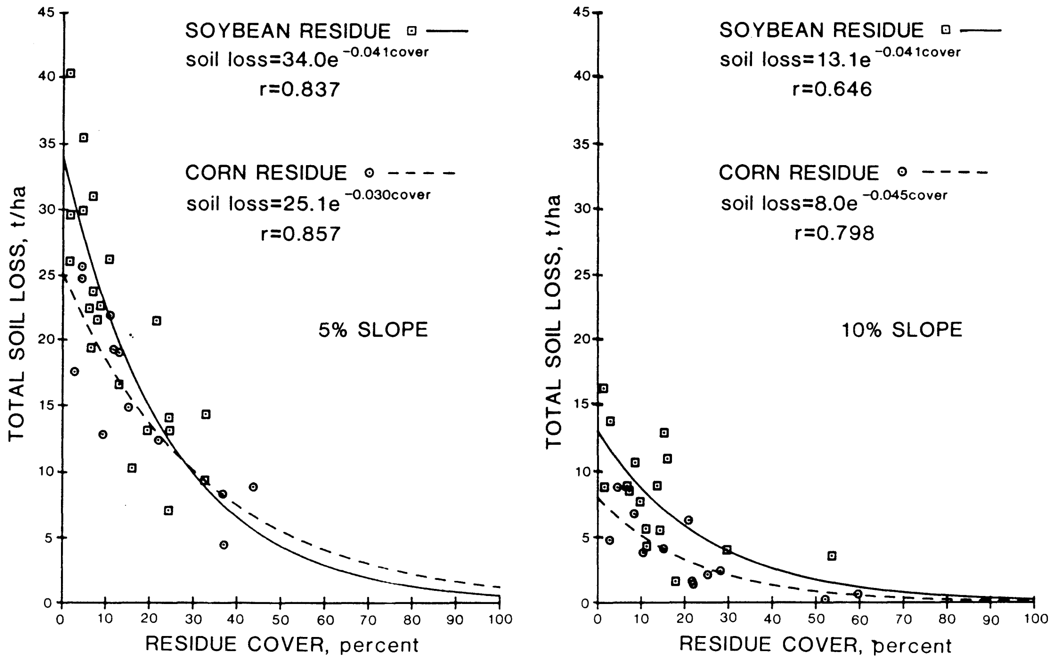

Fig. 3—Relationships between soil loss at 50 mm of water applied and residue cover for soybean and corn residues.

The magnitude of the soil loss from the silty clay loam soil on a 5% slope at the Rogers Farm was greater than the loss from the silt loam soil on a 10% slope at the Northeast Station. A partial explanation for this difference was because the soil erodibility factor (K) for the silty clay loam soil is 0.37, whereas the K factor for the silt loam soil is 0.32 (SCS, 1978 and 1980). Secondly, the residue cover for equivalent tillage treatments was greater at the Northeast Station than at the Rogers Farm, thus offering more erosion control potential. However, valid comparisons between the soils and slopes cannot be made since the measurements were made in different years at each location.

Soil Erosion and Surface Cover

The data on crop residue cover and total soil loss after 50 mm of water application were analyzed using nonlinear curve fitting techniques. The equation,

$$\text{Erosion} = Ae^{B \cdot RC} \quad \ldots\ldots\ldots\ldots\ldots\ldots [1]$$

where A and B are constants and RC is the percent surface cover, was fitted to minimize the residual sum of squares of the untransformed data (Fig. 3). The data were separated by site because of different soil types and slopes. The till-plant treatment was not included in this analysis because the residue was in strips between cleanly-tilled rows and thus was not uniformly distributed.

For the tilllage treatments used at the Rogers Farm, the equations developed had correlation coefficients (r) of 0.84 and 0.86 for soybean and corn residues, respectively. At the Northeast Station, the r values were 0.65 for soybeans and 0.80 for corn. The value of the exponent, B, following soybeans was -0.041 at both the Rogers Farm and the Northeast Station. For corn residue, the B values were -0.030 and -0.045 for the Rogers Farm and Northeast Station, respectively. These B values are all within the range of -0.03 to -0.07 reported for row cropped land (Laflen et al., 1980; Laflen and Colvin, 1981; Dickey et al., 1984).

The intercept value A, which indicates the soil loss with no residue cover, was 34.0 t/ha following soybeans and 25.1 t/ha following corn at the Rogers Farm. Thus, for a cleanly-tilled, residue-free soil condition, the erosion following soybeans was 35% greater than following corn on the silty clay loam soil having a 5 percent slope. Similarly, at the Northeast Station, the soil loss following soybeans with no residue cover was 13.1 t/ha or 64% greater than the 8.0 t/ha following corn.

Definitions of conservation tillage indicate that at least 20 to 30% of the soil surface should remain covered with residue after planting (Dickey et al., 1984; CTIC, 1984). By using the minimum suggested residue cover of 20% and the equations relating soil erosion to residue cover (Fig. 3), the magnitude of erosion reduction can be established. For instance, conservation tillage systems used in soybean residue at either location would have soil losses at least 52% less than the losses expected to occur from a tillage system having a 2% residue cover. Similarly, following corn production, a 20% residue cover would reduce erosion by 38 and 51% of that occurring from a moldboard plow or other system leaving a 4% residue cover at the Rogers Farm and Northeast Station, respectively. Thus, in three of the four situations, a 20% cover of either corn or soybean residue would result in more than a 50% reduction in the erosion occurring from a nearly residue-free condition.

Several tillage systems are available for use following corn production which will leave the 20% minimum residue cover. However, only the no-till treatment consistently left more than a 20% surface cover in soybean residue (Table 1). Even though the average soybean cover for the blade plow and till-plant treatments were about 25%, not all plots were consistently above the 20% criterion. Any tillage system involving a disking operation in soybean residue did not leave enough residue cover to realistically be considered conservation tillage.

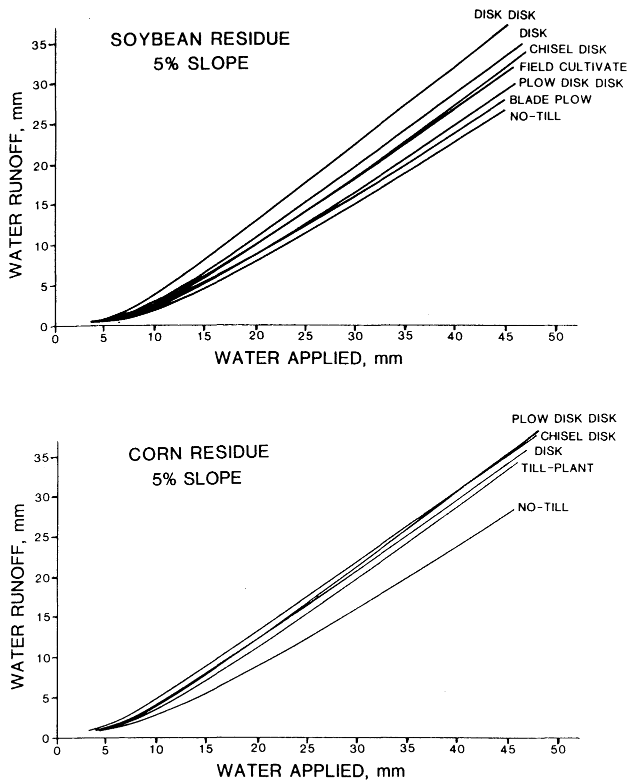

Fig. 4—Cumulative runoff vs. water application for tillage treatments used in soybean and corn residues on a silty clay loam soil.

TABLE 3. MEASURED RUNOFF AND RUNOFF RATE FOR VARIOUS TILLAGE SYSTEMS USED IN SOYBEAN AND CORN RESIDUES.

Tillage system	Runoff,† mm		Runoff Rate,‡ mm/h	
	Soybean residue	Corn residue	Soybean residue	Corn residue
5% slope silty clay loam				
Plow, disk, disk, plant	33.3bcd§*	40.4a	54.4bcd	* 60.0a
Chisel, disk, plant	36.6bc	40.1a	58.9ab	55.4a
Disk, disk, plant	41.7a	—	62.0a	—
Disk, plant	37.9ab	38.9a	55.9bc	57.4a
No-till plant	30.5d	32.0b	50.0d	54.9a
Till-plant	—	38.4a	—	59.9a
Field cultivate, plant	35.6bcd	—	54.9bcd	—
Blade plow, plant	32.0cd	—	52.1cd	—
10% slope silt loam				
Plow, disk, disk, plant	11.7a	7.9ab	34.0a	29.5a
Chisel, disk, plant	11.4a	4.6b	29.0a	20.3ab
Disk, disk, plant	11.9a	6.1ab	35.6a	24.9ab
Disk, plant	9.1a	—	25.9a	—
No-till plant	12.5a	7.9ab	32.5a	19.6b
Till-plant	10.7a	7.6ab	30.5a	21.8ab
Strip rotary-till, plant	10.9a	10.4a	31.2a	29.5a

*Runoff and/or runoff rate within slope and soil type was significantly different (Duncan's Multiple Range Test, 10% level) between corn and soybean residues for these systems only.
†Total runoff after 50 mm water applied.
‡Runoff rate after reaching equilibrium runoff conditions.
§Values within each column having the same superscrips were not significantly different (Duncan's Multiple Range Test, 10% level) within slope and soil type.

Runoff

The cumulative runoff from the various tillage treatments used following soybeans and corn at the Rogers Farm is shown in Fig. 4. The magnitude of runoff from the silt loam soil on a 10% slope was considerably less than for the silty clay loam soil on a 5% slope (Table 3). The measured saturated infiltration rate, averaged across tillage treatments and residue type, was 7.2 mm/h for the silty clay loam soil and 35.5 mm/h for the silt loam soil. This assumed that infiltration was equal to the difference between rainfall application rate and runoff rate after reaching equilibrium. The reported permeability for the silty clay loam soil ranges from 5 to 15 mm/h whereas the permeability for the silt loam ranges from 15 to 50 mm/h (SCS, 1978 and 1980).

Although few statistical differences were measured in either runoff or runoff rate at the Rogers Farm, the no-till treatment had the least cumulative runoff following 50 mm of water application. For corn residue, the runoff from no-till was statistically less than all other treatments. At the Northeast Station, the chisel treatment had the least runoff in corn residue while the single disk treatment had the least following soybeans. There was a trend toward less runoff and lower runoff rates following soybeans than following corn at the Rogers Farm. The opposite trend was observed at the Northeast Station.

Sediment Concentration

Sediment concentrations in the runoff during rainfall simulation at the Rogers Farm are illustrated in Fig. 5. Results from the Northeast Station were similar. The sediment concentration tended to increase as the rate of runoff increased, until an equilibrium condition was obtained, usually after 25 mm of water application. As

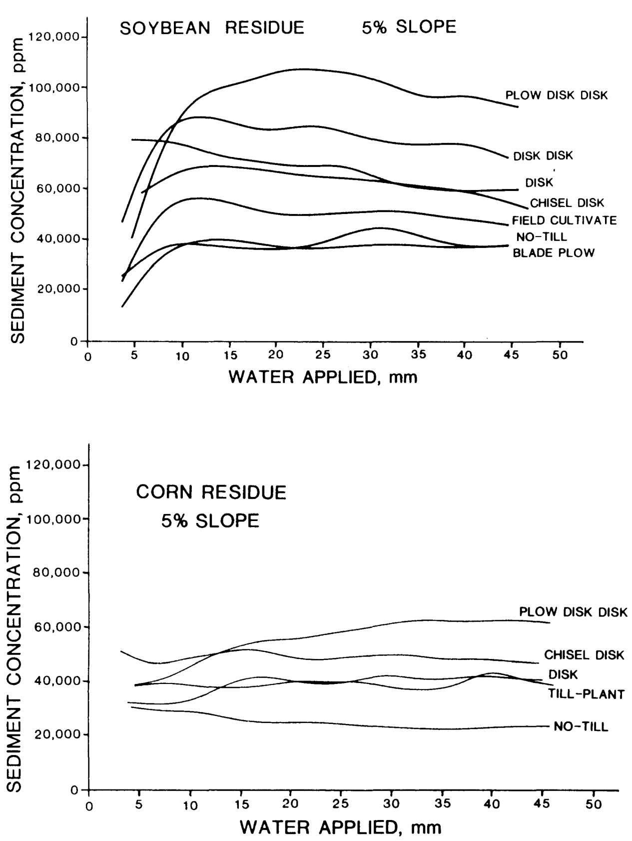

Fig. 5—Sediment concentration in the runoff vs. water application for tillage treatments used in soybean and corn residues on a silty clay loam soil.

TABLE 4. AVERAGE SEDIMENT CONCENTRATION IN THE RUNOFF DURING RAINFALL SIMULATION FOR VARIOUS TILLAGE SYSTEMS USED IN CORN AND SOYBEAN RESIDUES.

Tillage system	Concentration,† ppm			
	5% slope silty clay loam soil		10% slope silt loam soil	
	Soybean residue	Corn residue	Soybean residue	Corn residue
Plow, disk, disk, plant	95,300a‡	* 55,900a	111,200ab	* 84,600a
Chisel, disk, plant	59,500cd	46,900ab	54,400d	* 33,200c
Disk, disk, plant	77,300b	—	90,000bc	37,400bc
Disk, plant	63,000c	* 37,900b	64,400cd	—
No-till plant	37,000e	* 22,200c	41,500d	* 5,300d
Till-plant	—	37,600b	129,300a	* 42,500bc
Strip rotary-till, plant	—	—	71,400cd	* 49,600b
Field cultivate, plant	47,900de	—	—	—
Blade plow, plant	35,100e	—	—	—

*Sediment concentration within slope and soil type were significantly different (Duncan's Multiple Range Test, 10% level) between corn and soybean residues for these systems only.

†Concentration was determined by dividing the total soil removed by the total runoff after 50 mm of simulated rainfall.

‡Values within each column having the same superscript were not significantly different (Duncan's Multiple Range Test, 10% level).

with the erosion results, the sediment concentration in the runoff from a given tillage system was always greater following soybeans than following corn. In general, the no-till system tended to have the least sediment concentration in the runoff. The moldboard plow treatment, with only one exception, had the greatest average sediment concentration in the runoff within residue type (Table 4). The till-plant system used in soybean residue on the silt loam soil with a 10% slope had the greatest sediment concentration. This reflects a potential problem when a till-plant system is used up-and-down the hill rather than on the contour.

Within residue and tillage system, there were several similarities in the sediment concentration in the runoff from the 5 and 10% slopes. However, the runoff was considerably greater from the 5% slope. This, in conjunction with the greater erodibility factor and smaller amounts of residue cover, help explain why the soil loss was greater from the 5% slope than the 10 percent slope.

SUMMARY AND CONCLUSIONS

Soil losses from various tillage systems were evaluated using rainfall simulation on soybean and corn residues. The tillage systems were used on a silty clay loam soil with a 5% slope and a silt loam soil with a 10% slope. The moldboard plow system generally had the greatest soil loss while no-till had the least. In soybean residue, soil losses from the disk and moldboard plow treatments were not statistically different at the 10% significance level. Following corn, no-till planting reduced soil loss by as much as 94% of that which occurred from the moldboard plow treatment. However, the reduction following soybeans was only about 60%.

The soil loss for equivalent tillage treatments was always greater following soybeans than following corn. One reason for this was because equivalent tillage treatments had about 40% less surface cover in soybean residue than in corn residue. Averaged across tillage treatments, the erosion following soybeans was 44% greater than following corn on the silty clay loam soil and more than 3.5 times greater on the silt loam soil.

Relationships developed between soil loss and cover indicated that erosion following soybeans, with no residue cover, was 35 and 64% greater than following corn for the silty clay loam and silt loam soils, respectively. These same relationships showed that conservation tillage systems leaving a 20% residue cover in soybean residue would reduce erosion by more than 50% of that expected to occur from a tillage treatment having a 2% cover remaining after planting. Similarly, conservation tillage systems would reduce the soil loss following corn production by 38 and 51% of that occurring from a moldboard plow treatment (4% cover) on the silty clay loam and silt loam soils, respectively.

Several tillage systems left more than a 20% residue cover in corn residue. However, only the no-till system consistently left a 20% cover in soybean residue. A single operation of either a blade plow or field cultivator may offer some opportunity for limited tillage in soybean residue while leaving enough cover to achieve about a 50% reduction in soil loss. Tillage systems which included a disking operation in soybean residue did not leave enough residue cover to be considered conservation tillage.

The no-till treatment tended to have a lesser runoff rate and the least cumulative runoff but there were very few statistical differences in these variables among the tillage treatments. Also, there tended to be more runoff following corn than following soybeans in the silty clay loam soil and more runoff following soybeans in the silt loam soil.

The sediment concentration in the runoff was generally greatest in the moldboard plow treatment and least for the no-till treatment. Unlike runoff, the sediment concentration from the silty clay loam soil was often greater following soybeans than following corn.

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(continued on page 1140)

Soil Erosion from Tillage

(continued from page 1129)

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