Agricultural Research Service
United States Department of Agriculture

National Sedimentation Laboratory
Oxford, Mississippi 38655

# CROPLAND MANAGEMENT RESEARCH AT THE NELSON FARM AND HOLLY SPRINGS

## 1990 RESULTS

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Technology Application Project Report No. 15

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Dear Sirs:

The enclosed reports give results of our cropland management research conducted during 1990 at the Nelson Farm and at the North Mississippi Branch Experiment Station. Most of these experiments are designed to continue several more years to better sample the variety of rainfall and temperature patterns that will help make the results more typical. Also, these results will require more analysis before being ready for formal publication.

We appreciate the assistance of our cooperators in these projects - the Soil Conservation Service and Mississippi Agricultural and Forestry Experiment Station.

We recognize your requests for research information at the earliest time possible and hope that these reports are helpful. For further information on this research, I suggest you contact Mr. Bill Lipe, SCS Liaison to the Laboratory.

Sincerely,

C. K. MUTCHLER
Laboratory Director

Enclosures

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# CONSERVATION PRODUCTION SYSTEMS RESEARCH AT THE NELSON FARM

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This section summarizes the results of cooperative agronomic research at the Ed Nelson farm near Senatobia, MS from 1988 through 1990. Additional details are available in USDA-Sedimentation Laboratory Technology Applications Project Report No. 8, "Cropland Erosion Research - 1989 Results" (TAP #8).

Topics covered in this section include:

- Seasonal weather for 1988, 1989 and 1990
- Production plot yields and economic returns for cotton, sorghum, and soybean/wheat
- Tillage systems for corn
- Row spacing studies
- Cover crop studies
- Earthworm studies
- Vetiver grass (erosion-control hedge) studies

## Weather

Rainfall (inches) at the Nelson Farm during the past three years has varied greatly:

| Year | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1988 | 1.95 | 2.91 | 4.71 | 4.52 | 0.69 | 0.04 | 14.31 | 0.29 | 5.21 | 1.19 | 6.90 | 6.38 |
| 1989 | 6.07 | 7.09 | 5.52 | 1.27 | 3.68 | 13.42 | 8.62 | 2.94 | 5.12 | 1.23 | 4.19 | 2.93 |
| 1990 | 4.80 | 12.66 | 7.38 | 5.81 | 8.14 | 2.08 | 2.44 | 0.22 | 1.68 | 5.53 | 3.89 | 13.50 |

Weather has been unusually wet or unusually dry during portions of each year of this study. This has affected the yields and profitability of all cropping systems. Very dry weather during May and June, 1988, were followed by very heavy rains in July and then another period of drought. In contrast, wet weather during June 1989 promoted soybean disease (stem canker) development which was aggravated by dry weather during Aug and early Sept. During 1990, unusually dry weather from June through Sept 1990 limited yields of all crops.

In the several studies described, tillage method has not affected soybean or corn yields, but no-till planting resulted in increased yields of sorghum and cotton in the second or third year of use. Cropping systems with a winter wheat crop have been the most profitable. In large part, this resulted from two crops harvested per year and because wheat was not subject to drought conditions.

## Production plot yields and economic returns

Three summer crops (cotton, soybean, and grain sorghum) are being grown under four tillage systems in the main production plots: conventional tillage, ridge tillage, reduced (one-pass) tillage, and some form of no-tillage. The no-till soybean treatment is double-cropped with winter wheat; the no-till cotton treatment is planted into a winter wheat cover crop, and the grain sorghum treatment is planted into a hairy vetch winter cover crop. An additional no-till treatment, a two-year rotation of grain sorghum followed by wheat double-cropped with soybean, is included and provides a harvest of each crop each year. Ten replications of 14 plots each are used in this research. The land area utilized was in unimproved pasture prior to 1987 when preliminary herbicides, tillage, and fertilizer and lime applications were made. The area was uniformly sowed to a wheat cover crop during the winter of 1987-1988 and all tillage treatments were initiated with the plantings of spring 1988. Studies have indicated plant parasitic nematode populations have not limited yields of any crop in these studies.

Cotton: No-till cotton yields were less relative to conventional tillage in 1988 but were greater in 1990 (Table PS-1). During 1988, one-pass and no-till cotton treatments were planted in small trenches because residue removing devices (trash whippers) were set too deeply. These treatments grew-off slowly because of soil temperature, moisture, and fertility factors. All cotton was well planted in 1989, but was severely stunted by contaminated insecticide applications 8 to 10 weeks after planting. In both 1988 and 1989, weed pressure from perennial vines in no-till cotton forced reliance on cultivation. In 1990, no-till planted cotton grew-off faster than other treatments and yielded more. Rapid growth combined with timely application of post-directed spraying treatments made cultivation unnecessary in the no-till treatment in 1990. The dry weather in 1990 resulted in very short cotton plants in all treatments.

Economic analyses of the cotton production systems (Table PS-2) indicate that none of the tillage systems were profitable at this location under the dry conditions of 1990. At current prices, and with normal production inputs, cotton production will not be profitable with any of the production systems studied unless yields exceed 1.5 bales/acre (about 1850 lbs seed cotton/acre).

Table PS-1. Yields of cotton on Nelson Farm production plots, 1988 - 1990.

| System | DES 119 Seed Cotton Yield† | | |
|---|---|---|---|
| | 1988 | 1989 | 1990 |
| | | lb/acre | |
| Conventional tillage | 1830 | 1230‡ | 1125 |
| Ridge tillage | 1560 | 960‡ | 825 |
| One-pass tillage | 1430 | 1080‡ | 1130 |
| No-till (wheat cover crop) | 1560 | 890‡ | 1335 |

† fertilized with 90 lb N/acre as $NH_4NO_3$.
‡ all 1989 cotton treatments damaged by a contaminated pesticide application during July 1989.

Table PS-2. Net returns to land and management of Nelson Farm production treatments for 1988, 1989, and 1990

| | Net returns per acre | | |
|---|---|---|---|
| TREATMENT | 1988 NET RETURNS[1] | 1989 NET RETURNS[2] | 1990 NET RETURNS[3] |
| Cotton--conv. till. | $65.00 | | -$138.00 |
| Cotton--ridge till | $ 7.00 | | -$168.00 |
| Cotton--min. till | -$28.00 | | -$ 99.00 |
| Cotton--no till d/c with wheat | -$ 5.00 | | -$124.00 |
| Grain sorghum--conv. till | -$17.00 | -$ 10.00 | -$ 59.00 |
| Grain sorghum--ridge till | -$35.00 | -$ 29.00 | -$ 67.00 |
| Grain sorghum--min. till | -$35.00 | $ 1.00 | -$ 68.00 |
| Grain sorghum--no till with vetch | -$52.00 | $ 2.00 | -$ 64.00 |
| Grain Sorghum--no till in soybean/wheat rotation | -$25.00 | $ 20.00 | -$ 45.00 |
| Soybeans--conv. till | $13.00 | -$ 24.00 | -$ 40.00 |
| Soybeans--ridge till | -$ 5.00 | -$ 9.00 | -$ 26.00 |
| Soybeans--min. till | $13.00 | -$ 20.00 | -$ 33.00 |
| Soybeans--no till d/c with wheat | $222.00 | $ 64.00 | $ 52.00 |
| Soybeans--no till d/c with wheat in Grain Sorghum rotation | $210.00 | $ 61.00 | $ 59.00 |

[1]Prices paid based on 1988 prices and prices received are based on a 5-year average (1984-1988): cotton lint ($.59/lb); cotton seed ($.03/lb.); grain sorghum ($4.11/cwt.); wheat ($3.21/bu.); and soybeans ($5.96/bu.).

[2]Prices paid based on 1989 prices and prices received are based on 5-year average (1985-1989): grain sorghum ($3.62/cwt.); wheat ($3.24/bu.); and soybeans ($5.91/bu.); cotton economics not determined because of plot damage.

[3]Prices paid based on 1990 prices and prices received are based on 5-year average (1986-1990): cotton lint ($.57/lb.); cotton seed ($.04/lb.); grain sorghum ($3.95/cwt.); wheat ($3.26/bu.); and soybeans ($5.86/bu.).

<u>Sorghum:</u> In 1988, both no-till treatments had to be re-planted due to poor stands. This resulted in reduced yields of these treatments. In 1989 and 1990, no replanting was necessary and sorghum yields were higher in the no-till treatments (Table PS-3). One difference between 1988 and the subsequent two years was that, in the latter two years, burndown herbicides were applied to no-till plots at least three weeks ahead of sorghum planting whereas the interval was only 12 days in 1988. Experience has shown that an 3-week interval improves sorghum stand establishment when no-till planted into a cover crop by allowing populations of pests and pathogens to decline.

The hairy vetch cover crop made good growth each year, although biomass and above ground nitrogen was somewhat lower in 1990 than in the previous years. The vetch accumulated 275 lb N in its above-ground biomass in 1988, 109 lb N/a in 1989, and 70 lb N/a in 1990. Because of these contributions, fertilization of sorghum following vetch was 75 lb/a of fertilizer N per year less than the other sorghum treatments, a savings which approximately offset the cost of the vetch seed. Observations in 1989 and 1990 suggested that yields of sorghum following vetch may have been N limited, and tissue analyses confirmed that N concentrations in the second leaf below the ear at heading were lowest for this treatment. Therefore, in future years, an additional 25 lb N/a will be applied to the no-till vetch treatments.

No-till sorghum grown in rotation with soybean double-cropped with wheat has been one of the most productive and profitable cropping systems evaluated (Table PS-2). In part this may be due to the profitability of wheat, but it is also true that the no-till rotation system has resulted in the highest grain sorghum yield during the last two years.

Table PS-3. Yields of sorghum on Nelson Farm production plots, 1988 - 1990.

| System | DPL G-1602 Grain Sorghum Yield 1988 | 1989 | 1990 |
|---|---|---|---|
| | | lb/acre | |
| Conventional tillage† | 3990 | 4240 | 2640 |
| Ridge tillage† | 3710 | 3920 | 2280 |
| One-pass tillage† | 3930 | 4250 | 2050 |
| No-till (vetch cover)‡ | 3580 | 4780 | 2930 |
| No-till (soybean rotation)† | 3160 | 5290 | 3160 |

† fertilized with 120 lb N/acre as $NH_4NO_3$.
‡ fertilized with 45 lb N/acre as $NH_4NO_3$.

Soybean and Wheat: Soybean yields have been disappointing each year due to different factors. In 1988, the problem was an infestation of stink bugs; in 1989, stem canker was serious; in 1990, drought was the problem. There have been no significant differences in soybean yield attributable to tillage for full-season soybean planting (Table PS-4). Double-crop yields have been as good or better than full season yields in each of these years; however, this result is not expected to continue over a longer period of study.

During fall 1988, stink bugs delayed soybean maturity, and wheat following soybean was not planted until Dec, one month later than wheat following grain sorghum. This resulted in less time available for fall establishment, greater spring disease problems (primarily sceptoria), and reduced yields. A similar planting delay occurred during 1990 and resulted in a wheat crop failure. In the future, we will employ an earlier maturing soybean (eg. Group V) to reduce the likelihood that late maturity will delay wheat.

Table PS-4. Yields of soybean and wheat on Nelson Farm production plots, 1988 - 1990.

| System | Bedford | | DPL-415 |
|---|---|---|---|
| | Soybean Yield | | |
| | 1988 | 1989 | 1990 |
| | | bu/acre | |
| Conventional tillage | 20.5 | 20.2 | 14.8 |
| Ridge tillage | 20.4 | 21.9 | 17.3 |
| One-pass tillage | 23.5 | 19.6 | 14.4 |
| Soybean-Wheat double crop (no-till) | 24.7 | 26.7 | 13.3 |
| Soybean-Wheat double crop (no-till sorghum rotation) | -- | 24.0 | 14.1 |

| System | Florida 302 Wheat Yield | | |
|---|---|---|---|
| | 1988 | 1989 | 1990 |
| | | bu/acre | |
| Soybean-Wheat double crop (no-till) | 81.0 | 29.7 | 44.1 |
| Soybean-Wheat double crop (no-till sorghum rotation) | 77.4 | 40.2 | 44.7 |

## Tillage systems for corn

A study begun in 1989 compares 8 tillage systems for corn in plots replicated 4 times. Three of the treatments are analogous to the conventional, ridge till, and one-pass tillage treatments previously described. The five additional treatments are: no-till, no-till with corn residues removed before planting each year (residues will remain on all other treatments), no-till into killed sod (no pre-experiment tillage of old pasture), and shallow preplant tillage (disking only) with and without postemergence cultivation (the 3 no-till treatments will also not be cultivated).

During 1989, 20 inches of rain fell during June and the first half of July at the Nelson farm. In contrast, during 1990 only 6 inches fell during the period June through September. These differences are reflected in corn grain yields. During 1989, all corn treatments yielded between 129 to 155 bu/a while during 1990 yields were only 61 to 101 bu/a (Table PS-5). No significant differences were attributable to intended treatment comparisons in either year. In part this is a positive result since it indicates that corn could be no-till planted into old pasture sod without preliminary tillage and not cause a significant yield penalty. That is, no benefit resulted from initial chiseling to incorporate lime and fertilizer or to loosen the soil.

Although economic analyses have not been completed of the various tillage systems, production costs of corn production are similar to those of grain sorghum except that about an additional 80 lb/acre of fertilizer N is applied. In both years, the yield of corn has been substantially above that of grain sorghum grown in the production plots with similar cultural practices. Although the corn and sorghum yields cannot be compared in a statistical sense, from a practical point of view, corn appears to have been a more profitable crop than grain sorghum during the past two years.

Table PS-5. Corn grain yield in tillage study at Nelson Farm, 1989 and 1990.

| System | | Pioneer 3165 Corn Grain Yield 1989 | 1990 |
|---|---|---|---|
| | | bu/acre | |
| Chisel/disk tillage | (Cultivated) | 151 | 66 |
| Ridge tillage | (Cultivated) | 148 | 71 |
| One-pass tillage | (Cultivated) | 132 | 83 |
| No-till (with residues) | | 138 | 91 |
| No-till (residues removed) | | 129 | 61 |
| No-till into pasture sod | | 157 | 75 |
| Disk tillage | (Cultivated) | 129 | 101 |
| Disk Tillage | (No Cultivation) | 155 | 84 |
| Mean | | 142 | 79 |
| LSD (0.05) | | 29(NS) | 41(NS) |

Earthworm study

A study was initiated during 1989 to determine the interrelations of earthworm populations, tillage systems, and water infiltration rates. Five treatments are replicated 4 times: fertilized grassland, conventional till (chisel, double - disk) soybean, no-till soybean, "optimal" soybean, and "optimal" soybean plus vermicide. Subsurface (trickle) irrigation, winter wheat/vetch cover crop, and no-till management constitute the "optimal" treatment from the standpoint of earthworm habitat in a soybean production system. The treatment managed identically except with a vermicide (worm killer) applied to reduce earthworm activities allows estimation of the earthworm influence on yield and water infiltration rates apart from the tillage, cover, and irrigation. The first vermicide was applied after soybean harvest in 1989.

Trickle irrigation tubing was placed 6" underground on 36" centers during March 1989 using a vibratory plow which caused minimal soil disturbance. Soybeans were no-till planted on top of the irrigation tube or in non-irrigated no-till or conventional-tillage plots. No-till planted soybean yield was higher than following tillage in 1989 but not in 1990 (Table PS-6). Trickle irrigation increased no-till yields 5 to 7 bu/a in 1989 (by reducing the severity of stem canker symptoms and delaying leaf drop) and by 23 to 25 bu/a in 1990 when no serious disease problems were noted. A total of 9 inches of irrigation water was applied to the irrigated treatments in 1989 and 13 inches was applied in 1990.

Earthworm populations have been consistently lowest in the conventional-tilled soybean treatment. Little difference has been found between the no-till grass and no-till soybean, with or without irrigation (Table PS-7).

Water infiltration studies were conducted during November 1990 following soybean harvest. A rainfall simulator applied 2.7 inches of simulated rainfall over a one hour period. Runoff was collected from 4-$ft^2$ areas at four-minute intervals after ponding occurred. In related studies, water containing blue dye was allowed to infiltrate into single 0.7-$ft^2$ rings under ponded conditions. Treated areas were later excavated and the fraction of dyed soil at successive one-inch depth increments was determined. Both of these techniques were applied to three separate areas within each plot: the planted row, non-wheel-tracked interrows, and wheel-tracked interrows. Preliminary results indicate no significant difference between tillage systems or between soybean and grassed areas with respect to cumulative infiltration from 2.7 inches of simulated rainfall. However wheel-tracked interrows infiltrated less than 0.4 inches of applied water while row and non-wheel-tracked interrows infiltrated more than twice that much. At depths of 2 or more inches below the surface, less than 10% of the soil was affected by dye, suggesting great heterogeneity in water flow patterns, even under saturated conditions.

Table PS-6. Soybean grain yield in Nelson Farm earthworm study in 1989 and 1990.

| System | 1989 Bedford | 1990 DPL 415 |
|---|---|---|
| | bu/acre | |
| Conventional tillage | 16.5 | 19.3 |
| No-tillage | 23.3 | 17.0 |
| No-till plus irrigation | 30.6 | 42.7 |
| No-till, irrigation, and vermicide† | 28.6 | 42.0 |
| Fertilized grassland (internal control) | | |
| Unfertilized grassland (external control) | | |
| LSD (0.05) | 6.9 | 9.4 |

† first vermicide (benomyl) application made November 1989

Table PS-7. Earthworm populations, Nelson Farm 1989 - 1990.

| | Earthworm Populations | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1989 | | | 1990 | | | |
| System | June | Sept | Dec | Mar | June | Sept | Dec |
| | ------------ number/$m^2$ ----------------- | | | | | | |
| Conventional tillage | 17 | 68 | 54 | 29 | 9 | 11 | 12 |
| No-tillage | 52 | 211 | 79 | 62 | 85 | 82 | 73 |
| No-till plus irrigation | 65 | 157 | 68 | 49 | 71 | 69 | 77 |
| No-till, irrigation, and vermicide | 79@ | 171@ | 56 | 42 | 54 | 40 | 52 |
| Fertilized grassland (internal control) | 103 | 122 | 119 | 76 | 57 | 52 | 105 |
| Unfertilized grassland (external control) | 37 | 69 | 45 | 14 | 28 | 15 | 35 |

@ first vermicide (benomyl) application made during November 1989 (after these sampling dates).

Row spacing studies for soybean and sorghum

The objectives of these studies are: 1) determine interaction of tillage and row spacing on soil loss from soybean and sorghum grown on loess soil, and 2) evaluate the productivity, economics, and weed populations of reduced-input conservation-tillage production systems. Yields are evaluated in plots replicated three times and erosion on simulator plots replicated two times.

Soybean: In both 1989 and 1990, soybean yields were decreased about 6 bu/acre when no pre- or postemergence herbicides were used compared to the average of all treatments receiving such herbicides (29 bu/acre in 1989 and 19 bu/acre in 1990; Table PS-8). No other significant effects of tillage, row spacing, herbicide level, or their interactions were found during 1990 but a tillage by row spacing interaction in 1989 favored drill planting over 36-inch rows for no-till. This study is continuing; economic analyses are not completed.

Sorghum: Using a hairy vetch cover crop in lieu of 75 lbs/acre of fertilizer N has resulted in symptoms of sorghum N deficiency and a reduction in sorghum grain yield in both years of this study (Table PS-9). Similarly, not using any preemergence herbicides resulted in yield declines except in the not-cultivated wide-row treatments in 1990 when postemergence directed-spray treatments effectively controlled weeds in and between rows. Tillage had no significant effect on grain yield, so yields have been averaged over this factor in Table PS-9. During 1989, severe bird damage occurred and grain yields were derived from hand harvested panicle weights and calibration of threshed panicle weights to grain yields. During 1990, bird damage was not severe and samples were combine harvested.

Table PS-8. Soybean yield as affected by tillage, row spacing, and herbicide combinations, Nelson Farm, 1989 and 1990.

| | 1989 Bedford | | 1990 DPL 415 | |
|---|---|---|---|---|
| System | Till | No-till | Till | No-till |
| | bu/acre | | | |
| Drilled | | | | |
| No Preemerg. Herb. | 19.7 | 24.9 | 11.0 | 14.2 |
| All Postemergence | 24.2 | 29.5 | 21.3 | 16.6 |
| Canopy Pre | 28.8 | 29.7 | 18.9 | 21.1 |
| Canopy and Dual Pre | 26.4 | 31.1 | 19.6 | 16.3 |
| 36" Rows - Cultivated | | | | |
| No Preemerg. Herb. | 25.0 | 22.3 | 17.2 | 14.8 |
| Canopy Pre | 27.2 | 30.3 | 20.8 | 17.6 |
| Canopy and Dual Pre | 33.8 | 28.8 | 20.6 | 18.0 |
| 36" Rows - Not Cultivated | | | | |
| Canopy and Dual Pre | 31.0 | 29.0 | 15.8 | 16.8 |
| | LSD(0.05) = 3.7 | | LSD(0.05) = 6.7 | |

Table PS-9. Sorghum yield from tillage/row spacing study, averaged over preplant tillage, Nelson Farm, 1989 and 1990.

| System | Funk G-1711 Sorghum Yield 1989 No-cover† | 1989 Vetch‡ | 1990 No-cover† | 1990 Vetch‡ |
|---|---|---|---|---|
| | lb/acre | | | |
| Drilled | | | | |
| No Pre Herbicide | 6270 | 5460 | 2090 | 1470 |
| Atrazine Pre | 6280 | 5340 | 2350 | 1800 |
| Atrazine and Dual Pre | 6490 | 5930 | 2350 | 1890 |
| 36" Rows - Cultivated | | | | |
| No Pre Herbicide | 4730 | 4880 | 1970 | 1410 |
| Atrazine Pre | 5470 | 5250 | 2080 | 2050 |
| Atrazine and Dual Pre | 6140 | 5350 | 2210 | 1990 |
| 36" Rows - Not Cultivated | | | | |
| No Pre Herbicide | 5940 | 4563 | 2450 | 2050 |
| Atrazine Pre | 5910 | 4420 | 2360 | 2130 |
| Atrazine and Dual Pre | 6630 | 5460 | 2430 | 2150 |
| Mean | 5980 | 5180 | 2250 | 1880 |

† fertilized with 100 lb N/acre as $NH_4NO_3$.
‡ fertilized with 25 lb N/acre as $NH_4NO_3$.

Soil Erosion: Rainfall simulator studies conducted during 1989 indicated that cultivation shortly before an intense storm can greatly increase erosion rates (Table PS-10). This was true regardless of preplant tillage. As expected, no-till planting resulted in less erosion than conventional tillage, however, because of increased residue disturbance, no-till drill planting increased erosion compared with no-till not-cultivated wide-row planting.

Table PS-10. Soil loss from a 1-hour, 2.5-inch simulated rainstorm applied to soybean 4 to 8 weeks after planting on a 6%, simulated 240-ft slope.

| System | Pre-plant tillage Till | Pre-plant tillage No-till |
|---|---|---|
| | tons/acre | |
| Drilled | 2.6 | 1.2 |
| 36-in row (not cultivated) | 2.2 | 0.5 |
| 36-in row (cultivated) | 25.0 | 14.9 |

Cover crop studies

Studies have been conducted during the past 3 years to develop cropping systems which include a legume cover crop that will produce seed and naturally reestablish a stand the subsequent fall (reseed). Both commercially available and native species collected in north Mississippi have been evaluated for growth, vigor, winter survival, nitrogen accumulation, flowering date, and reseeding success. The cost of legume seed is a considerable expense which can frequently exceed the value of fertilizer N savings.

During the winter of 1988 - 1989, a number of legume cover crops were established and killed at two-week intervals between 9 March and 18 May. The 18 May date was considered the latest possible date to begin land preparation for timely planting of grain sorghum. 'Tibbee' crimson clover was the earliest and most reliable reseeder of commercial cover crops (Figure PS-1), but it did not produce viable seed until early May. 'Woogenellup' subterranean clover and 'Woodford' big flower vetch also reseeded, but slightly later than Tibbee crimson clover. 'Amclo' arrowleaf clover, 'Bigbee' berseem clover, and hairy vetch did not reseed at any date. These results indicate a need to identify earlier flowering legume cover crops so planting dates for cotton or grain sorghum can be optimized in systems employing reseeding legume cover crops. Delaying cover crop killing and crop planting until late May increases the risks of late season drought and/or insect damage to the subsequent crop.

In nursery evaluations, about 20 legume accessions have been observed each year. Strains of bur clover (Medicago spp.) and of subterranean clovers have been identified which reseed earlier than Tibbee crimson clover (Figure PS-2). Although one of the bur clovers begins flowering during December, none of the commercially available strains has proven sufficiently cold-hardy to be recommended. During the winter of 1990 - 1991, several very early cultivars of subterranean clover were evaluated which show great promise. Several of these appeared to have produced seed my mid-April at several locations. The reseeding success of these cultivars will be evaluated this fall, and testing to determine range of climatic and soil adaptation of these strains will be continued.

Stiff-grass hedge studies (including Vetiver grass)

All four established accessions of vetiver grass (Vetiveria zizaniodes (L.) Nash.) (obtained as seedlings during May 1989 from the ARS Plant Introduction Station at Griffin, GA) were killed during Dec 1989 when minimum temperatures were -20° C.

Seedlings of three of the same accessions were obtained during spring 1990 from the SCS Plant Materials Center at Coffeeville, MS, and were used in a study in which the effects of pre-transplanting tillage and herbicide applications on vetiver grass transplant growth rates were evaluated. Extended leaf-tip height, number of tillers, and clump circumference 5 cm above the soil were measured weekly for six weeks after transplanting on 20 June, and again during November. Seedlings were planted on a 3-ft spacing into a well-watered area, and each treatment and accession combination was replicated three times. No significant main or interaction effects of accession on growth early in the season were found. However, growth was faster with no-tillage prior to planting than where a seedbed was prepared with a rototiller (Figure PS-3). Also, growth was increased by preplant applications of atrazine (1.7 lb ai/a) or by atrazine plus

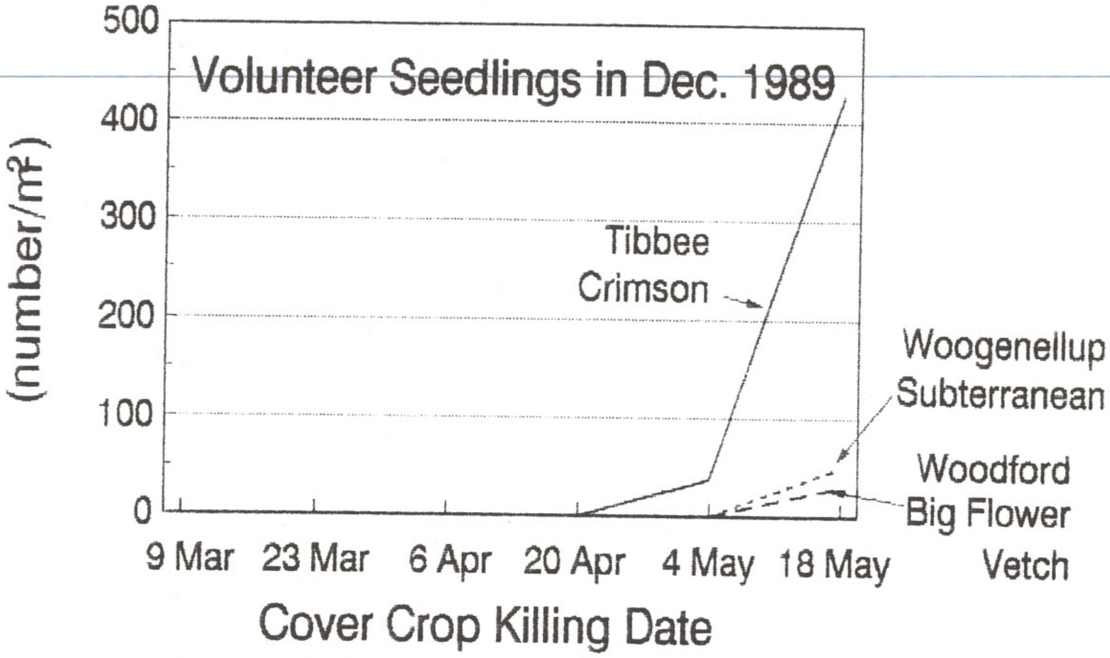


Figure PS-1. Fall cover crop reseeding after 6 spring killing dates

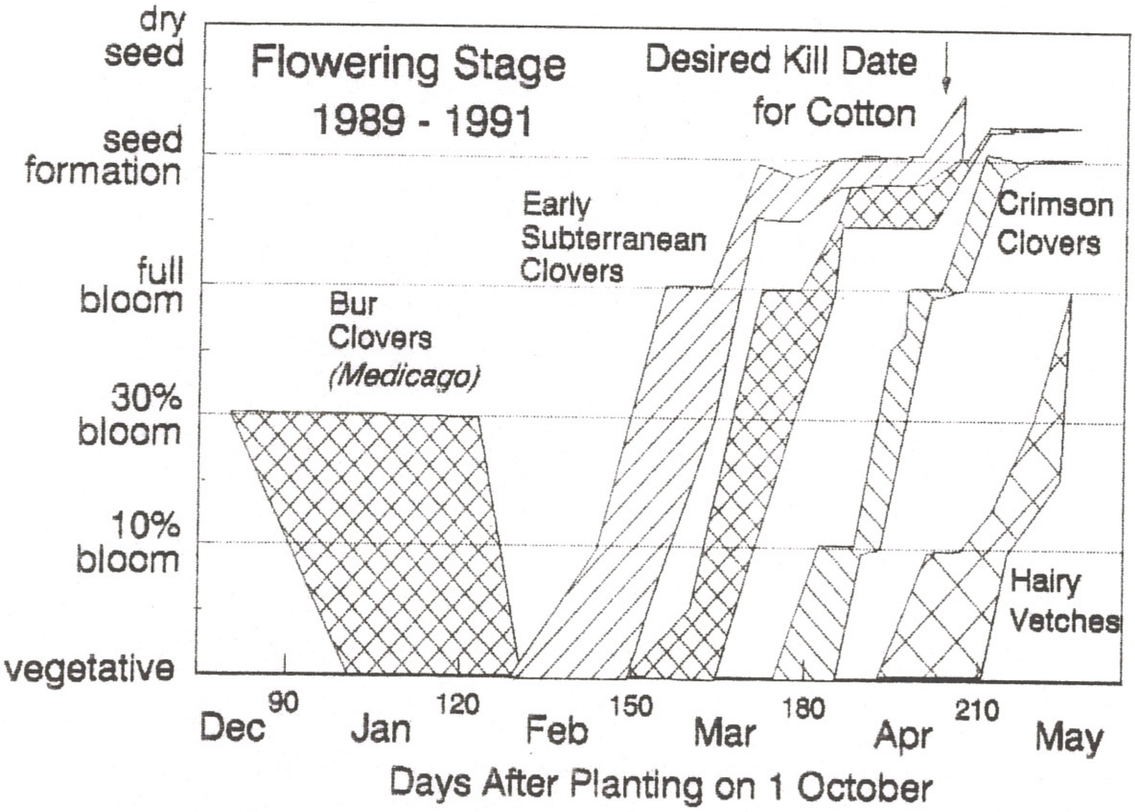


Figure PS-2. Flowering stages of legume cover crops planted in early October of each year. (Shaded areas are ranges of dates.)

metolachlor (1.7 + 2.0 lb ai/a) because of reduced weed competition compared with the no-herbicide treatment which was hoed three times during the 6 week period (Figure PS-3). The growth trends reported for clump diameter (Figure PS-3) were similar to those observed for plant height and tiller number. No significant effect of tillage was found at the November observation date (144 days after transplanting) but herbicide differences remained statistically significant. The grass clumps had diameters of about 10 inches, about 80 tillers, and extended leaf tip heights of 1.75 m (5.7 ft) in November.

During spring 1991, all of the vetiver clumps in the previously described establishment study retained great structural integrity, but were very slow to resume growth. Since the winter was a relatively mild one, it is unlikely that any of these accessions will prove reliably hardy in our North Mississippi climate.

Work on stiff-grass hedges is continuing with a search for other species with similar mechanical properties to vetiver grass but with superior cold tolerance. Species being evaluated include: switchgrass (Panicum virgatum L.), eulalia (Miscanthus sinensis Anderss), and weeping lovegrass (Eragrostis Curvula (Schrad.) Nees).

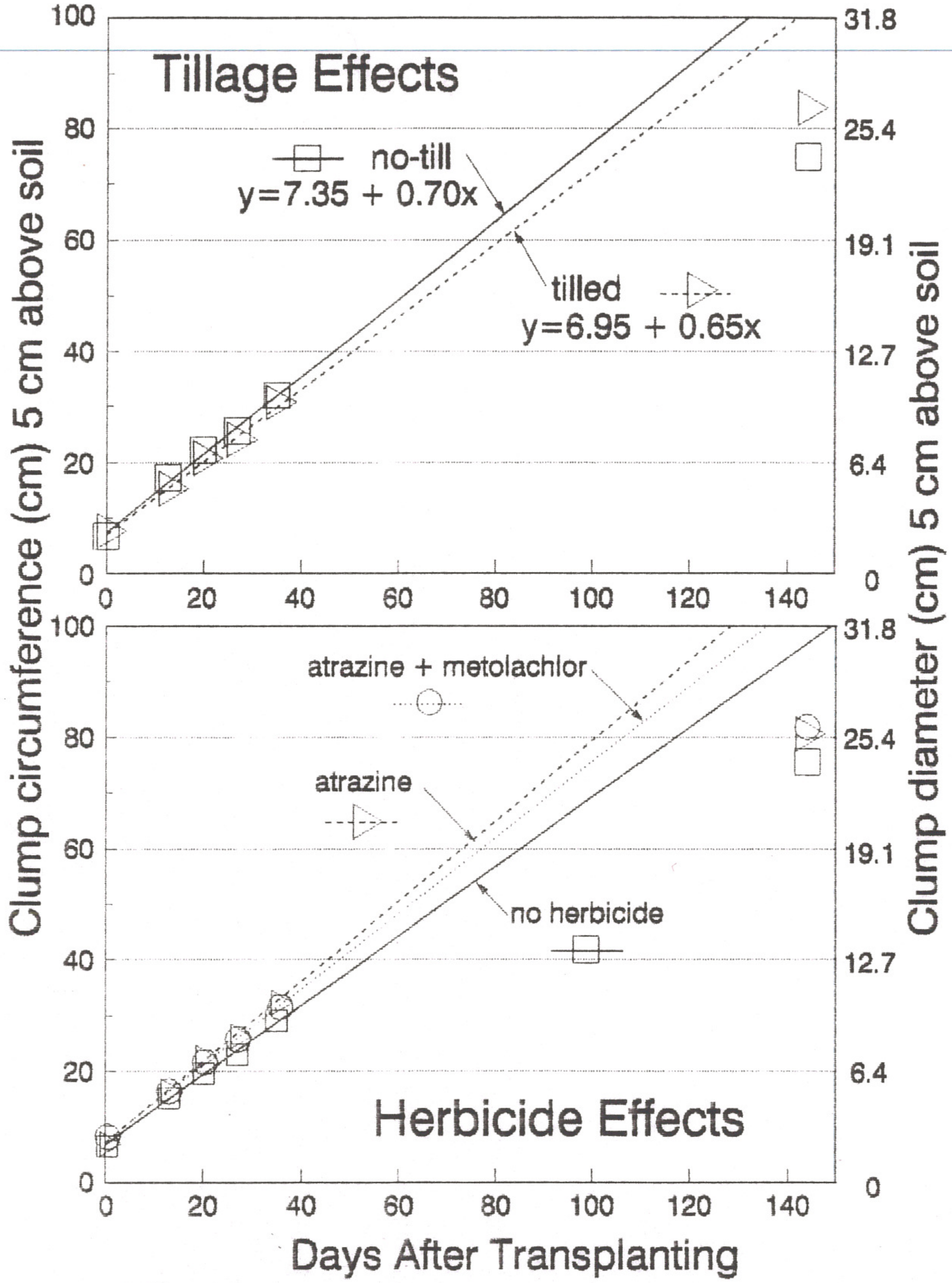


Figure PS-3. Effects of tillage and herbicides on growth of vetiver grass clumps transplanted on 20 June 1990.

# RUNOFF, EROSION, AND SEDIMENT YIELD RESEARCH AT THE NELSON FARM

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## Runoff and Erosion from Nelson Farm Erosion Plots

Runoff and soil loss are being measured on sixteen 72.6 x 12′ erosion plots of 4% slope at two locations on the Nelson Farm. The erosion plots consist of two replications of eight cropping systems selected from among those being studied in the production study: conventional tillage, ridge-till, and no-till soybeans; double-cropped no-till wheat-soybeans; two no-till grain sorghum, one with hairy vetch for winter cover and the other with volunteer vegetation as winter cover; and two no-till cotton plots using wheat for winter cover on one and volunteer vegetation on the other. Management practices on the erosion plots are consistent and comparable with those used on the nearby production plots.

Monthly and annual results during the second year of cropping are shown in Table EP-1. All management practices were no-till except the conventional-tillage soybean and ridge-till soybean treatments. Figure EP-1 shows soil losses from the four management practices with losses totaling more than 1 ton/acre during 1990. However, results from only one year of data are sometimes misleading because of abnormal rainfall distribution during the year. This type of abnormality occurred during 1990 with 39% of the annual rainfall (26.2 in.) during February and December (a period of normally low erosion potential) and only 9% of annual (6.4 in.) during June, July, August, and September.

The data in Table EP-1 show that grain sorghum with vetch cover crop had much less runoff than the other treatments and little erosion. This was the only treatment with vetch, a cover that uses soil water throughout most of the winter and provides excellent soil cover. The sorghum-wheat doublecrop had the lowest soil loss because of the year-round cover, but runoff was about 5 inches greater than sorghum with vetch although less than any other treatment. Conventional soybean produced the greatest soil loss followed by the two cotton treatments. Soil losses from all treatments were relatively low, especially since they were farmed up-and-down the slope, but recognize that these losses occurred during a year when little of the rainfall occurred during the more erodible periods. Also, plots are only 72.6 feet long and are only 4% steep, so losses would be greater on longer and steeper slopes, particularly those subject to serious rilling. Finally, the cover crops planted on some of the treatments were very effective in controlling erosion, but the volunteer cover on the other plots including the conventional soybean also gave effective erosion protection during the winter months when most of the erosive rainfall occurred during 1990.

Although these results are for only the first year of measurement, they suggest that a cover crop such as vetch has excellent potential to reduce annual runoff and peak runoff rates. Note that the 1990 runoff on these plots varied from less than 6 inches for grain sorghum with vetch cover to nearly 19 inches for one of the cotton treatments. The results also show the importance of crop cover throughout the year, including the volunteer growth that greatly reduced erosion rates from all such treatments.

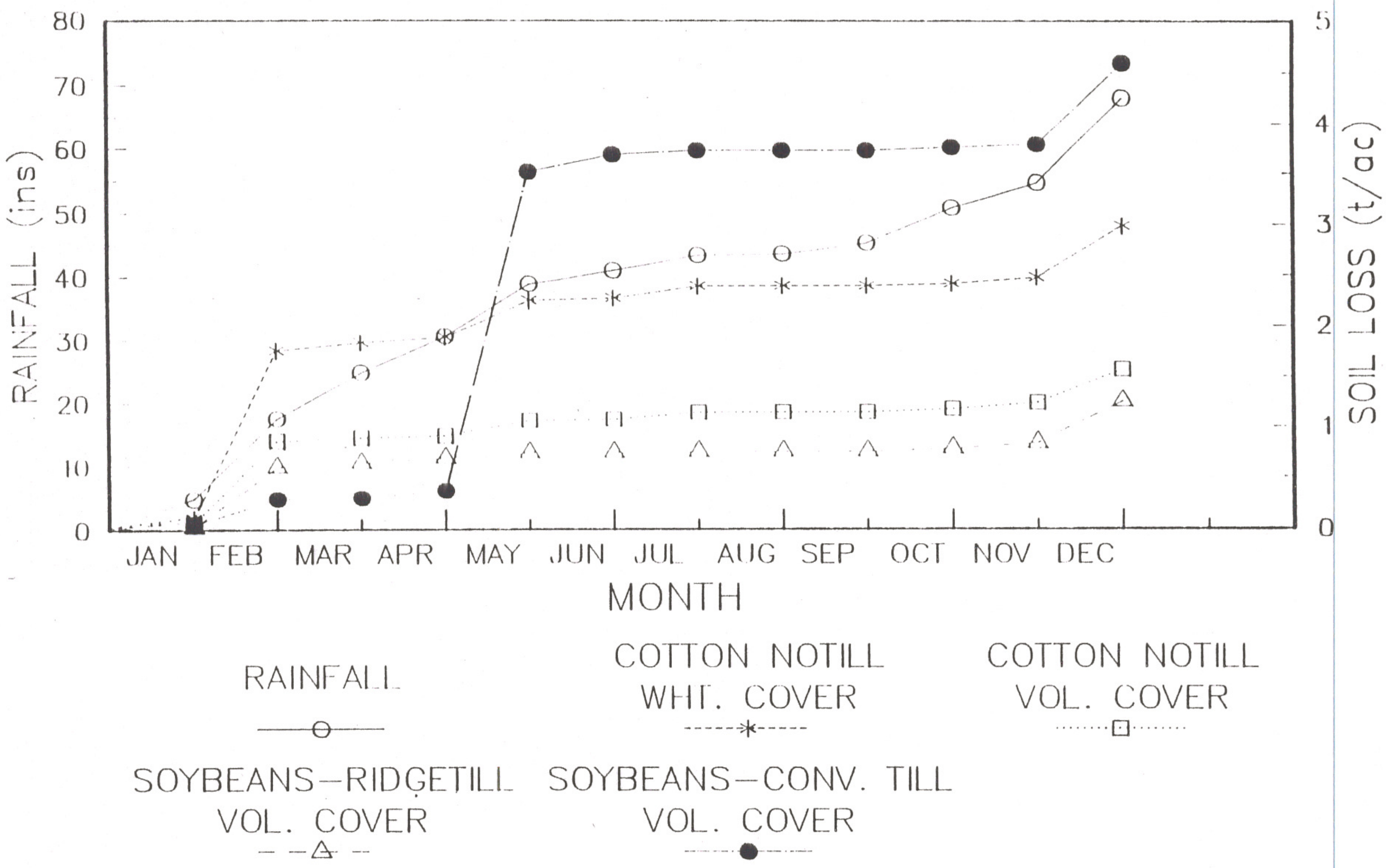


Figure EP-1. Management practices producing greater than 1 ton/acre of soil loss during 1990 from Nelson Farm erosion plots.

Table EP-1 1990 Monthly and annual runoff and soil loss from Nelson Farm erosion plots

RUNOFF (in.) AND SOIL LOSS (t/ac)*

| MONTH | NT COT WH COV | NT COT VOL COV | NT GS VET COV | NT GS VOL COV | SB RIDG VOL COV | SB/WHT DBLCRP | NT SOYB VOL COV | CONV SB VOL COV |
|---|---|---|---|---|---|---|---|---|
| | JANUARY PRECIP - 4.80 in. | | | | | | | |
| JAN RO | 0.754 | 0.655 | 0.030 | 0.065 | 0.414 | 0.211 | 0.497 | 0.705 |
| JAN SL | 0.110 | 0.059 | 0.001 | 0.003 | 0.018 | 0.023 | 0.015 | 0.043 |
| | FEBRUARY PRECIP - 12.66 in. | | | | | | | |
| FEB RO | 5.957 | 4.167 | 1.817 | 3.690 | 5.261 | 3.709 | 5.033 | 5.208 |
| FEB SL | 1.664 | 0.812 | 0.085 | 0.362 | 0.587 | 0.091 | 0.317 | 0.252 |
| | MARCH PRECIP - 7.38 in. | | | | | | | |
| MAR RO | 1.088 | 0.452 | 0.000 | 0.437 | 0.399 | 0.135 | 0.819 | 0.533 |
| MAR SL | 0.080 | 0.029 | 0.000 | 0.015 | 0.041 | 0.006 | 0.008 | 0.014 |
| | APRIL PRECIP - 5.81 in. | | | | | | | |
| APR RO | 1.107 | 0.560 | 0.228 | 0.754 | 0.618 | 0.415 | 0.767 | 0.960 |
| APR SL | 0.041 | 0.018 | 0.011 | 0.033 | 0.049 | 0.018 | 0.065 | 0.070 |
| | MAY PRECIP - 8.14 in. | | | | | | | |
| MAY RO | 2.798 | 1.805 | 0.925 | 1.703 | 0.859 | 1.286 | 2.591 | 2.217 |
| MAY SL | 0.369 | 0.151 | 0.056 | 0.220 | 0.054 | 0.008 | 0.063 | 3.137 |
| | JUNE PRECIP - 2.08 in. | | | | | | | |
| JUN RO | 0.086 | 0.076 | 0.000 | 0.017 | 0.014 | 0.000 | 0.081 | 0.138 |
| JUN SL | 0.011 | 0.006 | 0.000 | 0.001 | 0.001 | 0.000 | 0.001 | 0.173 |
| | JULY PRECIP - 2.44 in. | | | | | | | |
| JUL RO | 0.563 | 0.268 | 0.123 | 0.173 | 0.088 | 0.398 | 0.287 | 0.024 |
| JUL SL | 0.123 | 0.076 | 0.004 | 0.008 | 0.011 | 0.006 | 0.007 | 0.040 |
| | AUGUST PRECIP - 0.22 in. | | | | | | | |
| AUG RO | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| AUG SL | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | SEPTEMBER PRECIP - 1.68 in. | | | | | | | |
| SEP RO | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.016 | 0.000 |
| SEP SL | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | OCTOBER PRECIP - 5.53 in | | | | | | | |
| OCT RO | 0.347 | 0.505 | 0.114 | 0.115 | 0.315 | 0.048 | 0.184 | 0.258 |
| OCT SL | 0.022 | 0.030 | 0.009 | 0.007 | 0.027 | 0.002 | 0.008 | 0.033 |
| | NOVEMBER PRECIP - 3.89 in. | | | | | | | |
| NOV RO | 0.422 | 0.451 | 0.019 | 0.066 | 0.348 | 0.559 | 0.156 | 0.278 |
| NOV SL | 0.064 | 0.060 | 0.001 | 0.010 | 0.050 | 0.030 | 0.012 | 0.029 |
| | DECEMBER PRECIP - 13.50 in. | | | | | | | |
| DEC RO | 5.789 | 2.910 | 2.377 | 4.112 | 3.801 | 3.871 | 4.072 | 4.670 |
| DEC SL | 0.502 | 0.328 | 0.174 | 0.127 | 0.414 | 0.060 | 0.119 | 0.798 |
| | 1990 PRECIP - 68.12 in. | | | | | | | |
| 1990 RO | 18.910 | 11.802 | 5.631 | 11.115 | 12.115 | 10.630 | 14.495 | 15.025 |
| 1990 SL | 2.984 | 1.566 | 0.339 | 0.785 | 1.250 | 0.242 | 0.614 | 4.587 |

*---runoff and soil losses are an average value of east and west plots with the same management systems.

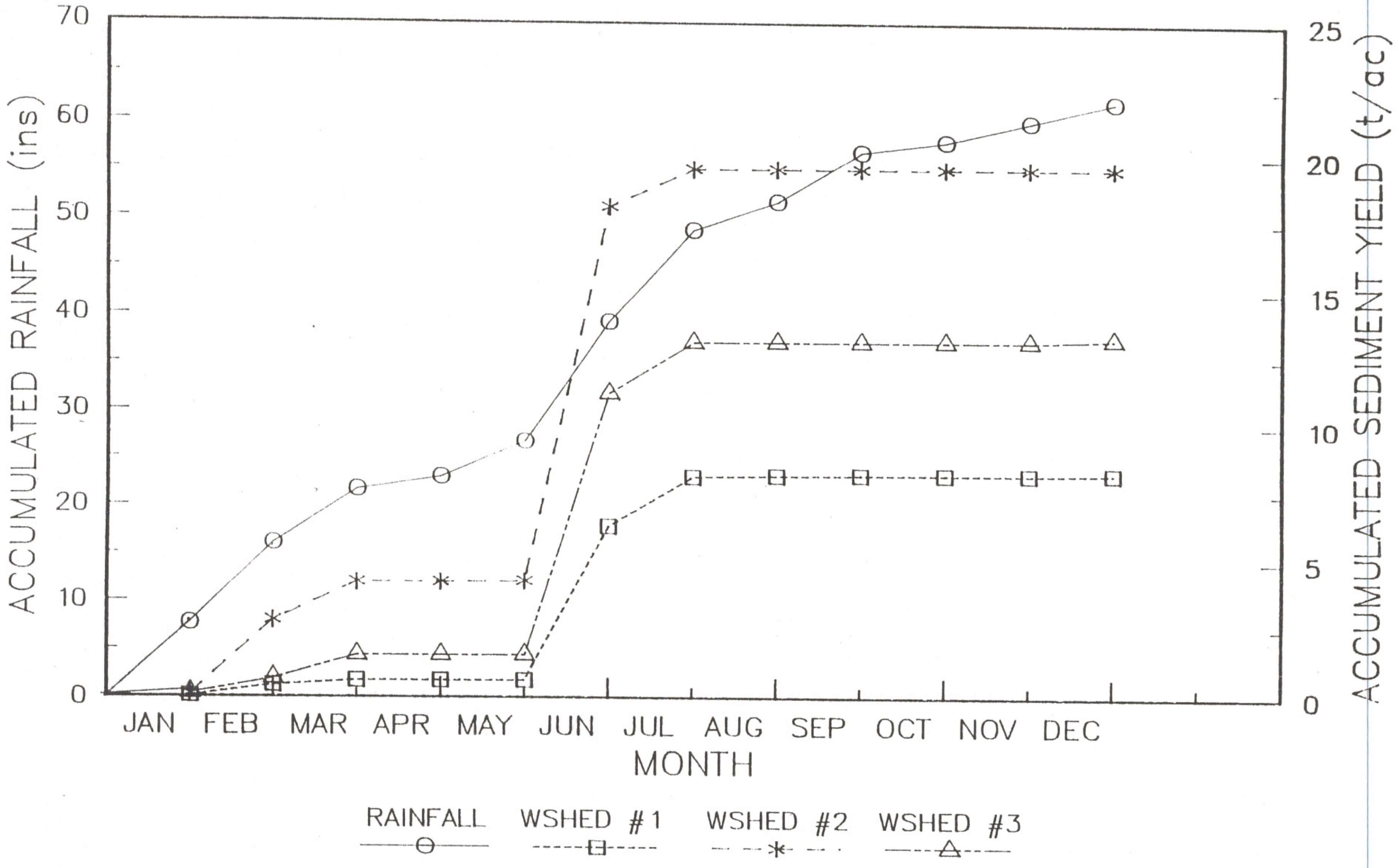


Fig. WS-1. Sediment yields from three Nelson Farm watersheds while cropped to conventional-tillage soybeans in 1989.

Runoff and Sediment Yield from Small Upland Watersheds

Runoff and sediment yield were measured from three small watersheds averaging 4% in steepness on the Nelson Farm project during CY89-90. All three watersheds [#1 (5.2 ac), #2 (5.2 ac), and #3 (7.8) ac)] were instrumented in late 1988 to measure and compute volume of storm runoff and to collect samples of sediment-water mixture at intervals during storm runoff events for determining sediment losses. During CY89, tillage and management practices on all three watersheds were kept identical to determine runoff and sediment yield characteristics of each watershed. During CY90, watershed #1 was farmed as no-till soybean, watershed #2 was farmed as conventional tillage soybeans, and watershed #3 was farmed as no-till soybean like watershed #1 except the main watercourse was planted to fescue during Sept. 1990, for protection from ephemeral gullying. Farming operations on all watersheds were generally on the contour.

Sediment yields from the three watersheds for CY89-90 are shown in Table WS-1 and Figures WS-1 and 2. The 1989 results (when all watersheds were treated similarly) indicate some difference in runoff and sediment yield characteristics for these two watersheds. The 1990 results indicate a major effect of no-till on sediment yield and a slight effect on runoff. However, sediment yields from all watersheds were very low in 1990 even though the runoff was about the same as for 1989, because the erosive rains did not occur at the time when these cropping systems were most susceptible to erosion.

Table WS-1. Annual rainfall, runoff and sediment yield from three Nelson Farm watersheds cropped to soybeans

| 1989 CY<br>Tillage Practice | Watershed #1<br>Reduced conv.* | Watershed #2<br>Reduced conv.* | Watershed #3<br>Reduced conv.* |
|---|---|---|---|
| Rainfall 61.9"<br>Runoff<br>Sediment yield | <br>23.4"<br>8.3 t/ac | <br>27.2"<br>19.6 t/ac | <br>32.4"<br>13.3 t/ac |
| 1990 CY<br>Tillage Practice | No-till | Conventional tillage | No-till |
| Rainfall 68.1"<br>Runoff<br>Sediment yield | <br>21.2"<br>0.52 t/ac | <br>27.2"<br>4.54 t/ac | <br>30.6"<br>1.02 t/ac |

*Seedbed preparation was with a one pass mulch tillage implement and then cultivation as needed for weed control.

Both calendar years 1989 and 1990 had above average annual rainfall (31% and 18% greater than 30-year average), and both had abnormal rainfall distribution during the year. The wet winter and dry summer of CY90 have already been discussed in the erosion plot section of this report. CY89 was abnormal in the opposite respect, because June and July had abnormally high erosion potential. Rainfall during these two months totaled 22.0 in. which caused storm runoff that produced more than 3/4 of annual sediment yield from the watersheds.

In another study on a 5% slope with soil similar to that of the Nelson Farm, a broad-base terraced watershed (8.63 ac) with a tile drain outlet system on the W. S. Taylor farm located 7 miles southeast of the Nelson Farm was gaged for storm runoff and sediment yield, beginning in April 1986 and ending March 1989. The terraces and tile drain system were installed during 1985, and soybeans were drilled over the entire watershed including the terraces in the spring of 1986 and three subsequent years. Tillage practice for seedbed preparation was disking two times, followed by do-all to smooth and consolidate surface

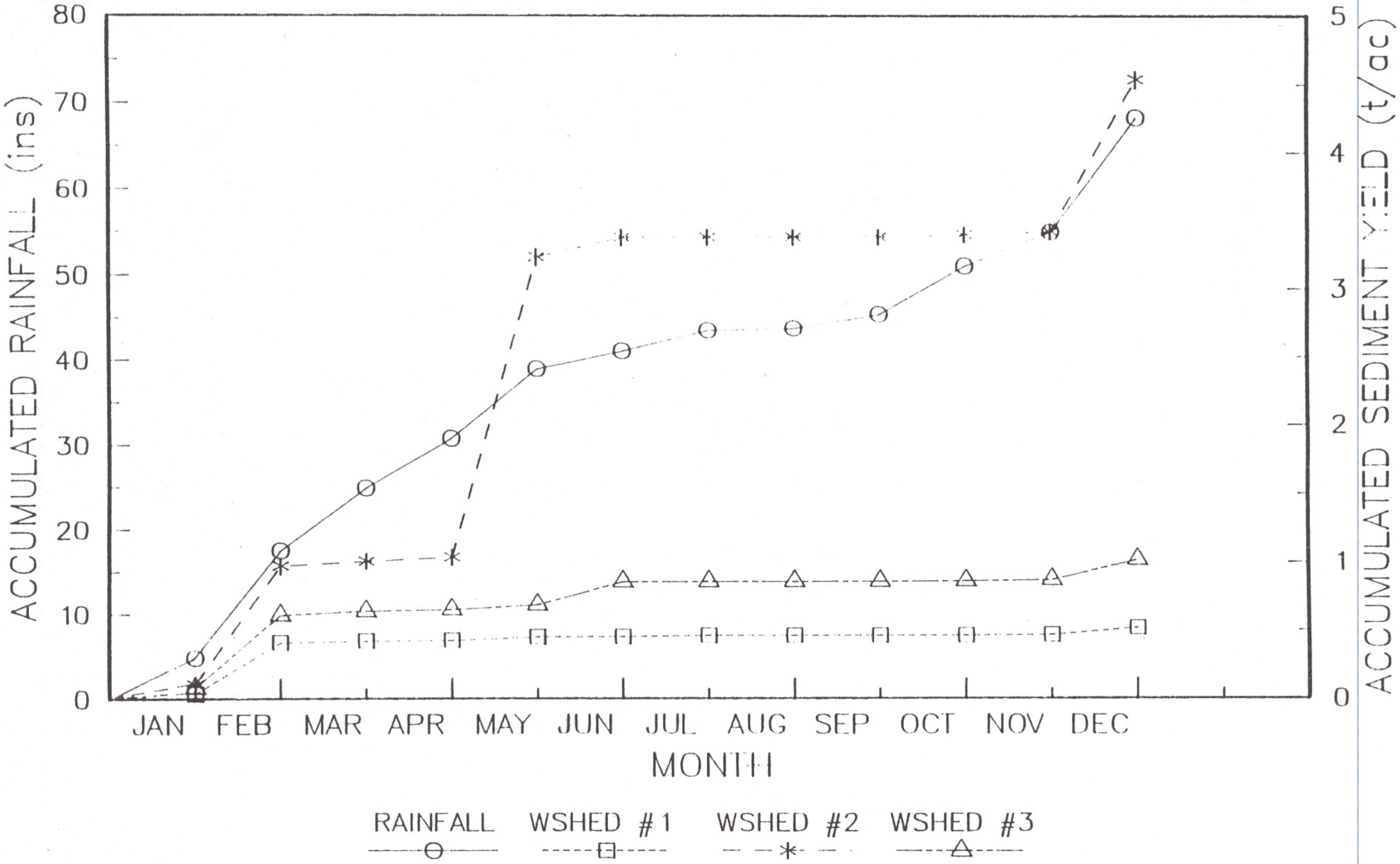


Fig. WS-2. Sediment yields from three Nelson Farm watersheds (#2-conventional-till soybean #1 and #3-no-till soybean) in 1990 material. Due to topsoil being removed from terrace channels to build terrace ridges, canopy cover and plant size on the ridges was generally much better than in the channels during the growing season for the three-year study period. Annual rainfall, runoff and sediment yield for the terraced watershed are shown in Table WS-2. These results show the excellent erosion control characteristics of terraces on these intensively cropped upland fields.

Table WS-2. Annual Runoff and Sediment Yield from Taylor Farm Terraced Watershed

| Water Year | Rainfall (ins.) | Runoff (ins.) | Sed. Yield (t/ac) |
|---|---|---|---|
| 1987 | 55.9 | 18.8 | 2.78 |
| 1988 | 42.3 | 10.2 | 1.31 |
| 1989 | 57.3 | 23.4 | 1.68 |

Rainfall Simulator Studies at the Nelson Farm

Simulated rainstorms were used to test the effectiveness of several conservation tillage practices for controlling erosion during early summer of 1990 on rows of moderate gradient and length. Two replications of the following four management practices were studied on crop rows up and down a 4% slope: conventional-tillage soybean, no-till soybean, doublecrop no-till wheat/soybean, and no-till grain sorghum. The tests were made on plots in the third year of their respective management practice. A hour of simulated rain at an intensity of approximately 2.7 in. per hour was applied the first day. Following this initial rainstorm on a dry condition, rain was applied the second day plus inflow water that was added to the upper end of the 30-ft. furrow to simulate longer rows. Inflow was added in seven successively larger increments to simulate conditions during a very intense rainstorm for rows up to about 300 ft. long.

The results in Table RS-1, 2, and 3 show that all conservation tillage treatments were very effective in erosion control as compared with the conventional soybean treatment. Losses from rows with conventional soybean were about 50 times those from any of the conservation tillage treatments. Of the three conservation tillage treatments (all with very minor erosion rates), doublecrop wheat/soybean had least erosion followed by no-till grain sorghum and no-till soybean. These results show that conservation tillage is an effective erosion-control practice on moderate slopes during crop stages when the soil is subject to serious erosion.

Table RS-1 Soil losses from 30-ft. row during first hour of rain. Rain intensity - 2.7 in/h; row grade - 4%

| Management Practice | Soil Loss (t/ac) |
|---|---|
| Soybean, conv. tillage | 2.17 |
| Soybean, no-till | .07 |
| Grain Sorghum, no-till | .03 |
| Soybean-wheat, double crop | .01 |

Table RS-2 Soil losses per hour of intensive rain as indicated from data with inflow to simulate longer rows. Rain intensity - 2.7 in/h; row grade - 4%.

| Management Practice | Soil Loss (t/ac) from Row Length of: 100 ft. | 200 ft. | 300 ft. |
|---|---|---|---|
| Soybean, conv. tillage | 15 | 25 | 34 |
| Soybean, no-till | .25 | .35 | .42 |
| Grain Sorghum, no-till | .12 | .16 | .20 |
| Soybean-wheat, double crop | .03 | .04 | .05 |

Table RS-3 Erosion rate for the last 30-ft. segment of a 300 ft. row

| Management Practice | Erosion Rate (t/ac-h) |
|---|---|
| Soybean, conv. tillage | 60.6 |
| Soybean, no-till | .6 |
| Grain Sorghum, no-till | .3 |
| Soybean-wheat, double crop | .1 |

# GROUND AND SURFACE WATER QUALITY RESEARCH AT THE NELSON FARM

J. D. Schreiber (NSL), S. Smith, Jr. (NSL), and R. F. Cullum (NSL)

Knowledge of the effects of conservation tillage on agrichemical percolation to ground water and transport by runoff is needed for development of improved management/transport models. Perched ground water 90.15 to 1.52 m) and surface runoff from a 2.13-ha watershed planted to no-till soybeans were sampled during the 1990 water year and analyzed for pesticides and plant nutrients.

Metribuzin (0.42 kg/ha) and metolchlor (2.24 kg/ha) were applied in early May 1990 for preemerge weed control to a 2.13-ha no-till soybean watershed on the Nelson Farm in Tate County, Mississippi. In mid June 1990, this watershed was treated with acifluorfen (0.28 kg/ha) for soil insect control. Mean concentrations of metribuzin and metolachlor in ground water 6 days after application were 23 and 67 $\mu$g/L, respectively; and were 1 and 3 $\mu$g/L 27 days after application (last ground water-producing rainfall). No measurable ground water resulted from rainfall events that occurred after acifluorfen, bentazon, and chlorpyrifos application. Concentrations of metribuzin and metolachlor in the water phase of runoff 6 days after application were 110 and 535 $\mu$g/L (ppb), respectively. By 85 days after application (last runoff event), these values had decreased to 0.3 and 1.2 $\mu$g/L. No metribuzin and metolachor residues were found in the sediment phase of runoff. No residues of acifluorfen, bentazon, and chlorpyrifos were detected in runoff from the single event which occurred 48 days after their application. Total seasonal losses of metribuzin and metolachlor in runoff were 0.017 and 0.085 kg/ha, respectively, or about 4% each of that applied. The rapidly decreasing pesticides concentrations observed to date in this ongoing study do not appear to present water quality problems.

The annual mean $PO_4$-P, $NH_4$-N, and $NO_3$-N concentrations for all ground water sites were 0.05, 0.08, and 11.56 mg/L, respectively. Ground water $NO_3$-N concentrations for some storms exceeded the U. S. Drinking Water Standard by as much as a factor of 2.7, and are of interest since no N fertilizers were applied after 1987. Soybean residues were suspected as the source of $NO_3$-N. In general, $NO_3$-N concentrations during the winter at depths $< 0.46$ m were greater than those deeper in the soil profile. However, these higher $NO_3$-N concentrations decreased during the spring due to continued leaching of the soil profile and nutrient uptake by a prolific growth of native vegetation. In runoff, the annual mean $PO_4$-P, $NH_4$-N, and $NO_3$-N concentrations were 0.56, 0.15, and 0.28 mg/L, respectively. However, only 8-days after a broadcast application of 0-20-20, soluble $PO_4$-P concentrations were exceeded 4 mg/L. Compared with ground water, concentrations of soluble $NO_3$-N in the runoff were considerably lower, and no $NO_3$-N was detected during March, April, and May. Soluble $PO_4$-P and N ($NO_3$-N + $NH_4$-N) losses were estimated to be 1.21 and 1.60 kg/ha respectively, and most likely represented almost all of the total nutrient losses since sediment concentrations were low. This 1-yr study suggests that no-till soybeans are nondetrimental to surface water quality. Additional research is needed to define the movement of shallow ground water that may contain high $NO_3$-N concentrations. In a related study, an adjacent soybean conventional-till watershed was instrumented for ground and surface water quality research in the fall of 1990, and sample collection has begun.

# EROSION RESEARCH WITH SOYBEANS AND GRAIN SORGHUM AT HOLLY SPRINGS

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This research report summarizes cooperative work on erosion control with conservation tillage systems at the North Mississippi Branch Experiment Station, Holly Springs, MS, by MAFES and the Sediment Yield Unit of the National Sedimentation Laboratory. These data are all preliminary to publication and will require further analysis before publication.

## Soil erosion effects on soybean productivity

This study was begun in 1983 to measure and document the loss of soil productivity as erosion progresses. Soybeans were grown each year on twelve pairs of plots on sites with similar soils and overland slopes of about 3%. In 1983, all plots were tilled preceding planting of soybeans; however, only one plot of each pair received tillage during the growing season of 1983. Since that time, no-till soybeans were grown in one plot of each pair and conventional-till soybeans were grown in the other plot. The 7-year (1984-1990) average crop yields were 27 and 24 bushels per acre for no-till and conventional-till soybeans, respectively. Crop yields from no-till exceeded those of conventional-till by an average of seven bushels per acre per year during the last four years (Table 1). Although soybean yields for both no-till and conventional-till have been low during several years, the developing trend for lower yields for conventional-till as compared to no-till indicates an adverse effect of excessive erosion on soil productivity.

Table 1. Average soybean yields from continuous no-till and conventional-till productivity plots.

| | Soybean Yield | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Treatment | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 |
| | bu/A | | | | | | | |
| No-till | 13* | 35 | 39 | 19 | 31 | 33 | 20 | 11 |
| Conventional-till | 16 | 39 | 40 | 19 | 26 | 19 | 17 | 6 |

* In 1983, all plots received tillage preceding planting.

A rainulator was used to apply simulated rainfall to the bottom third of three different pairs of plots in 1986, 1987 and 1990. Immediately preceding the tests, both the no-till and conventional-till plots used in the rainulator experiments received tillage of two diskings and harrowing. Plots with conventional-till history were more erosive than those with no-till history, even though tillage immediately preceding soil loss measurements were identical. Runoff from no-till was 10, 6 and 22% less than from conventional-till in 1986, 1987 and 1990, respectively; and soil loss was 36, 18, and 77% less for no-till than from conventional-till during 1986, 1987, and 1990, respectively. These results show that soils with significant erosion problems are more susceptible to further erosion than soils protected through a no-till or minimum-till management system.

1/4-Acre Plots in Grain Sorghum with Contoured rows

Treatments for duplicate, 1/4-acre plots with 5 % slopes were no-till grain sorghum with 20-inch contoured rows and ridge-till grain sorghum with 40-inch contoured rows. No-till grain sorghum in 40-inch contoured rows was grown on a single 1/4-acre plot with a slope of 2 1/2 %.; and this same treatment plus para-plowing (deep tillage several days before planting) was applied on another 2 1/2 % sloping plot. Runoff, soil loss, and crop yield data are presented in Tables 2, 3, and 4 for all these treatments. Six-years of data are available for the duplicate 5 % sloping plots and four years of data are available for the single 2 1/2% sloping plots.

Table 2. Runoff from 1/4-acre, grain sorghum plots with various tillage practices. Annual rainfall and annual rainfall erosion index (English Units) values are also shown.

| | RUNOFF | | | | | |
|---|---|---|---|---|---|---|
| YEAR | NO-TILL NARROW ROW S5-W5 * | NO-TILL PARA-PLOW S-2 1\2 * | NO-TILL N-2 1\2 * | RIDGE TILL N5-E5 * | RAINFALL | EI |
| | (inches) | (inches) | (inches) | (inches) | (inches) | |
| 1985 | 10 | | | 8 | 51 | 434 |
| 1986 | 7 | | | 5 | 40 | 252 |
| 1987 | 14 | 6 | 7 | 12 | 49 | 332 |
| 1988 | 10 | 2 | 3 | 8 | 41 | 242 |
| 1989 | 24 | 11 | 15 | 25 | 69 | 533 |
| 1990 | 14 | 8 | 9 | 14 | 51 | 473 |
| 4 YR AV | | 7 | 8 | | | 395 |
| 6 YR AV | 13 | | | 12 | 50 | 378 |

* S5-W5, and N5-E5 represent averages of duplicate plots on 5% slope; and S-2 1/2 and N-2 1/2 represent single plots on 2 1/2 % slopes. All annual entries represent water years (Oct. 1 - Sept. 30).

Table 3. Soil losses from 1/4-acre, grain sorghum plots with various tillage practices.

| | SOIL LOSS | | | |
|---|---|---|---|---|
| YEAR | NO-TILL NARROW ROW S5-W5 | NO-TILL PARA-PLOW S-2 1\2 | NO-TILL N-2 1\2 | RIDGE TILL N5-E5 |
| | (t/acre) | (t/acre) | (t/acre) | (t/acre) |
| 1985 | 1.2 | | | 1.7 |
| 1986 | 0.2 | | | 0.7 |
| 1987 | 0.3 | 0.1 | 0.1 | 0.8 |
| 1988 | 0.2 | 0.0 | 0.0 | 0.4 |
| 1989 | 0.4 | 0.1 | 0.2 | 1.1 |
| 1990 | 0.3 | 0.6 | 0.3 | 1.3 |
| 4 YR AVG | | 0.2 | 0.2 | |
| 6 YR AVG | 0.4 | | | 1.0 |

Table 4. Grain sorghum yields on 1/4-acre plots with various tillage practices.

| | CROP YIELD | | | |
|---|---|---|---|---|
| YEAR | NO-TILL NARROW ROW S5-W5 | NO-TILL PARA PLOW S-2 1\2 | NO-TILL N-2 1\2 | RIDGE TILL N5-E5 |
| | (bu/acre) | (bu/acre) | (bu/acre) | (bu/acre) |
| 1985 | 108 | | | 89 |
| 1986 | 60 | | | 56 |
| 1987 | 41 | 80 | 77 | 40 |
| 1988 | 73 | 64 | 59 | 58 |
| 1989 | 34 | 84 | 59 | 67 |
| 1990 | 35 | 44 | 60 | 33 |
| 4 YR AVG | | 68 | 64 | |
| 6 YR AVG | 59 | | | 57 |

1/45-Acre Plots with Grain Sorghum in Up-and-downhill rows

Treatments for another grain sorghum study consisted of minimum-till (no-till planted and cultivated during the growing season), conventional-till, no-till with conventional-till history, no-till with no-till history, and ridge-till. These treatments were conducted on 0.022-acre, five % sloping plots with two replications of each treatment. Row directions on all these plots were up-and-downhill. Runoff, soil loss and grain yield data are summarized in Tables 5, 6, and 7, respectively. Six years of data are available for the ridge-till practice; four years of data are available for remaining treatments. These data are from standard erosion plots and are used to verify or modify models that predict erosion from conservation tillage systems.

Table 5. Average runoff from duplicate 1/45-acre, grain sorghum plots on 5 % slopes with various tillage practices in up-and-downhill rows. Annual rainfall and annual rainfall erosion index (English Units) values are also shown.

| | RUNOFF | | | | |
|---|---|---|---|---|---|
| YEAR | MIN-TILL | CON-TILL | NO-TILL CT HIST | NO-TILL NT HIST | RIDGE TILL |
| | (inches) | (inches) | (inches) | (inches) | (inches) |
| 1985 | | | | | 8 |
| 1986 | | | | | 5 |
| 1987 | 11 | 10 | 14 | 4 | 9 |
| 1988 | 6 | 7 | 10 | 3 | 9 |
| 1989 | 15 | 16 | 24 | 9 | 25 |
| 1990 | 9 | 15 | 16 | 6 | 13 |
| 4 YR AVG | 10 | 12 | 16 | 6 | |
| 6 YR AVG | | | | | 12 |

Table 6. Average soil losses from duplicate 1/45-acre, grain sorghum plots on 5 % slopes with various tillage practices in up-and-downhill rows.

| | SOIL LOSS | | | | |
|---|---|---|---|---|---|
| YEAR | MIN-TILL | CON-TILL | NO-TILL CT HIST | NO-TILL NT HIST | RIDGE TILL |
| | (t/acre) | (t/acre) | (t/acre) | (t/acre) | (t/acre) |
| 1985 | | | | | 2.6 |
| 1986 | | | | | 2.1 |
| 1987 | 6.1 | 6.0 | 5.4 | 0.2 | 1.5 |
| 1988 | 1.4 | 2.3 | 0.4 | 0.1 | 1.0 |
| 1989 | 1.5 | 3.6 | 0.4 | 0.1 | 3.2 |
| 1990 | 1.9 | 5.6 | 0.9 | 0.3 | 6.4 |
| 4 YR AVG | 2.7 | 4.4 | 1.8 | 0.2 | |
| 6 YR AVG | | | | | 2.8 |

Table 7. Average grain sorghum yields from duplicate 1/45-acre plots on 5 % slopes with various tillage practices in up-and-downhill rows.

| | CROP YIELD | | | | |
|---|---|---|---|---|---|
| YEAR | MIN TILL | CON TILL | NO-TILL CT HIST | NO-TILL NT HIST | RIDGE T |
| | (bu/acre) | (bu/acre) | (bu/acre) | (bu/acre) | (bu/acre) |
| 1985 | | | | | 84 |
| 1986 | | | | | 49 |
| 1987 | 54 | 54 | 57 | 79 | 41 |
| 1988 | 72 | 50 | 53 | 70 | 55 |
| 1989 | 45 | 40 | 47 | 42 | 44 |
| 1990 | 46 | 57 | 45 | 51 | 44 |
| 4 YR AVG | 54 | 50 | 51 | 61 | |
| 6 YR AVG | | | | | 53 |

Residue management studies

Two sets of nine plots are being used to determine the effects of crop residue placement on runoff and erosion. Treatments consist of two different rates of corn residue compared with fallow, with three replications of each treatment. On the first set of plots, no-till corn with the two different plant populations are grown, and fallow is maintained on appropriate plots. On the other set of nine plots, corn residues are incorporated by at least two diskings at the normal planting time, and fallow plots are tilled in the same manner as the corn plots. No crop is grown and no further tillage is conducted during that year. One year of data have been collected but not yet processed for one set of plots while instrumentation for data collection is nearing completion for the other set.