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Progress Report

AN ALTERNATIVE EROSION CONTROL PRACTICE FOR CROPLAND

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INTRODUCTION

Soil erosion continues to be a serious problem in many row cropped areas in the South (Ball et al., 1991). Vegetated filter strips, planted across sloping cropland in 15 to 50 feet wide intervals, have been effective in slowing runoff, trapping sediment and removing some sediment-bound nutrients (Hayes et al., 1984; Magette et al., 1989). However, their effectiveness is greatly reduced in areas of concentrated flow (Dillaha et al., 1989; Flanagan et al., 1989).

An alternative to vegetated filter strips is stiff grass hedges. Stiff grass hedges are narrow (3-5 feet wide) strips of stiff, erect, perennial grass planted in parallel lines across the concentrated flow area and perpendicular to the dominant slope (Kemper et al., 1992). These hedges function to slow runoff, trap sediment, and encourage terrace formation (Meyers et al.,1994; Aase and Pikul, 1995). In the concentrated flow areas, deposited sediment forms a delta above the hedge that further disperses runoff and reduces ephemeral gully development. Grass hedges are an inexpensive conservation practice that require less land to install than grass filter strips and are compatible with the farmers current tillage system (McGregor and Dabney, 1993).

In 1993, USDA’s-Agriculture Research Service and the Natural Resources Conservation Service developed a national interim practice standard for the design and implementation of stiff grass hedges. In 1994, the NRCS in Mississippi initiated a three-year study to evaluate erosion control effectiveness of grass hedges in on-farm field demonstration plantings using the interim practice standard.

Objectives of this study were to establish a grass hedge in a cropland field in the Mississippi Delta, measure topographical changes above and below the grass hedge, and determine the impact of grass hedges on plant population, plant height and crop yield in rows near the hedge.

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STUDY SITE AND PROCEDURE

The farm selected for the study was located near Sumner, Mississippi, in Tallahatchie County. This field represents a typical highly erodible cropland field in the Mississippi Delta. It is characterized by a Dundee silt loam with a 0-2% slope, but slope increases to 3-5% on the northwest side of the field. Three concentrated flow areas with contributing areas ranging from 0.06 to 0.15 acre were identified in the field. Sheet and rill erosion were active where slope changes to 3-5%. Long-term cropping system has been narrow row soybean [*Glycine max* (L.) Merrill].

In March 1994, a single strip, 1800 feet long by 5 feet wide, was laid out across the field where rill erosion was evident. A seedbed was prepared by roto-tilling and firming the soil. 'Alamo' switchgrass (*Panicum virgatum* L.) was broadcast seeded at 20 lb/acre on 14 April 1994, lightly harrowed, and firmed. No herbicides were used for preemergence weed control.

Glyphosate (Roundup®) was applied with a wick bar on 21 June 1994 to control Johnsongrass [*Sorghum halepense* (L.) Pers.] during the establishment year. Mowing, as a weed control alternative, was performed 15 July 1994 with a rotary mower adjusted to leave a 10 inch cutting height. To control biomass, mower was adjusted to leave a 12-15 inch stubble height. Mowing was conducted on 10 June 1995. Mowing was not performed in 1996.

Fertilizer was excluded at establishment but the hedge received fertilizer when the soybean was planted. In succeeding years, the hedge received 60 pounds N/acre in late spring. Phosphorus and K application rates and dates were the same for the hedge and soybean.

Voids in the concentrated flow areas were repaired by transplanting live switchgrass plants on 6 inch centers on 11 May 1994. Six hay bales (18 inches by 32 inches) were placed approximately one foot below the transplants and end to end across two of the concentrated flow areas to protect transplants. Wire anchors (12 inches long) were used to secure transplants in one of the concentrated flow areas.

A baseline survey was made April 5 1994 before the grass hedge was planted. A single survey line was made at 100 feet intervals parallel to the upper side of the hedge where the hedge and the plowed ground joined. A profile survey was made in the center of each concentrated flow area and perpendicular to the hedge at 5, 10, and 15 feet intervals above and below the edge of the grass hedge.

Subsequent surveys were made on 15 February 1995 and 6 April 1996 to determine sediment gains and losses above and below the grass hedge.

The effects of the grass hedge on soybean plant population, plant height, and yield were determined in 1996 by selecting 10 linear feet of row from distances 3, 4.5, 6, 9, 18, and 27 feet above and below the hedge at two locations. These distances represented rows 1, 2, 3, 5, 11, and 22. Plant population and plant height were determined by counting the number of plants with mature pods and measuring the average height of mature plants. Soybeans were hand harvested on 25 September 1996 and yields adjusted to 13% moisture.

Plant population, plant height, and yield data were subjected to an analysis of variance and mean separation was performed at the 5% level of probability.

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RESULTS AND DISCUSSION

Hedge Maintenance and Management

An excellent stand of switchgrass was observed 30 days after planting, but frequent rainfall events in late April and early May washed the switchgrass from the concentrated flow areas. Voids in the concentrated flow areas were repaired by planting a row of live switchgrass plants (three to five viable shoots per planting unit) across the middle of the concentrated flow areas. Switchgrass transplants established quickly and were not affected by the first year's sediment deposition. Ninety-five percent of the transplants survived and had tillered enough to form an adequate hedge by the end of the first year. Alamo grew vigorously and produced a seed crop each year.

Hay bales were effective in protecting transplants in the concentrated flow areas during frequent rainfall events that occurred early in the establishment year. Without hay bales and wire anchors to protect or secure the transplants, surface runoff would have washed them from the concentrated flow areas. Monthly rainfall totals were not available for the site, but rainfall recorded at Charleston, Mississippi, (20 miles east) for 1994-1996 is presented in Table 1. Hay bales were effective in trapping sediment until their deterioration in early fall.

Table 1. Monthly rainfall totals at Charleston, Mississippi for 1994-1996.

Month	Rainfall 1994	1995	1996
	-------------Inches-------------		
January	6.22	7.11	5.87
February	4.10	4.06	2.49
March	6.31	8.33	4.50
April	1.55	5.43	6.26
May	2.75	4.12	2.54
June	7.36	6.82	7.60
July	8.67	2.76	2.93
August	4.05	1.77	2.50
September	4.46	.41	4.49
October	3.22	2.55	3.78
November	4.76	4.31	7.51
December	3.54	8.00	3.90

Use of herbicides for weed control in switchgrass hedges are often prohibited due to the agricultural crop and label restrictions. Mowing the hedge in the year of establishment becomes an important weed control consideration for removing competition from slow developing perennial grass seedlings and improving the appearance of the hedge. Competition from Johnsongrass was a problem during the establishment year. However, because of height difference of Johnsongrass and the first year's growth of switchgrass (36 inches vs. 18 inches), Johnsongrass was effectively controlled with a single Roundup treatment applied with a wick bar. A follow-up treatment was omitted, but would have been advantageous for additional control. Mowing was done to reduce competition from crabgrass [*Digitaria cilaris* (Retz.) Koel.], Johnsongrass, marestail [*Conyza canadensis* (L.) Cronq] and golden rod (*Solidago* sp.). Except for Johnsongrass, mowing was effective for control of these annual weeds during the establishment year. Mowing in succeeding years was done to reduce biomass and prevent the switchgrass from shading rows near the hedge. As the switchgrass thickened, Johnsongrass became more noticeable along the outside of the hedge rather than in the hedge. Weed control strategies and early spring recovery and growth of switchgrass probably contributed to these results.

Topographical Survey On Upper Side of Hedge For 1994 and 1996

Elevation changes and sediment gains or losses along the edge of the upper side of the hedge are presented in Figures 1a and 1b. Greatest deposition occurred in the concentrated flow areas at distances 444 and 818 feet. Ritchie et al. (1996) also found the greatest deposition to occur in the concentrated flow areas in similar field studies with grass hedges. Sediment depths of four and seven inches have occurred in these concentrated flow areas since hedge installation. Soil loss along the hedge was attributed to topography of the field and small berms created by tillage which functioned as diversions to carry surface runoff alongside the hedge. Sediment loads were either deposited in the concentrated flow areas or around the end of the hedge. Eight inches of soil lost on the end of the hedge was a combination of head cutting into the field where the hedge did not exist and erosion from around the end of the hedge. From this observation it appears that the hedge may prevent head cutting. Extending the hedge or installation of a grass waterway on the ends of the hedge may minimize further soil loss in this particular situation.

Topographical Survey Above and Below Concentrated Flow Areas For 1994 and 1996

Elevation profile and sediment gains or losses above and below the concentrated flow areas at distances 444, 818 and 1787 feet are presented in Figures 2a and 2b. The contributing area to the concentrated flow areas above the hedge at 444, 818 and 1787 feet was estimated to be 0.15, 0.11 and 0.06 acres, respectively, and characterized by an average 4% slope. Deposition patterns measured at 15 feet above the hedge and visual observations of deposition that occurred 25 feet above the hedge revealed that the hedge has been trapping sediment. McGregor and Dabney (1993) found grass hedges trapped two-thirds of the sediment in runoff plots. Development of a delta above the hedge has further dispersed runoff over a wider area, thus minimizing concentrated flow through the hedge. Soil loss below the hedge may be due to surface runoff that concentrates below the hedge and converges with water that moves through the hedge. Water leaving the hedge has more sediment carrying capacity than it had when it entered the hedge due to the loss of some of its sediment load as it moves through the hedge. Therefore, this water will be more erosive as compared to water entering the hedge. This occurrence coupled with tillage has produced a benching affect immediately below the hedge. An ephemeral gully below the concentrated flow area at 818 feet may require an additional conservation practice such as a grass waterway to reduce erosion and disperse water flow below the hedge. A possible alternative to a grass waterway in this concentrated flow area would be to install a shorter hedge below the existing hedge to further flatten the topography between the hedges and thus, prevent rill erosion. Visual observations have revealed that this ephemeral gully has been reduced since hedge installation.

Fig. 1a. Elevation on the upper side of the grass hedge for 1994 and 1996 in Tallahatchie County, MS.

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Fig. 1b. Sediment gain or loss on the upper side of the grass hedge from 1994 to 1996 in Tallahatchie county, MS.

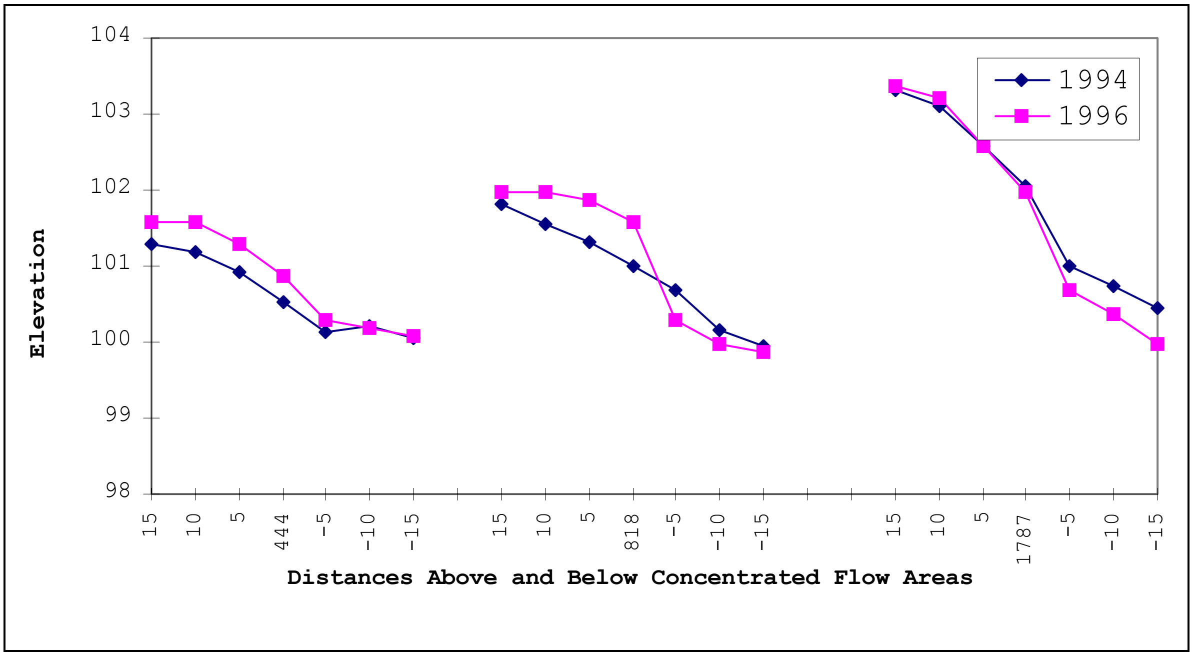

Fig. 2a. Elevation profile of concentrated flow areas at 444, 818 and 1787 feet for 1994 and 1996 in Tallahatchie County, MS.

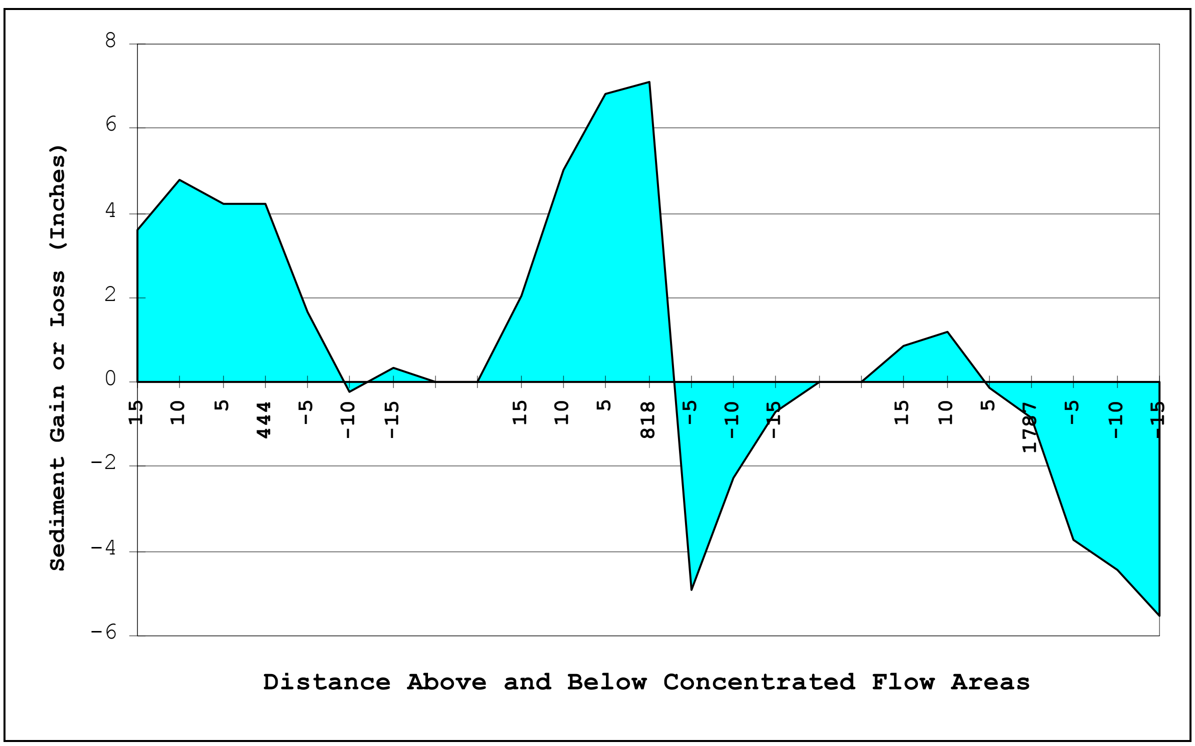

Fig. 2b. Sediment gain or loss above and below the concentrated flow areas at 444, 818 and 1787 feet from 1994 to 1996 in Tallahatchie County, MS.

Impact of Grass Hedge on Crop Parameters

As distance from the hedge increased from three to six feet, height and population significantly increased (Table 2). Yield significantly increased from three to four and one half feet. Ritchie et al. (1996) found a similar response to soybean and corn (*Zea mays* L.) yields as a function of distance from the hedge. Reduction in plant parameters in rows nearest the hedge is probably due to competition from the hedge. Switchgrass and Johnsongrass averaged seven feet tall along the outside of the hedge. Soybean plants in the first row were heavily shaded by switchgrass and Johnsongrass resulting in small, immature plants. A mid summer mowing in 1996 may have reduced plant competition and improved plant parameters in rows nearest the hedge. Soybean plant height, plant population, and yield were not significantly affected by position above or below the hedge (data not shown).

Alamo switchgrass is a prolific seed producer and yields of 270 lb/acre is not uncommon (USDA, 1992). Frequent inspections alongside the hedge and in the field have revealed no signs of switchgrass plants other than in the hedge. Slow establishment, tillage and herbicides are possible reasons for its lack of occurrence outside the hedge.

Table 2. Soybean plant height, plant population and yield as influenced by distance from the switchgrass hedge in Tallahatchie County, Mississippi, 1996.

	Distance (Feet)					
Plant Parameter	3	4.5	6	9	18	27
Plant height	inches					
	12c§	20bc	25ab	29a	29a	29a
Plant Population	No. of plants/10 feet					
	19b	27ba	31a	30a	30a	31a
Yield	Bu/acre					
	4c	13b	24a	24a	25a	27a

§ Main effect means in row followed by the same case letter are not significantly different at $P \leq 0.05$.

CONCLUSIONS

A switchgrass hedge established in a soybean field in the Mississippi Delta has been an effective alternative for controlling soil erosion. Deposition was greatest in the concentrated flow areas. Leveling of these areas has helped to disperse runoff and reduce concentrated flow. Soil loss below the hedge, particularly in the concentrated flow areas and around the ends, may require an additional conservation practice to minimize loss.

A row of live switchgrass plants were effective in repairing voids in the concentrated flow areas. Hay bales and plant anchors protected newly established transplants in the concentrated flow areas and trapped sediment the first year. Johnsongrass was effectively controlled in the establishment year with Roundup applied with a wick bar. Mowing was also beneficial for controlling annual weeds in the establishment year and biomass in succeeding years.

Soybean plant height, plant population, and yield were significantly reduced in the first two rows nearest the hedge.

This field study will be extended another year to gain more knowledge on the impact of the hedge on landscape modifications and its effect on crop yield.

Grass hedges have potential for controlling soil erosion on sloping cropland. However, more grass hedge field studies are needed in larger watersheds to further document their usefulness. Other research needs include installation of short grass hedges in the concentrated flow areas rather than the entire length of the field and the use of grass hedges in combination with other conservation practices.

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