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Department of Agronomy

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**EFFECTS OF TILLAGE AND GRASS FILTER STRIPS
ON SURFACE RUNOFF OF WATER, NITRATE,
SEDIMENT, AND ATRAZINE**

C.E. Madison, R.L. Blevins, and W.W. Frye

The contamination of streams and other natural bodies of water through agricultural runoff has become a very important environmental issue. Surface water runoff can contain heavy loads of sediment and/or agricultural chemicals, such as nitrogen and atrazine. Conservation tillage methods with vegetative filter strips downslope from cropped fields help to combat this problem. Conservation tillage has proven effective in decreasing erosion by decreasing exposure of the soil surface to rainfall. Vegetative filter strips provide an area where sediment and agricultural chemicals from cropland can be deposited before the runoff reaches a body of water.

How the Study was Conducted

Measurement of the effects of grass filter strips was begun in 1990 on a natural mixture of bluegrass and fescue sod. These filter strips were located immediately downslope from plots used for an erosion study that was established in 1989. Three erosion plots were under conventional tillage (moldboard plow with a single disk) and three were under no-tillage. All of the erosion plots and the filter strips were on a Maury silt loam soil with an average slope of 9%.

A rainfall simulator was used to apply 2.5 in of simulated rainfall per hour

for 2 hours on the erosion plots. This rate simulated a once in a 10 year storm rainfall intensity and was repeated on each plot approximately 3 weeks later. Before each simulated rainfall event, both the erosion plots and the filter strips were wetted to the point of runoff. The following chemicals were broadcast applied to each erosion plot immediately before the first rainfall event: 150 lb N/acre as granular ammonium nitrate and 2 lb atrazine/acre.

Runoff from both the erosion plots and the filter strips was periodically sampled throughout both rainfall events. Flow rates were calculated and the samples were analyzed for chemical concentrations and sediment amounts.

Results

Effect of tillage system on runoff

The sharp contrast in the amount of sediment lost from conventional tillage compared to no-tillage (Table 1) substantiates that no-tillage is an effective erosion control measure. No-tillage also had lower losses of applied nitrogen and atrazine than conventional tillage. These results are consistent with research done previously

in Kentucky and many other areas.

Effect of grass filter strip on filtering runoff

The grass filter strips were quite effective in filtering out sediment, nitrate, and atrazine, as indicated in the overall high trapping efficiencies (Table 2). Also, an average of less than 1% of applied nitrate and atrazine was present in runoff from the 15 and 30 ft grass filter strips (Table 3). The 30 ft filter strips were more consistent in filtration ability with time than the 15 ft filter strips. The slight increase in trapping efficiency of the 30 ft filter strips can be attributed to additional area available for runoff filtration. However, swags or natural humps in the 45 ft filter strips directed runoff into 1 or 2 small rivulets which decreased the filtration effectiveness of the 45 ft filter strip. This problem of channelization on the 45 ft filter strip caused average losses of 1-2% of applied $\text{NO}_3\text{-N}$ and atrazine.

Overall, the 30 ft filter strips performed most effectively. No-tillage with a 45 ft filter strip was the most effective combination of tillage system and filter strip length in preventing runoff. Generally, a 45 ft

filter strip should prove to be more desirable for runoff infiltration throughout the cropping season regardless of tillage system.

Other research has shown that disturbance of a grass filter strip by machinery traffic can decrease its effectiveness. It is recommended that an additional area of 15 ft to 25 ft be left

between the cropped field and the filter strip (regardless of length) so that the filter strip can remain relatively undisturbed by machinery throughout the year.

Kenneth C. Wells
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Table 1. Tillage system effects on sediment and water losses from erosion plots.

Tillage	Rainfall	Sediment Losses (tons/acre)	Water Losses (inches/acre)
Conventional			
	Event 1	5.78	0.24
	Event 2	12.18	3.62
	Total	17.96	3.86
No-tillage			
	Event 1	1.12	1.50
	Event 2	1.46	1.87
	Total	2.58	3.37

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Table 2. Trapping efficiency of grass filter strips (amount lost from erosion plots remaining on filter strips).

Filter strip width	Sediment	Water	Nitrate	Atrazine
-----%				
15'				
Event 1	98%	96%	93%	93%
Event 2	95%	96%	95%	93%
Average	96%	96%	94%	93%
30'				
Event 1	99%	99%	99%	99%
Event 2	99%	95%	96%	99%
Average	99%	97%	98%	99%
45'				
Event 1	99%	91%	97%	98%
Event 2	99%	90%	97%	97%
Average	99%	91%	97%	98%

Table 3. Amount lost of applied NO₃-N and atrazine in runoff from filter strips.

Filter Strip Width	NO ₃ -N	Atrazine
15'		
Event 1	0.7%	1.3%
Event 2	0.3%	0.3%
Average	0.8%	0.5%
30'		
Event 1	< 0.1%	< 0.1%
Event 2	3.2%	< 0.1%
Average	1.6%	< 0.1%
45'		
Event 1	0.3%	6.3%
Event 2	< 0.1%	0.9%
Average	0.2%	3.6%