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Trapping Fecal Bacteria and Sediment in Surface Runoff From Cropland Treated With Poultry Litter

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Introduction

Between 1991 and 1994 the broiler population exploded in Kentucky as the poultry industry began to expand. The Kentucky Department of Agriculture predicts that within four years annual broiler production could exceed 275 million birds. This may be good for Kentucky's economy but it carries some important environmental consequences. If expansion continues as anticipated, the estimated waste production from broilers for processing could reach 300,000 tons per year (assuming each broiler house produces 150,000 birds per year and the yearly manure and litter production per house is approximately 160 tons).

Most poultry waste nationwide is land applied using conventional manuring practices. This is the likely disposal method that will be used in Kentucky. However, since broiler production will be concentrated in about thirty counties in Kentucky, the capacity of nearby cropland and pasture to receive these wastes in a timely and environmentally safe manner may be frequently limiting. Poultry litter applied to the soil surface is susceptible to surface runoff. If it moves into streams, or infiltrates into the ground water, untreated waste will contribute fecal bacteria to agricultural nonpoint source pollution.

Grass filter strips bordering surface waterways are a recommended method of controlling sediment runoff from agricultural fields. However, relatively little is known about how grass filter strips affect fecal bacteria runoff from manured cropland. Since poultry wastes will be an important issue in Kentucky's future, we decided to examine how grass filter strips affect fecal contamination of surface runoff water in agricultural waterways bordering poultry waste treated land.

Table 1. Sediment trapping in surface runoff.

Tilled Strip Length	*Filter Strip Length*	*Plot No.*	*% Trapped*
60 feet	15 feet	1	97.2%
		2	93.1%
45 feet	30 feet	3	99.2%
		4	100.0%*
		5	96.6%

* Due to rounding

Methods

Five plots, ranging from 45 to 60 feet in length were utilized for this study. Each plot had a tilled strip that was amended with 4.5 tons/acre of undercage litter from a laying house. The litter was incorporated by a chisel plow and several diskings to a depth of about 6 inches. Downslope of each tilled strip was a grass filter (a mixture of bluegrass and fescue sod) that was either 15 or 30 feet long. Two days after the litter was incorporated, we simulated a rainstorm with an intensity of 2.5 in/hour using a rain simulator. Gutters were used to collect runoff water from the bottom of the tilled strips and the grass

filters. A sampling device was attached to the gutter below the tilled strip to direct runoff onto the grass filter, except for the brief intervals (5 - 10 seconds) during which samples were collected. Sediment and fecal bacteria concentrations (fecal coliforms, fecal streptococci, and *Salmonella*) were measured in the samples. We continued sampling runoff until it had occurred for at least one hour from the bottom of the filter strips.

Results and Discussion

The 15 and the 30 foot filter strips both did an excellent job of trapping sediment in surface runoff (Table 1). This is what we expected based on previous erosion studies at these sites. It again demonstrates the effectiveness of filter strips around surface waterways as a method of sediment runoff control.

Fecal bacteria trapping was a lot more variable, especially in the shorter filter strips (Table 2). Up to 95% of the fecal coliforms in surface runoff could be trapped. Fecal streptococci trapping wasn't as good. However, fecal coliforms are the bacterial group most often used to assess fecal contamination of water. *Salmonella*, which are morphologically and physiologically similar to fecal coliforms, were trapped with about the same efficiency as fecal coliforms in our study (data not shown).

Although the filter strips trapped most of the fecal bacteria in surface runoff, the concentration of fecal bacteria in runoff water was still quite high, greater than 2000 fecal bacteria /100 mL. The water quality standard for primary contact is only 200 fecal coliforms/100 mL, so the grass filters alone weren't sufficient to clean up surface runoff of fecal bacteria to primary contact standards.

Table 2. Fecal bacteria trapping in surface runoff.

	Filter Strip Length	*Plot No.*	*% Trapped*
Fecal coliforms	15 feet	1	95.0%
		2	50.0%
	30 feet	3	90.0%
		4	nd*
		5	92.1%
Fecal streptococci	15 feet	1	91.9%
		2	23.1%
	30 feet	1	80.3%
		2	nd*
		3	68.8%

*nd = not determined.

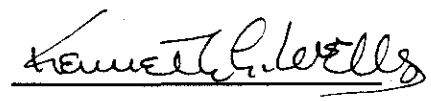
The grass filter strip length needed to protect water resources from fecal bacteria contamination in surface runoff is an important issue in the land application of poultry wastes. At our location, filter strips at least 15 feet long trapped more than 90% of the sediment in surface runoff from short tilled slopes and most of the fecal bacteria that eroded from poultry litter incorporated into cropland. Longer filter strips may be necessary to get the same effect elsewhere.

Despite a substantial reduction in fecal bacteria mass, their concentrations in surface runoff water remain high and can exceed the primary water contact standard. The runoff water from freshly tilled soil that has had recent manure incorporation will still have reduced water quality even though it runs through a 15 or 30 foot long filter strip.

This is a worst-case scenario, however. Our study used very intense rainfall (a one-in-ten year intensity) for an extended period (more than one hour) to cause surface runoff. Furthermore, rain was applied shortly after litter application and incorporation. The longer the interval between application and rain, the lower the fecal bacteria populations in soil become.

Conclusions

Common sense should restrict litter application to those periods when surface runoff is least likely. Depending on the length and slope of a manured field, and the management practices used, infiltration within grass filter strips as short as 15 feet should probably trap runoff if it occurs on relatively short slopes (the required length of grass filter must increase as infiltration capacity in a given soil decreases). Grass filter strips will reduce surface water contamination by fecal bacteria in runoff from poultry litter-treated fields on most occasions, but they won't provide absolute protection.



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