Optimization of Vegetative Filter Strips for Mitigation of Runoff from Golf Course Turf

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Objectives:

1. Use selected plant species in a field study to evaluate the efficacy of vegetative filter strips (VFS) and their most effective arrangement.
2. Determine the fate of pesticides retained in VFS and the major mechanisms of degradation.

Start Date: 2008
Project Duration: three years
Total Funding: $90,000

The loss of pesticides and nutrients into surrounding bodies of water and the resulting decreases in water quality has led to the use of best management practices on golf courses. One such practice is the use of vegetative filter strips (VFS) to intercept runoff water and thus prevent its loss and the loss of any associated pesticides and nutrients to surrounding water bodies.

Joint greenhouse and field studies have been implemented to evaluate selected plants for their effectiveness in removing pesticides and nutrients from turfgrass runoff waters that enter vegetative filter strips (VFS). A greenhouse pot study determined five species (big blue stem, blue flag iris, eastern gama grass, prairie cord grass, and woolgrass) most effectively removed the six selected pesticides (two fungicides, two herbicides, and two insecticides) from a silt loam soil.

In 2008, a run-on plot, consisting of 12 VFS planted in replicates of three (unvegetated, random mixture of plants, succession of plants, and turfgrass cut to three heights) was established. An overhead simulated rainfall system was constructed similar to those used in previous USGA-funded runoff studies in Minnesota. This growing season, we installed additional lysimeters 1' underground and conducted two studies using an estimated runoff volume generated during a 1-year storm event of 25.4 gallons over the course of 24 hours.

The purpose of the first application was to determine the runoff generated from VFS that had been planted in 2007. Soil presaturation was achieved prior to the initiation of the storm event by applying irrigation for 6 hrs (~2.4"). The 25.4 gal of run-on was applied to the top edge of each VFS as a water mixture with bromide (15.1 g/gal) via a solvent transfer pump. The run-on volume was applied over a 2-hour interval with the first hour in the presence of "rainfall" and the second hour without.

Runoff water was continuously collected at the bottom of the VFS. Three-minute grab samples were collected in 30 mL bottles for the first 30 minutes after the initiation of run-on and analyzed for bromide. There were little differences in runoff volumes from the VFS planted as turfgrass (0.5 gal), mixture of plants (0.2 gal), and succession of plants (0.3 gal) compared to the bare strips (7.1 gal). Bromide was detected in the runoff from the bare plots only (average time to bromide detection was 6.5 minutes).

The second run-on application occurred in the presence of overhead simulated rainfall. Soil presaturation was achieved prior to the initiation of the storm event by applying 0.8 inches/hr of rainfall for 9 hours, followed by 15 hours without rainfall. Three hours of overhead rainfall overlapped with the run-on for the last hour only.

Collecting runoff from the bottom of vegetative filter strips in the presence of overhead rainfall.

The overhead rainfall produced a four-fold increase in average runoff volumes and a greater distinction between treatments (1.2, 1.2, 4.6, and 27.3 gal over the course of 2 hours for turfgrass, mixture of plants, succession of plants, and bare plots, respectively). We collected 60 runoff samples, 84 subsurface water samples from 1' lysimeters, 108 subsurface water samples from 5' lysimeters, and 648 soil core samples that will be analyzed for pesticides.

We collected 132 30-mL samples to be analyzed for bromide. Bromide was detected after 3 minutes for the bare plots. In 2010, a 5-year storm event scenario will be tested.

VFS type	Irrigation		Overhead Rainfall	
	Average Total Volume (gal)	Average Time to bromide (min)	Average Total Volume (gal)	Average Time to Bromide (min)
Turfgrass	0.5	BDL	1.2	BDL
Mixed planting	0.2	BDL	1.2	TBA
Succession planting	0.3	BDL	4.6	TBA
Bare plots	7.1	6.5	27.3	3.0

BDL = below detection limit (0.1 ppm); TBA = to be analyzed; VFS = vegetative filter strip

Table 1. *Average total runoff volumes (gal) and time (min) to bromide detection in runoff water from vegetative filter strips during a simulated 1-year rain event utlizing irrigation or overhead rainfall.*

Summary Points

- A one-year rain event has been simulated twice on the VFS, once using irrigation and once using an artificial rainfall system.
- Preliminary bromide data indicates that bromide (and presumably pesticides) are being intercepted by the vegetative plots.
- 900 samples are currently being analyzed for pesticides.
- The pesticide application will be repeated next year using a 5-year storm scenario.