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.

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Project Duration: 3 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. A greenhouse pot study determined five species (big bluestem, 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; and an overhead simulated rainfall system was constructed similar to those used in previous USGA-funded runoff studies in Minnesota.

During the 2009 growing season, we installed additional lysimeters 1 ft underground and conducted two studies using an estimated runoff volume generated during a 1-year storm event of 25.4 gal over the course of 24 hours. 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, once using inground irrigation and once using an artificial rainfall system. Runoff water was continuously collected from the bottom of the VFS. 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).

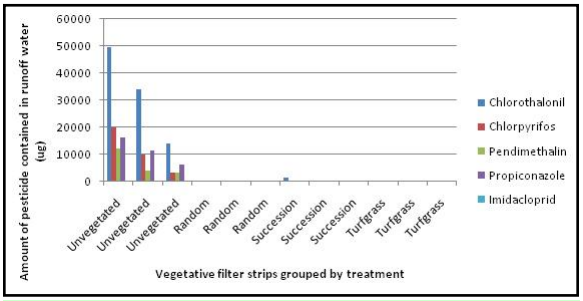

Figure 1. *Amount of pesticides contained in runoff water collected from the bottom of vegetative filter strips (VFS) during a simulated 1-year storm event.*

Bromide was detected in the runoff from the unvegetated VFS only (average time to bromide detection was 6.5 min). An average of 32.4 mg of chlorothalonil, 10.9 mg chlorpyrifos, 6.3 mg pendimethalin, 11.3 mg propiconazole, and 68.6 µg of imidacloprid were detected in the runoff collected continuously from the unvegetated VFS. Chlorothalonil (0.7 mg), propiconazole (0.1 mg) and imidacloprid (2.0 µg) were detected in two of the three succession of plants VFS. Pesticides were not detected in the runoff from either the random mixture of plants or turfgrass VFS. 2,4-D was not detected in the runoff from any of the VFS. Lysimeter samples and soil core samples are currently being analyzed for pesticide residues.

We conducted a 5-year storm event which 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/hour of rainfall for 9 hours, followed by 15 hours without rainfall. Three hours of overhead rainfall overlapped with the run-on (62.1 gal of water mixed with the six pesticides from the greenhouse study, at 5% their maximum application rate, and bromide at 1.5 g/gal as a tracer) for the last hour only. Overhead rainfall produced a greater distinction between the treatments than was apparent during the 1-yr rain event (3.2, 7.9, 14.9 and 74.94 gal over the course of 2 hours for turfgrass, mixture of plants, succession of plants and unvegetated VFS, respectively).

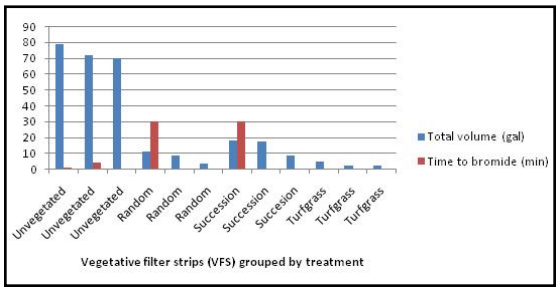

Figure 2. *Average total runoff volumes (gal) and time (min) to bromide detection in runoff water from vegetated filter strips (VFS) during a simulated 5-year storm event.*

Bromide was detected in the runoff from all the unvegetated VFS at 2 minutes following the initiation of the run-on event. Bromide was detected in the runoff from only two of the vegetative VFS (one succession and one random mixture of plants) at 30 minutes. We collected 60 runoff samples, 84 subsurface water samples from 1-ft lysimeters, 108 subsurface water samples from 5-ft 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 unvegetated VFS.

Summary Points

- A 1-year storm event has been simulated twice on the VFS, once using irrigation and once using an artificial rainfall system.
- A 5-year storm event has been simulated on the VFS using an artificial rainfall system.
- Preliminary bromide data indicate that bromide (and presumably pesticides) are being intercepted by the vegetative plots.
- We are currently analyzing 1,800 samples for pesticides.