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

J. Marshall Clark, Jeffery J. Doherty, Guy R. Lanza, and Om Parkash
University of Massachusetts

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). Ten plant species were evaluated in a greenhouse pot study to determine which species most effectively remove six pesticides (2 fungicides, 2 herbicides, and 2 insecticides) from a silt loam soil. Five species (big blue stem, blue flag iris, eastern gama grass, prairie cord grass, and woolgrass) were determined to be most effective.

A run-on plot, consisting of 12 VFS, was established. Each VFS had a 5% slope and was lined with an impermeable liner. A manifold was placed on the front (top) edge of each VFS to evenly apply run-on water using a solvent pump delivery system. At the bottom of each VFS, runoff water was collected. Lysimeters near the bottom of each strip sampled subsurface water. A bromide tracer study determined any hydraulic differences between VFS prior to planting. VFS were then established in replicates of three (unvegetated, random mixture of plants, succession of plants, and turfgrass cut to three heights).

The six pesticides used in the greenhouse study, plus cyfluthrin, will be used in the VFS run-on field trials (growing seasons 2009 and 2010). Pesticides will be applied with a water volume that would be generated for both a 1-year and a 5-year rain event. Bromide will also be added to the pesticide containing water at 4 g/L as a tracer.

Several storm/run-on scenarios on the bare (pre-planted) VFS were evaluated. The volume of runoff water applied as runon to each VFS was based on a 1-year rain event. The runoff water generated during a 1-year rain event was calculated to be 25.4 gallons over the course of 24 hours from an turfgrass area 3 feet by 20 feet with a 5% slope. This water volume is then applied to the top of the VFS as run-on water. Soil presaturation was achieved prior to the initiation of the storm event.

An artificial rainfall system has been constructed similar to those used in previous USGA-funded runoff studies in Minnesota. This system provides uniform droplet size with low kinetic energy. The storm scenario selected for the 1-year rain event and the initial bromide tracer studies was as follows: Artificial rain for 6 hours total (6 am - 12 noon, for ~2.4 inches total rainfall, 0.4 inches/hr) and run-on for 2 hours (11 am - 1 pm @ 12.7 gal/hour). In the case of the 5-year rain event, this would involve adding 3.8 inches of water as rain over 24 hours and 62.1 gallons of water as runoff over 24 hours.

The mass of pesticide lost will be evaluated using the concentration of the pesticide and the volume of water collected during runoff. In addition to pesticides, runoff water will be monitored for losses of nitrogen and phosphorus from fertilizer inputs. Soil, soil water, and plants within the VFS will be analyzed to determine if the pesticides lost from the runoff water are sorbing to the soil, being degraded in the soil, taken up by the plants, or lost to leaching or subsurface flow. Values will be compared against the bromide tracer, which will move freely with the run-on water.

Soil sampling will be conducted at three different depths at 3 locations within the VFS (0.3 m, 1.83 m, and 3.35 m from the top of each strip). Even chemicals that sorb tightly to the soil can be found deeper in the soil profile than would be expected based on their physical and chemical properties because of preferential flow pathways.

Soil, soil water, and plants within the VFS will be analyzed to determine if the pesticides lost from the runoff water are sorbing to the soil, being degraded in the soil, taken up by the plants, or lost to leaching or subsurface flow.

Summary Points

- A pump-driven delivery system has been fabricated to deliver run-on water onto the VFS.
- Nine VFS have been planted (3 VFS will remain unvegetated) with either turfgrass or the five plant species selected from the greenhouse study and allowed to mature.
- An artificial rainfall simulator system has been fabricated and installed at the run-on plot.