Comparison of Turf Chemical Runoff from Small- and Large-size Plots

Mark Carroll
University of Maryland

Objectives:

1. Develop and employ a standardized protocol to measure turf chemical runoff in different regions of the United States.
2. Determine the "scalability" of turf runoff events from field plot size areas.
3. Examine the relationship between thatch age, thatch organic carbon content, and turf chemical runoff.

Start Date: 2003
Project Duration: three years
Total Funding: $90,000

Development of "streams of flow" are seen in large plots midway through a simulation rainfall event.

The use of standardized protocols to generate data needed to register new pesticides is favored by the regulatory community and by the pesticide industry. The pesticide industry uses meso-size plots (i.e., ~ 0.07-ha plots) to generate pesticide runoff data for agricultural crops. Thus, there is already a precedent within the pesticide industry and the regulatory community to use large-size plots to generate the runoff data needed to register pesticides. Most turf runoff investigations have used plots that are much smaller than 0.07 ha. to investigate pesticide and nutrient runoff.

Processes that affect chemical transport such as entrainment and sediment transport are more realistically represented in large plots than in small plots. These processes, however, are of minimal importance in turf. This suggests that plot size will have less effect on turf chemical runoff than runoff losses from crops that do not fully shield the soil from impacting raindrops and the erosive forces of moving water. Data in support of this line of reasoning is lacking and is needed to support extending the results small-plot turfgrass runoff investigations to larger scales of measure. Moreover increased emphasis on obtaining computer model estimates of chemical losses from large land parcels has highlighted the need to better understand how the size of a study area may affect unit area chemical runoff losses.

This project has focused on examining the runoff losses of granular applied N (urea) and P (triple superphosphate) and liquid applied 2,4-D, flutolanil, and chlorpyrifos. Chemical runoff losses from two size (3.6 by 9.1 m, and 12.2 by 38.1 m) creeping bentgrass plots were evaluated by simulating a 3.5 cm hr^{-1} rainstorm for time needed to initiate runoff plus 90 additional minutes. The simulated rainstorm occurred one day after chemicals had been applied to the turf.

Results obtained over a three-year period have revealed that chemical runoff losses of relatively insoluble granular materials are affected by plot size. Triple superphosphates per unit area runoff losses were 1.5 times greater from large plots than from small plots. Plot size however had no impact on the runoff losses of liquid applied low water solubility chemicals (ie., flutolanil and chlorpyrifos). Total suspended solids data collected during the runoff events indicate that the greater amount of P found in large-plot runoff is not the result of different proportions sediment and clippings being lost from the two size plots.

Numerous partially solubilized triple superphosphate granules present on the surface of bentgrass canopy at the end of each simulation rainfall event suggest that these granules do not migrate into the canopy of fairway maintained bentgrass, but are instead carried down slope in concentrated streams of overland flow that develop during protracted high intensity rainfall events. Plots possessing long down slope lengths more readily develop streams of overland flow than do plots having short down slope length dimensions.

Foliage and thatch were collected immediately before, and a few hours after, each rainfall event to access the contribution of each canopy layer to pesticide losses in runoff. To date, pesticide concentration in foliage and thatch has been determined for two of the three years samples were collected. Preliminary results indicate that there is substantial plot-to-plot variability in the loss of pesticides from foliage and thatch.

In general, pesticide losses from foliage and thatch during the rainfall event were larger than total pesticide losses in runoff. This suggests that most of the pesticide that is dislodged from thatch and foliage occurs early in a storm event before most of runoff associated with the storm event takes place.

Summary Points

- Data are needed to support extending the results small-plot turfgrass runoff investigations to larger scales of measure.
- Unit area losses of granular applied P are greater from large-size plots than from small-size plots.
- Plot size had no impact on the runoff losses of liquid applied low water solubility pesticides.
- Primary results of before and after rainfall event pesticide concentrations in foliage and thatch suggest that most pesticide dislodged from foliage and thatch during a high intensity rainfall event is intercepted by the soil rather than lost as runoff.